

Handbook Series in  
Occupational Health Sciences  
*Series Editors: K. Daniels · J. Siegrist*

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REFERENCE

Töres Theorell  
*Editor*

# Handbook of Socioeconomic Determinants of Occupational Health

From Macro-level to  
Micro-level Evidence

 Springer

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# **Handbook Series in Occupational Health Sciences**

## **Series Editors**

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The *Handbook Series in Occupational Health Sciences* offers a unique opportunity to get acquainted with robust updated evidence on specific topics of key interest in occupational health research and practice. The series provides a venue for the large amount of significant recent scientific advances in research on occupational health due to the overriding importance of work and employment in developed and rapidly developing countries. The series is interdisciplinary, encompassing insights from: occupational medicine, epidemiology, ergonomics, economics, occupational health psychology, health and medical sociology, amongst others. Volumes in the series will cover topics such as socioeconomic determinants of occupational health; disability, work and health; management, leadership and occupational health; and health implications of new technologies at work and of new employment-related global threats. With a broad scope of chapters dealing with in-depth aspects of the volume's themes, this handbook series complements more traditional publication formats in the field (e.g. textbooks; proceedings), using a new system of online updating and providing explanatory figures and tables. Written by an international panel of eminent experts, the volumes will be useful to academics, policy researchers, advanced students and high-level practitioners (e.g. consultants, government policy advisors).

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Töres Theorell  
Editor

# Handbook of Socioeconomic Determinants of Occupational Health

From Macro-level to Micro-level  
Evidence

With 37 Figures and 32 Tables

 Springer

*Editor*

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ISBN 978-3-030-31437-8                      ISBN 978-3-030-31438-5 (eBook)  
ISBN 978-3-030-31439-2 (print and electronic bundle)  
<https://doi.org/10.1007/978-3-030-31438-5>

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## Series Preface

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## Volume Preface

This anthology provides readers of scientific literature on socioeconomic factors and working conditions with the latest knowledge in this field. Since our world is subjected to constant change in accelerating speed, scientific reviews and updates are needed. Fortunately, research methodology in epidemiology, physiology, psychology, and sociology is also developing rapidly and therefore the scientific community can provide politicians and policy makers with increasingly sophisticated and exact descriptions of societal factors in relation to work.

The anthology starts in the macro level sphere – with international perspectives and reviews related to working conditions in relation to political change (the fall of the Soviet Union), gender, age, precarious employment, national economy, and retirement. Two chapters relate to national policies and activities in international organizations.

The second part of the book relates to the meso level sphere – with reviews on social patterns in distributions of psychosocial and physical risks at work in general as well as reviews on noise, shift work, under/overemployment, occupational physical activity, job intensity (which may be a particularly important problem in low income countries), digitization in modern work, climate change, childhood determinants of occupational health in adult years, and theoretical models currently used in occupational epidemiology – demand/control, effort/reward, organizational justice, psychosocial safety climate, conflicts, and bullying/harassment. This part of the book ends with two chapters on interventions (one chapter on the use of cultural interventions and one on interventions and their evaluation in general) and two chapters on financial aspects of poor/good work environments and evaluations of interventions.

In the third part of the book the micro level is addressed. Here mechanisms translating working conditions into physiology are discussed. This starts in general theory relating basic theories regarding energy storage and release to psychosocial theory (extension of demand control theory). It also includes regeneration physiology, autonomic nervous system function, immunology, and adverse behavior.

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August 2020

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**Töres Theorell** M.D., Ph.D., became a physician in 1967 and has served in internal medicine, cardiology, and social medicine. His Ph.D. thesis subject in 1971 was critical life events in relation to myocardial infarction. He became professor of health care research in 1980 and professor of psychosocial medicine at the Karolinska Institute in 1995. After his retirement in 2006 he has been a scientific advisor at the Stress Research Institute at the University of Stockholm. Theorell's research areas have been epidemiology of psychosocial factors in relation to cardiovascular and psychiatric disease, endocrinological and cardiovascular stress mechanisms, and intervention research. Theorell has published 755 scientific articles and books/book chapters. 470 of those are available in the international medical data base medline (pubmed). He is a member of the Academia Europaea. During later years, he published research in the area of health effects of cultural activities.

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**Part I**

**Macro-level Determinants of Occupational  
Health**



# The Impact of Sociopolitical Upheaval: Russia and Eastern Europe

1

Hynek Pikhart

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## Abstract

Unfavorable working conditions are common in countries of Central and Eastern Europe, a region with high mortality and morbidity. This chapter reviews the evidence related to the association between work-related social and psychosocial factors, such as unemployment, job insecurity, long working hours, or work stress, and health outcomes in the region and investigates whether these factors could contribute to an increased risk of death and other health outcomes among working population in countries of Central and Eastern Europe.

## Keywords

Central and Eastern Europe · Unemployment · Job insecurity · Work stress · Long working hours

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_35](https://doi.org/10.1007/978-3-030-31438-5_35)

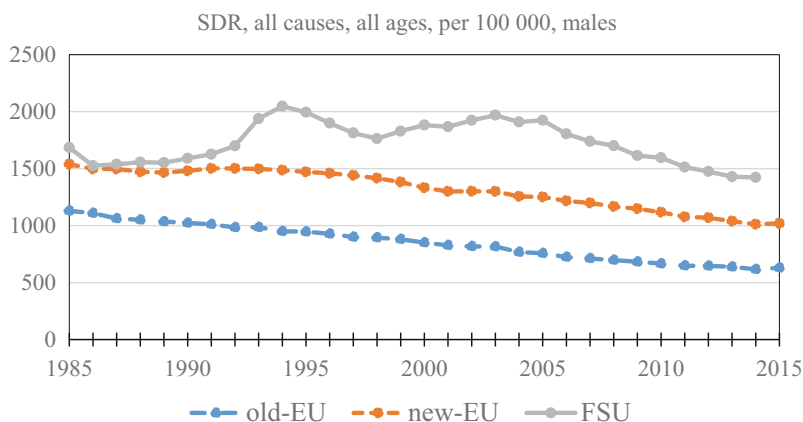
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## Introduction

Historically, there was a gap in mortality and morbidity between Western and Central/Eastern Europe, and this gap has been repeatedly reported (Bobak and Marmot 1996). A gap in mortality existed after 1970 but was relatively small until the gap developed after political changes in 1990 (Bobak and Marmot 1996; Hertzman 1995). In 1996, Bobak and Marmot reported that the difference in life expectancy between countries with the highest and the lowest life expectancy in Europe (Iceland and Sweden vs. several countries of former Soviet Union) was more than 10 years (Bobak and Marmot 1996). While the difference in mortality between Western Europe (“old-EU” countries) and countries of Central and Eastern Europe (“new-EU” countries) has remained virtually unchanged in the past 30 years, differences between Western Europe and countries of former Soviet Union (“FSU”) changed dramatically after 1990. Trends in male all-cause mortality since 1985 are shown in Fig. 1. Figure for women would be generally similar.

Differences in morbidity and mortality are not experienced only between countries. Similar to countries in Western Europe or elsewhere, social differences within countries are reported also in countries of Central and Eastern Europe and FSU, particularly for mortality, and they increased after 1990 (e.g., Shkolnikov et al. 1998; Murphy et al. 2006; Leinsalu et al. 2003).

Range of explanations for the differences in mortality and morbidity between countries of Western and Central and Eastern Europe have been proposed including environmental pollution, medical care, smoking, high consumption of alcohol, poor diet, education, income, or psychosocial factors (Bobak and Marmot 1996; Nanda et al. 1993). Factors related to work environment might play prominent role among social and psychosocial determinants of poor health in the region.



**Fig. 1** Trends in all-cause mortality in Europe, since 1985. (Source: HFA database, WHO Europe, *SDR* Standardized death rates, *EU* European Union, *FSU* former Soviet Union, *HFA* Health for All, *WHO* World Health Organization)



## Work Environment and Health in the Region of Central and Eastern Europe

The main problem in relation to explaining poor health in Central and Eastern Europe is lack of reliable and representative data. As a result, the evidence from the region is rare, and only handful of high- or average-quality studies related to work environment and health in the region has been published in the last 30 years.

Following the fall of the Soviet Union in 1991, the Central and Eastern European nations began their transition from a centrally planned economy to a market economy. These nations were particularly stricken by unemployment and job insecurity during the transition (Cornia 2016). The role of unemployment and job insecurity has been studied extensively in countries of Western Europe and North America. There is an extensive evidence showing adverse effects of unemployment on range of health outcomes, such as mortality (Martikainen and Valkonen 1996; Roelfs et al. 2011), cardiovascular disease (Lundin et al. 2014; Meneton et al. 2015), or mental health outcomes (Nordt et al. 2015). For example, Roelfs and colleagues estimated in their meta-analysis that unemployment has been associated with a 63% increased mortality risk (Roelfs et al. 2011). Job insecurity has been shown to relate, among other outcomes, to poor self-rated health (Cheng et al. 2005; D'Souza et al. 2003; Ferrie et al. 1995, 1998a, 2005), minor psychiatric morbidity (D'Souza et al. 2003; Ferrie et al. 1998a, 2005; Pelfrene et al. 2003; Rugulies et al. 2006; Swaen et al. 2004), incident coronary heart disease (Lee et al. 2004), and its risk factors, such as high cholesterol (Ferrie et al. 1995), hypertension (Ferrie et al. 1995, 1998b; Levenstein et al. 2001), and obesity (Ferrie et al. 2002). Only limited research has, however, investigated the effect of these exposures on health outcomes in post-communist countries of Central and Eastern Europe and the former Soviet Union. As the region experienced major economic upheaval that resulted in high unemployment and large job insecurity, the evaluation of the association between job insecurity, unemployment, and different morbidity and mortality outcomes within the Central and Eastern Europe is particularly important.

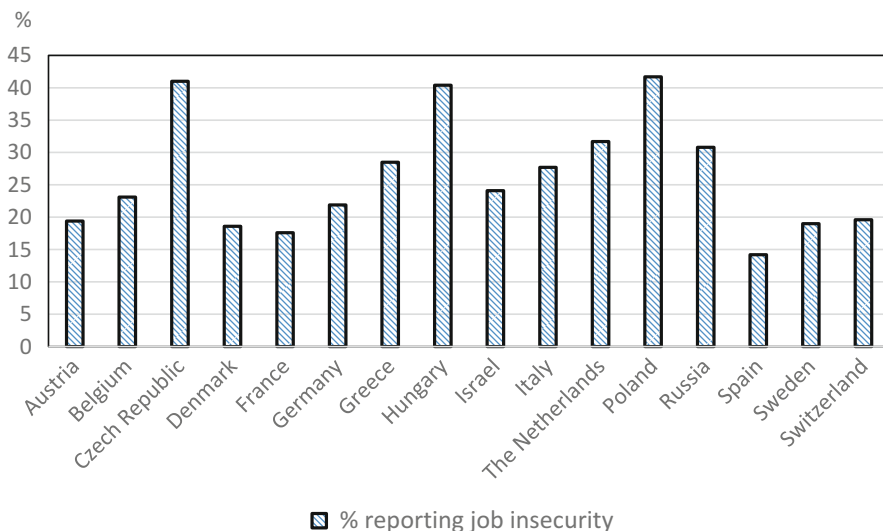
A two-fold increase in the age-standardized mortality rate for coronary heart disease associated with unemployment was reported relatively recently in Polish men (Zagozdzon et al. 2009). In later paper, Zagozdzon and his colleagues reported that unemployment was also related to statistically significant increase in major CVD risk factors (Zagozdzon et al. 2014). Tillmann and colleagues (Tillmann et al. 2017) in the analysis of the Health, Alcohol and Psychosocial Factors in Eastern Europe (HAPIEE) study data from Russia, Poland, and the Czech Republic found that unemployment reported at the time of the data collection was related to almost threefold increase in CVD mortality over approximately 7 years of follow-up when age-sex adjusted. This increased hazard reduced to 1.75 in the model adjusted for wide range of classical cardiovascular risk factors, health behaviors, and other social, psychosocial, and demographic characteristics but remained statistical significant.

In another analysis of the HAPIEE data, it has been shown that unemployment was associated with worse physical functioning expressed by physical functioning subscale of SF-36 (Pikhart 2017). This analysis proposed dose-response nature of the association suggesting that those who experienced longer periods of unemployment reported worse physical functioning.

For job insecurity, László and colleagues identified Poland, the Czech Republic, and Hungary as having the highest percentage of job insecure individuals among 16 European countries (Fig. 2) (Laszlo et al. 2010). In this study the authors identified employees in Poland, the Czech Republic, and Russia who reported being in insecure jobs to have a significantly increased risk of poor health.

Despite the evidence supporting an association between job insecurity and poor health, little research has been conducted to investigate the effect of job insecurity on mortality risk. Ward in her analysis of the HAPIEE study found that job insecurity did not contribute to increased risk of all-cause and cause-specific mortality within three countries (Russia, Poland, and the Czech Republic) included in this cohort (Ward 2018). Additionally, analysis of the short-term consequences of job insecurity suggested neither short- nor long-term exposure to job insecurity has contributed to increased risk of death in this cohort.

Working long hours is another characteristic of work environment that might negatively affect person's health (White and Beswick 2003). Large number of previous studies showed that long working hours had been adversely related to range of health outcomes including incident coronary heart disease and stroke (Kivimaki et al. 2015), pre-term delivery (Van Melick et al. 2014), breast cancer



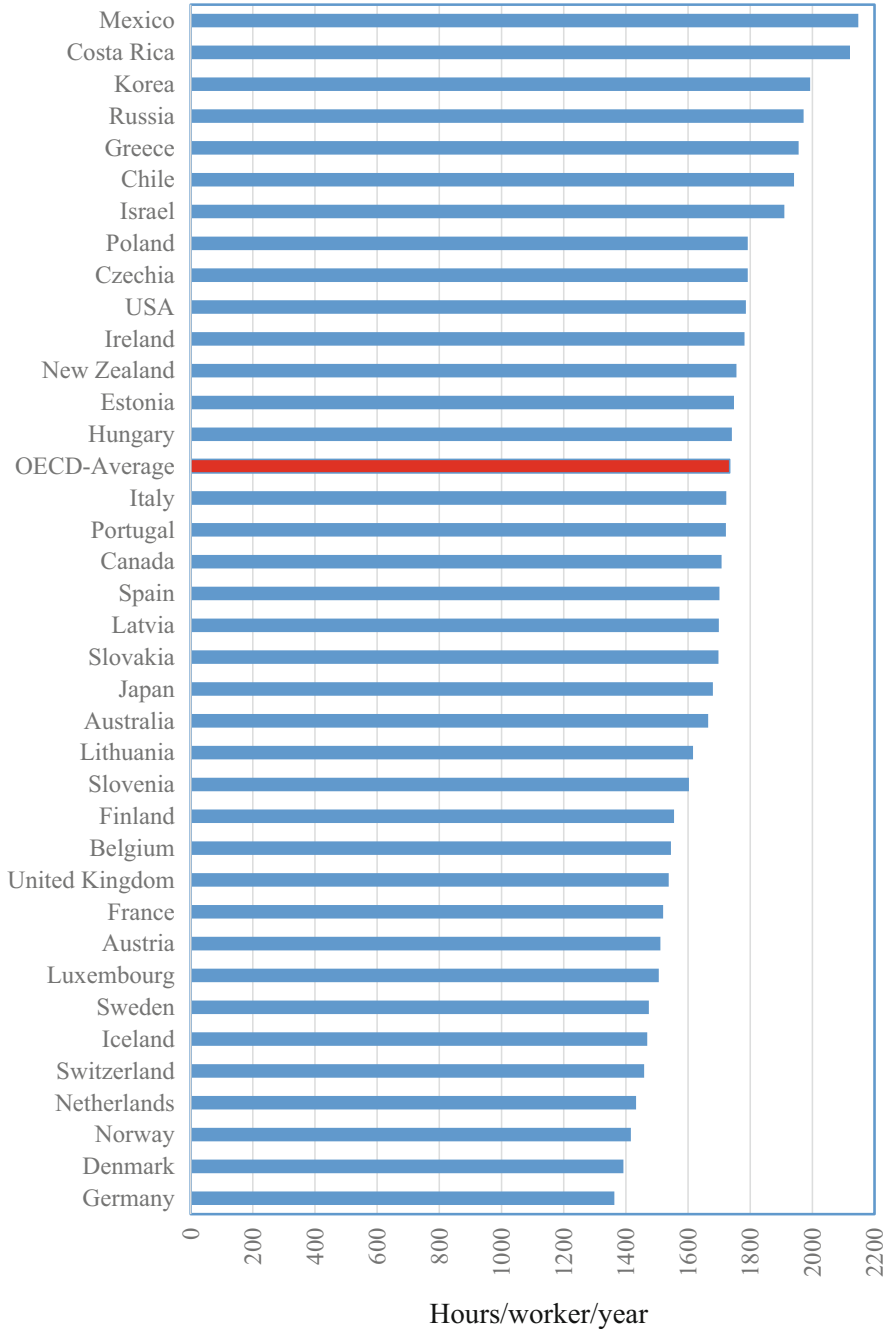
**Fig. 2** Proportion of individuals reporting their jobs as insecure. (Source: Adapted from Laszlo et al. 2010)

(Heikkilä et al. 2016), or high prevalence of anxiety, depression, sleeping difficulties, and accidental injuries at work (Dembe et al. 2005; Bannai and Tamakoshi 2014). Because long working hours have such adverse effects on health, it is important to know how long working hours affect mortality. Unfortunately, similar to unemployment and job insecurity, most of the evidence comes from Western Europe, North America, Korea, and Japan, and there is only very limited evidence from Eastern and Central Europe. This is paradoxical as long working hours are relatively common in the region. As Fig. 3 shows, most CEE countries have mean working time very close to or exceeding OECD average.

In another analysis of mortality in the HAPIEE data, Liu showed that long working hours have been associated both with all-cause and cause-specific mortality. In comparison with individuals working 36–45 h per week, those working at least 61 h had 35% higher risk of death during almost 15-year follow-up time. When focusing on specific causes of death, those working at least 61 h had 76% increased risk of cardiovascular mortality in comparison to those working between 36 and 45 h per week (Liu 2018).

Work stress plays an important role among psychosocial factors. Two theoretical models play a dominant role when studying the effects of work stress: the job demand-control model developed by Karasek (1979) and the effort-reward imbalance model developed by Siegrist et al. (1990). The evidence from Central and Eastern Europe comes primarily from HAPIEE study. In the cross-sectional analysis on the association between work stress and depressive symptoms using data from pilot of HAPIEE including Poland, the Czech Republic, and Russia, it has been found that job control was inversely associated with depression score in Poland and the Czech Republic, while the opposite association was found in Russia (Pikhart et al. 2004). The effect, however, almost disappeared after controlling for socioeconomic characteristics. On the other hand, effort-reward imbalance remained statistically significantly associated with depressive symptoms even in fully adjusted model. In recent prospective analysis of HAPIEE using first two waves of the study, it has been shown that employees experiencing low control at work may be at increased risk of developing severe depressive symptoms although neither job demands nor combination of high demands and low job control were related to depressive symptoms (Felici 2019). Those in bottom tertile of job control had 55% increased odds of severe depressive symptoms in age-sex adjusted models. This reduced to 34% increased odds of depressive symptoms when fully adjusted for social, demographic, and behavioral characteristics.

When studying mortality, low job control was associated with all-cause mortality and cardiovascular mortality after more than 10 years of follow-up. This association, however, reduced (HR 1.22 for cardiovascular mortality) and was not statistically significant when adjusted for social and demographic characteristics and classic cardiovascular risk factors (Li 2018). In unpublished analysis of Lithuanian HAPIEE data, effort-reward imbalance was related both to CVD and CHD mortality. High effort-reward imbalance was particularly strongly related to mortality in men, with HR 1.97 for CHD mortality.



**Fig. 3** Average annual working hours per worker in OECD countries in 2018. (Source: Data from OECD 2019 (<https://data.oecd.org/emp/hours-worked.htm>))

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## Summary

Unemployment, job insecurity, long working hours, and work stress seem to be related to range of health outcomes including mortality in countries of Central and Eastern Europe. The magnitude of the effects seems to be similar to the effects reported in Western Europe or North America. However, the evidence from CEE is still very limited, and more research is needed. Most of the evidence comes primarily from the HAPIEE study. The evidence also suggests that these work-related factors may not explain the gap in mortality between countries of CEE/FSU and Western Europe as the effects of work-related characteristics are not larger in CEE than Western Europe. Furthermore, the evidence from FSU, the region with particularly high morbidity and mortality, comes almost entirely from Russia. More effort should be spent in identifying other existing data that may include at least some work-related exposures.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Underemployment, Overemployment, and Mental Health](#)

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# Precarious Employment Conditions, Exploitation, and Health in Two Global Regions: Latin America and the Caribbean and East Asia

# 2

Carles Muntaner, Edwin Ng, Virginia Gunn, Faraz Vahid Shahidi, Alejandra Vives, Deb Finn Mahabir, and Haejoo Chung

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_39](https://doi.org/10.1007/978-3-030-31438-5_39)

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## Abstract

This chapter examines the topic of precarious employment in the context of health outcomes in two global regions: (a) Latin America and the Caribbean and (b) East Asia. First, drawing from several recent reports released by the International Labour Organization, it compares and contrasts the concepts of precarious employment and nonstandard employment. Second, it offers a glimpse of the macro-level context that enabled the fast rise of precarious employment within both the Global North and the Global South, albeit with distinct manifestations, with significant and lasting effects on population health and health inequities. Third, it recapitulates key measurement considerations that pose challenges for researchers setting out to measure the impact of precarious employment and related constructs on health and social outcomes. Next, building on research from two distinct global regions, this chapter summarizes labor market trends, specific precarious employment measurement approaches, and mixed findings from studies concerned with the impact of precarious employment and other similar concepts on a range of health outcomes. The concluding statements cover limitations in the extant literature and future research and policy recommendations.

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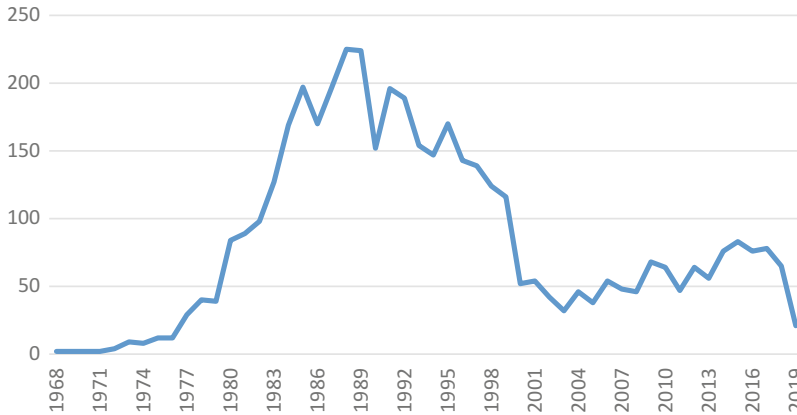
## Keywords

Precarious employment · Nonstandard employment · Informal employment · Labor market · Flexicurity · Political economy of health · Occupational health · Population health

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## Introduction

Over the past 50 years, interest in learning about the connections between employment conditions, globalization, and health has ebbed and flowed. An examination of *PubMed* publications from 1968 to 2019 yielded 4381 articles. As revealed in Fig. 1, three trends emerged that can be characterized as “rise,” “plateau,” and “fall.” First, during the rise period from 1968 to 1982, the number of published articles rose exponentially from 2 to 98, accounting for 10% of all results. Second, between 1983 and 1999, the number of articles on globalization, employment conditions, and health reached an impressive peak. More than two-thirds of the articles were published during this period ( $n = 2838$  articles), with an annual average of 177 studies per year. Apex years include 1988 and 1989 when 224 and 225 articles were



**Fig. 1** Publication trends on employment conditions, globalization, and health, 1968–2019 ( $n = 4381$ ). (Source: PubMed)

published, respectively. Third, in the most recent period from 2000 to 2019, the average publication rate decreased to 55.5 articles per year, which accounts for 25.1% of all studies possibly suggesting that interest in the overall topic has waned.

The inclusion of Goal 8 – *To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all* in the United Nation’s 2030 Agenda for Sustainable Development (United Nations 2015) p. 14, and several recent reports prepared on behalf of the International Labour Organization (ILO) (Quinlan 2013; ILO 2016, 2018b), has kindled renewed attention to the key roles played by individual nations in developing and implementing strategies to ensure safe working environments and to safeguard labor rights and will be probably followed by an imminent increase in such publications. The term precarious employment (PE), initially popular before the 1930s, has seen a resurgence in its use (Benach et al. 2014), especially among academic researchers and some policymakers, as attributed to labor markets starting to display certain insecure employment characteristics more typical of the period of time before the World War II (Quinlan 2012).

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## Key Terms

In a comprehensive report meant to enrich understanding of the global complexities of nonstandard employment, the International Labour Organization (ILO) examines the concepts of nonstandard employment (NSE) and PE, which, although used interchangeably at times, are distinct from each other (ILO 2016).

First, NSE is labelled as a deviation from standard employment (SE), commonly characterized by continuity, a full-time character, and bilateral employment

associations. In contrast, NSE differs across a number of characteristics, including (a) *employment duration*, which could vary according to contract lengths and structures (e.g., short or long term, daily/seasonal/casual); (b) *part-time and on-call work*, characterized by a range of working hours, usually fewer than in full-time employment; (c) *multiparty employment relationships* that replace the direct, subordinate relationship between an employee and an employer, typical of standard employment; and (d) *disguised employment/dependent self-employment*, a form of veiled employment relationships between so-called independent contractors and those who pay for, and directly control, the work contracted (ILO 2016, p. xxii).

Second, PE is acknowledged as a multidimensional construct that covers work features such as (a) temporality, as related to unpredictability of employment duration; (b) low income, often stagnating below or around poverty thresholds; (c) lack of legal or collective agreements that could safeguard occupational health and safety, social security, the right to nondiscrimination, and/or other worker protection rights; and (d) closely linked, very little worker control over work features and earnings (ILO 2016). Precarious working conditions can exist in both SE and NSE, especially since key staples of standard jobs have been gradually modified and eroded, and there are numerous inconsistencies around the world, and often within the same country, with regard to the working conditions experienced by people in both standard and nonstandard jobs (ILO 2016). In developing countries, considerations of employment arrangements are centered on the formal or informal character of the work, instead of its standard or nonstandard status (ILO 2016). Given that informality is summarized as the lack of, or inadequacy of, formal arrangements to cover the economic activities of firms and their workers, informal and nonstandard work, despite significant differences, shares similar concerns regarding the problematic legal protection of workers (ILO 2016).

Given that precariousness can affect a range of job aspects, instead of labelling NSE or informal employment as precarious, the consideration of worker insecurities – potentially associated with any job, be it standard, nonstandard, formal, or informal – could offer a more constructive approach (ILO 2016). Potential worker insecurities could impact areas such as employment permanency, wage assurances, guaranteed working hours and predictable schedules, safe working conditions, protection through social benefits, access to necessary training, and respect for fundamental worker rights, including collective bargaining coverage; in turn, such worker insecurities could have harmful effects on individual workers, businesses, and labor market environments and required increased understanding to facilitate the development of targeted solutions (ILO 2016).

Several social epidemiology glossaries have been developed to increase understanding of and consistency in the use of terms describing the organization of work, with specific attention to employment relations (Benach et al. 2010), social psychology (Muntaner et al. 2006a), sociology of work and organizations (Muntaner et al. 2006b), and a number of labor market elements (Hadden et al. 2007; Muntaner et al. 2012).

## Socioeconomic and Political Context

PE has been associated with several macro-level influences including neoliberalism, globalization, international trade agreements and/or policies, deindustrialization, changing demographic trends, and rapid technological innovation. Such structural factors affect *labor politics* in individual countries in different ways, as mediated by nation-specific (a) institutions and sociocultural and political processes; (b) welfare regimes and the availability of social protections; and (c) constraints imposed by international financial establishments such as the International Monetary Fund and World Bank in return for financial supports (Kalleberg 2012). Not surprisingly, PE manifests differently in the Global North and South, as it will be further detailed and exemplified in the following sections. Besides its immediate impact on workers' health, jobs, and work environments, the effect of PE extends to whole families, communities, and, given its wider collective implications and potential for worker solidarity, collective action and resistance counter movements (Quinlan 2012; Mosoetsa et al. 2016; Standing 2014), and/or civil/military conflict (McKee et al. 2017), even societies. This was most recently materialized into sociopolitical resistance movements, such as the Occupy Wall Street, that reached not only across classes but also across nations (Kalleberg 2012).

Neoliberalism, as a prevailing ideology and a key staple of our times, has a strong influence on the public policies adopted by large international organizations and individual countries in both the Global North and South (Navarro and Muntaner 2014). The push toward achieving neoliberalism's theoretical principles of reduced state intervention in socioeconomic spheres, deregulation of labor and financial markets, and increased mobility of human resources, capital, products, and services across the world has acted as a key catalyst of globalization (Navarro and Muntaner 2014). Globalization has multifaceted economic, political, and cultural dimensions, all of which can have an impact on employment conditions, worker exploitation (Muntaner et al. 2006b), and health, which form the focus of this chapter.

Simply defined, economic globalization refers to a process of rapid economic integration between countries, as driven by the increased liberalization of international trade and foreign direct investment and by freer capital flows (Labonte et al. 2011; Navarro and Muntaner 2014). The process manifests itself mainly through an intensification of activities in the following areas: international trade in goods, services, and labor; capital flows; the role of multinational enterprises; the reorganization of production networks on an international scale; and the adoption of new technology, including information technology (Kalleberg 2012; Labonte et al. 2011). Globalization has shaped a new economy that emphasizes flexibility and competition in international economic exchanges, which, in turn, has contributed to the global restructuring of work (Muntaner et al. 2006b) and of labor markets, the undermining of standard employment relationships, and the intensifying of precarious work (Caldbeck et al. 2014; Vives et al. 2010), often facilitated by an ensuing weakening of unions (Kalleberg 2012). In some instances, cost-cutting labor market policies are matched by a decrease in labor market regulation (Kalleberg 2012) and a shirking of legal obligations to workers by multinational companies worldwide. Not

surprisingly, precarious working conditions may lead to both short- and long-term negative health outcomes for workers, posing a new macro-level challenge to public health and health promotion (Caldbeck et al. 2014).

Another offspring of neoliberal ideology, international trade policies and agreements provide the legal infrastructure needed to apply neoliberalism's theoretical tenets on the global stage, significantly diminishing individual government's capacity to adopt domestic policies meant to protect the socioeconomic and health interests of their citizens, on the basis that such policies might threaten *free* trade and, as a result, could trigger costly and lengthy legal action (Schrecker 2016). Such trade agreements, acting through various mechanisms, have been linked to an increase in health concerns and health inequalities within countries (Schrecker 2016). The resulting erosion of legislative protection of working standards, facilitated by a growing deregulation of labor markets and relentless pressures to lower production costs, has seen an increase in precarious working conditions with negative overall health outcomes – since good quality jobs are linked to improved health – and an increase in occupational injuries and fatalities (Friel et al. 2015). A recent study comparing mortality rates from unintentional occupational injuries across high-income countries (HICs) as well as low- and middle-income countries (LMICs), from 1990 to 2016, concluded that, although there is a downward trend in such injuries, they continue to be a global concern, affecting disproportionately more LMICs than high-income ones (Wu et al. 2018). A systematic review of the literature on the topic of health vulnerabilities among garment workers in South and Southeast Asian countries brings further insight to these findings, emphasizing that unsafe and hazardous working environments, along with protective equipment deficiencies, pose serious health risks to workers and suggesting that this often neglected topic constitutes an emerging area of research due to a surge in workplace disasters (Kabir et al. 2019).

Intersectionality has become a construct that aims at integrating race, gender, and class analyses in the social sciences and public health, although in practice it rarely encompasses more than one or two inequality relations (Muntaner and Augustinavicius 2019). Not surprisingly, the concepts of intersectionality and PE have numerous points of overlap. For example, the negative health consequences of PE have been found to be heightened by factors such as gender (Mosoetsa et al. 2016), race (Mosoetsa et al. 2016), age (Standing 2014), income and social class (Artazcoz et al. 2007), education (Hammarström et al. 2011; Standing 2014), citizenship (Mosoetsa et al. 2016; Kalleberg 2012), immigration status (Davidson 2019; Lewchuk et al. 2018), and mental health and disability (Davidson 2019).

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## Measurement Considerations

An increasing number of epidemiological studies and systematic reviews address the impact of PE and related employment constructs on physical and mental health (Bones Rocha et al. 2014), the use of health services, occupational health and safety (Quinlan 2013), health behaviors (Dixon et al. 2014), and overall health and health

equity (Benach et al. 2013, 2014; Schrecker 2016; Bones Rocha et al. 2013; Burgard and Lin 2013). A majority of studies considering the health-related consequences of precarious employment define precariousness in terms of the objective status of individual employment contracts. Thus, investigators usually distinguish between standard or formal (i.e., full-time, permanent) and nonstandard or informal (e.g., part-time, temporary, fixed-term, zero-hour, on-call, etc.) employment contracts in an attempt to estimate the impact of precarious employment conditions on various health outcomes (Virtanen et al. 2003; Muntaner et al. 2010a; Muntaner and Barnett 2000). Despite an increased interest in measuring the impact of PE on health outcomes and health equity, given that, currently, there is no universally accepted multidimensional conceptualization of this construct, several substantive and methodological challenges exist (Benach et al. 2014; Mosoetsa et al. 2016; Burgard and Lin 2013).

In response, a number of tools have been developed to measure precarious employment. First, the Spanish Employment Precariousness Scale (EPRES) is a validated questionnaire composed of six theory-based constructs reflecting contract duration, level of negotiation of employment conditions, defenselessness in the face of authoritarian treatment, low or insufficient wages, entitlement to workplace rights and social security benefits, and powerlessness to exercise workplace rights (Vives et al. 2010). The EPRES tool is now in the process of being translated and validated to other national contexts (Jonsson et al. 2019). The second measurement tool is the Employment Precarious Index, a scale used in the 2011 and 2017 longitudinal surveys conducted in the context of the *Poverty and Employment Precarity in Southern Ontario* (PEPSO) project to measure the impact of PE on family well-being and community involvement (Lewchuk et al. 2018). This questionnaire combines questions related to income level, income security, employment security, schedule predictability, contract type, employment-related benefits, fear of raising concerns at the workplace, and receiving salary in cash (Lewchuk 2017). A different multi-construct tool put forward is centered on several problematic levels of job security in PE, including *employment, job, occupational, workplace, competence, income, and representation security* (Standing 2014). Yet another analytical frame proposes a clear distinction between PE, precarious work, and both worker and social life precariousness (Campbell and Price 2016). The need for such a distinction is further reinforced by suggestions to focus employment discussions on PE to maintain attention to employment relationships and the need for relevant labor market policies; a focus on precarious workers and their individual vulnerabilities could move the discussion away from policy solutions (Muntaner 2016).

Despite the existence of sophisticated theoretical frameworks that describe the health-damaging potential of PE (Muntaner et al. 2010c; Tompa et al. 2007), while numerous studies find an association between precarious employment relations and adverse physical and mental health outcomes (Benavides et al. 2015; Kim et al. 2018), others fail to find such associations (Bernhard-Oettel et al. 2005; De Moortel et al. 2014). In general, longitudinal studies tend to find stronger associations than their cross-sectional counterparts (Kivimäki et al. 2003).

Several explanations have been offered for this discrepancy between theoretical predictions of disadvantage and actual existing findings. For example, scholars argue that inconsistencies in findings may reflect disparities in the health effects of different types of NSE contracts (Silla et al. 2005). Indeed, evidence suggests that some forms of temporary employment have a greater potential for health harm than others (Artazcoz et al. 2005). Similarly, several studies tend to find that temporary employment is more consistently associated with adverse health outcomes than other forms of NSE (Benavides et al. 2000). Other studies point out that differences in the impact of precariousness also exist across socioeconomic and demographic subgroups (Artazcoz et al. 2007; Kivimäki et al. 2003). For this reason, aggregated analyses may be underestimating such associations among women, youth, and other deprived vulnerable populations. Other explanations justifying inconsistent findings underline the need to distinguish between involuntary and voluntary forms of NSE, since people who pursue it intentionally might actually benefit from it (Kinnunen et al. 2011).

Moreover, investigators have also argued that there is a need to construct more specific metrics of precariousness in order to better estimate its impact on health (Benach and Muntaner 2007). These metrics should include factors such as earnings, power and autonomy, legal protections, and benefit entitlements to better capture precise dimensions of employment relations – beyond simply the type of contract – that may adversely affect health outcomes (Benavides et al. 2006; Lewchuk et al. 2008; Muntaner et al. 2010c; Tompa et al. 2007; Vives et al. 2010). The use of such metrics would allow investigators to locate employment experiences across a multi-dimensional space. This, in turn, would enable a broader and more detailed analysis of both employment conditions and the various pathways by which they contribute to the creation of health inequalities within and between different labor market groups (Benach et al. 2014, 2016).

Yet, another explanation posits that the observed inconsistency in research findings reflects systematic differences in the experience of PE relations across national contexts. Drawing insight from the broader literature on the health effects of welfare state regimes (Chung and Muntaner 2007), scholars who advance this hypothesis argue that the health-related consequences of precarious employment may be more pronounced in countries characterized by weak social protection systems (i.e., liberal welfare states) and less pronounced in countries characterized by strong social protection systems (i.e., social democratic welfare states) (Bambra and Eikemo 2009; Chung and Muntaner 2007; Artazcoz et al. 2016; Kim et al. 2012; Benach et al. 2013). They hypothesize, in other words, that generous and comprehensive social and labor market policies have the potential to mitigate the adverse health consequences of negative labor market experiences. This further justifies the need to adjust the construct of precariousness when using it in different world regions to accurately assess its impact on health outcomes and health equity; this tailoring is needed since a country's income (Vives et al. 2016) and the availability, and or extent, of labor market regulation and social protection, quite different across nations, could modulate the health effects of PE (Muntaner 2016). Research on the attenuating role of such policies is still in its early stages although the study

by Shahidi et al. did not support this hypothesis among European nations (Shahidi et al. 2016).

Given that all workers in capitalist societies are exposed to varying degrees of employment insecurity, low wages, and, in the case of workers in nonmanagement positions, limited control over the work they conduct, precariousness can be framed as a matter of class politics (Muntaner 2016). From this perspective, PE and social class can be perceived as complementary, and employment precariousness can be regarded as a higher level of worker exploitation and domination (Muntaner 2016). In the context of, and facilitated by, labor market deregulation, a reduction in collective bargaining opportunities, the shifting of power from workers to capital owner/organizational leaders, alongside the shifting of responsibility and risk from capital to labor, and the reduction of social protections – often resulting from weakened welfare states – PE contributes to increased wealth and health inequalities among workers everywhere (Benach et al. 2013).

Several frameworks have been proposed to guide analyses of the effects of precarious work environments on health and outcomes social (Muntaner et al. 2010b; Tompa et al. 2007; ILO 2016). The following adapted model is an example of a comprehensive employment precariousness framework reflective of the multifaceted socioeconomic and political factors and numerous axes of intersectionality relevant to this topic (Muntaner et al. 2010b), which could be used to support ongoing efforts to create multidimensional tools that capture the impact of PE on several health and social outcomes with increased accuracy (Fig. 2).

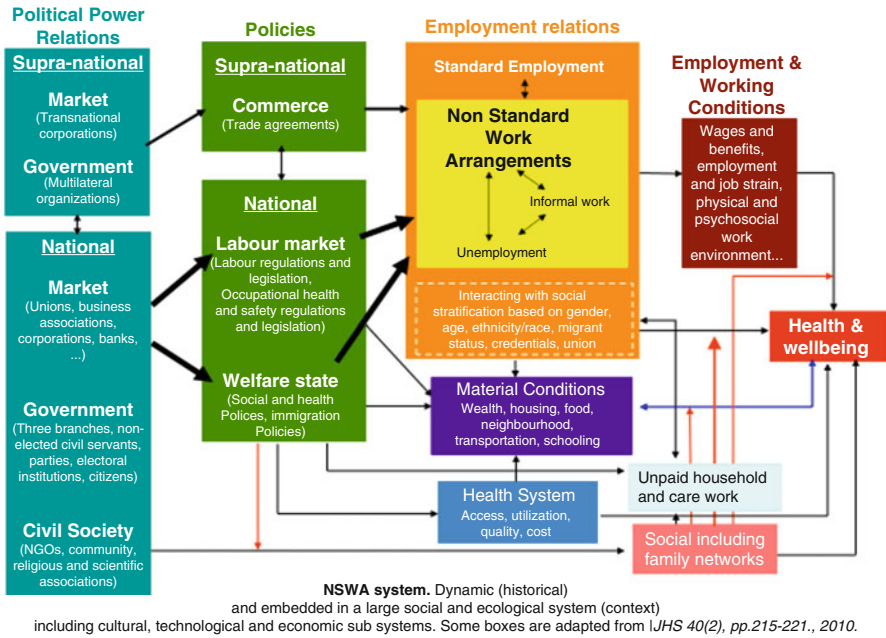
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## Regional Reports

Research investigating the health and social effects of PE and other related concepts in European and North American countries has benefited from somewhat more attention and funding over the years. Until the last two decades, there was much less emphasis on other regions of the world. However, this is rapidly changing, and new clusters of PE research are developing in countries such as Chile and South Korea. For instance, in Chile, the body of PE and occupational health research is visibly expanding (Bones Rocha et al. 2013, 2014; González and Vives 2019), and the first occupational health survey containing questions on employment precariousness was conducted in 2009–2010 (Bones Rocha et al. 2013; Vives et al. 2016). Similarly, a diverse body of PE-related research has been conducted in South Korea starting in the late 2000s (Yoo et al. 2016; Seon et al. 2017; Min et al. 2016; Yoon et al. 2017; Kim et al. 2016a).

The findings in this section are grouped around two global regions: (a) Latin America and the Caribbean and (b) East Asia. The initial plan for this chapter was to summarize research evidence from studies examining the health impacts of PE and related concepts only in LMICs. However, given an overall scarcity of such research in LMICs (Lopez-Ruiz et al. 2015, 2017), the chapter combines findings from both LMICs and high-income countries (HIC), making references to the broad body of research on this topic conducted in both Chile and South Korea. As a result, given





**Fig. 2** A theoretical framework of employment precariousness. (Modified from Muntaner 2010 (thanks to Emma Vignola and Seth Prins for their contributions). Note: NSWA = nonstandard work arrangements)

distinct challenges affecting economies and labor markets in these regions, as detailed next, this chapter presents a unique glance into the development of different areas of research and methodological approaches in both LMICs and HICs.

## Latin America and the Caribbean

Latin America and the Caribbean region encompass *semi-peripheral* middle-income countries with emergent labor markets and *peripheral* low-income countries with informal labor markets (Muntaner et al. 2012).

### Labor Market Trends

During the first decade of the twenty-first century, Latin America and the Caribbean have seen an important fall in unemployment rates in urban areas, from 11.2% in 2002 to 6.4% in 2012 (Weller 2014), followed by some slight increases and decreases within the second decade (ILO 2018a). According to the 2018 *Labour Overview of Latin America and the Caribbean*, the 8.1% unemployment rate in 2017 went down to 7.8% in 2018 and is expected to continue its decrease to 7.5% in 2019,

as facilitated by an expected economic growth of 2.2% (ILO 2018a). Although a decrease in unemployment rates has a positive outlook, aggregate unemployment rates camouflage discrepancies across regions, countries, and vulnerable subgroups such as women and youth, whose rates are over 10% and almost 20%, respectively (ILO 2018a). Moreover, despite improvements in overall unemployment rates, this region exhibits persistently large shares of informal or nonstandard employment, which represent the predominant form of employment in many sectors of the economy (ILO 2016, 2018a). For instance, in Latin America and the Caribbean, across both agricultural and nonagricultural fields, informal employment is slightly higher than 50% with some estimated 140 million people practicing in occupations commonly linked to precarious work environments, limited social rights, and increased vulnerabilities (ILO 2018a), a significant increase when compared to previous estimates of 130 million people working in such occupations (ILO 2014). At a global level, two billion people, representing more than 61% of the employed populations, work in the informal economy (ILO 2018b).

Informal work, which could be considered a form of NSE or *atypical* employment in HICs (Carré and Heintz 2009), has become pervasive in most underdeveloped economies; however, given its underground character and the belief that it will fade away in the face of economic development, its multifaceted socioeconomic and political consequences are insufficiently studied by researchers and as a result, less understood and, to a large degree, neglected by politicians (Cling and Mireille 2015). Although there are many differences in the context of informal work across developing countries, there are also many similarities, including precariousness of working conditions, average incomes, exclusion from the formal economy, and low educational and skill qualifications, which prevent many workers from finding jobs in the formal work network (Cling and Mireille 2015). Besides commonalities, informal work is nonhomogenous and could include numerous and varied forms of employment, including a large portion of own-account work, as well as informal salaried employment in both the formal and informal sectors (ILO 2016; Cling and Mireille 2015). Additionally, informal work is characterized by a high proportion of older people, including those who have been pushed from salaried employment into informal, self-employed work, given a need to supplement retirement incomes (Standing 2014).

Informal employment in Latin America and the Caribbean, in particular own-account work, appears as a response toward joblessness and a lack of income (ILO 2018a), according to mainstream economics. Given the lack of unemployment compensation schemas and the incapacity of most workers to sustain their living standards in times of unemployment, whoever loses a dependent job will need to find work in the short term and will most likely do so as an informal own-account worker or dependent worker (ILO 2018a). Given that informal employment is usually not regulated by formal employment contracts, it does not have to adhere to labor market standards, and, as a result, the working conditions often reflect the lack of regulation (ILO 2016). Challenging employment conditions could also affect high proportions of workers in the formal workforce even in the most formalized labor markets of the region. One key reason is that in *semi-peripheral* nations there is less regulatory

oversight of social rights and democratic mechanisms, and, as a result, recent changes leading to increased deregulation of labor markets have accentuated imbalances in the worker/capital relationships, negatively impacting the availability of quality employment (Muntaner 2016).

As a result, PE in Latin America and the Caribbean takes two main forms: that of informal employment, concerning a majority of workers, especially in countries with a limited development of a formal labor market and that of precarious formal employment, characterized by precarious employment conditions, in countries where formal labor markets have reached a greater development (ILO 2016). However, although both informal and precarious formal employment are linked to problematic working conditions, it is desirable to keep both concepts apart for at least four main reasons. First, there appear to be more health damaging features in informal employment than there are in formal precarious employment (ILO 2016), possibly given that informal employment relationships operate outside any regulatory framework. Second, understanding PE conditions in Latin America and the Caribbean region – similar to other regions such as Asia and Africa – requires the understanding that informal employment is the main form of PE conditions in the region (ILO 2016). Third, informal employment in the region responds to different historical processes and backgrounds than precarious formal employment. Fourth, the extent to which formal employment conditions are precarious within the new forms of regulation driven by flexibilization of labor markets or complete deregulation requires closer examination (ILO 2016). In conclusion, to identify and understand the mechanisms linking these different forms of employment to health and its public health impact, these concepts should be studied separately.

## **Precarious Employment: Regional Problems of Measurement**

Similar to the situation in the rest of the world, and although the large shares of informal and precarious employment conditions in the region constitute a serious reason for concern about the quality of employment in Latin America, little academic research has examined this issue in any systematic way, resulting in a lack of both conceptual definitions and internationally comparable data within the region (Ocampo and Sehnbruch 2015). A common prescription is the need for Latin American countries to invest in more accurate, comprehensive, and internationally comparable data on employment conditions, which could serve to better describe both informal and precarious employment (Ocampo and Sehnbruch 2015). This applies to both the measurement of informal employment and that of precarious employment. In the case of informal employment, ILO has set out recommendations to address specific country needs, resulting in national differences in definitions and coverage (ILO 2016), which could, however, inadvertently limit the international comparability of the indicator. Currently, data are scattered, and, in several countries, no official estimates exist of informal employment, and much less of precarious employment (ILO 2016).

Currently, both policy and academic research lack the proper empirical evidence to challenge established labor market theories such as the need for further labor market flexibilization (Ocampo and Sehnbruch 2015). Clearly, accurate data collection is a key necessity if the quality of employment is to be assessed and if countries in the region are to overcome the relative neglect of job quality issues. Besides the regular collection of data through labor force surveys, employment and working conditions surveys are a key resource to estimate not only the extent and distribution of these employment conditions but also their association with health and worker well-being. In the last decade, approximately 12 countries in Latin American and the Caribbean have conducted national surveys on working conditions, employment, and health, and more are expected to come (Merino-Salazar et al. 2015). Several of these surveys capture information that may allow an assessment of informal and precarious employment, thus representing a key advancement in the description of employment quality in this region.

## Precarious Employment and Health

Research on employment conditions and health in Latin America and the Caribbean is scant, and an occupational epidemiology body of research into employment and health in the region has yet to be developed. Regarding informal work, the literature on informal employment or the informal economy and its association with health is still very scarce. The informal economy is understood as activities that are not government regulated or taxed, and since working conditions are unregulated and workers do not receive benefits such as health insurance or pension, work in the informal economy may result in significant health risks (Hadden et al. 2007). Similarly, since employees in nonstandard employment could work on a part-time, seasonal, and contingent basis, they are provided with little or no benefits, since such benefits are often limited to full-time employment (ILO 2016) and are exposed to employment conditions that include reduced job security, less financial compensation, and inadequate work environments (Hadden et al. 2007) that, not surprisingly, may increase health risks. Register-based information on the health of informal workers is limited by the fact that their condition of informality keeps them out of most, if not all, register systems. Further, since employment and working conditions surveys in Latin America and the Caribbean are only beginning to develop, currently there are limited knowledge and understanding of both informal and nonstandard workers' health status and health outcomes (Solar 2016).

There is much to learn about the association between informal employment and health and how it varies across different types of informal workers. The potential mechanisms leading from both informal and nonstandard employment to poor health are various low and irregular income, the frequent association with poor working conditions, and lack of social protection. This implies, among others, the inability to take sick leave and recover from disease, risking a further deterioration of health or even death (Burgard and Lin 2013). Most, if not all, studies in the region are of cross-

sectional nature; most of them coming from Brazil, Colombia, and Central America. As a general statement, most studies find that informal workers are in worse health than formal workers. For example, recent work has investigated plausible links and interactions among paid work, family characteristics, gender, informal employment, and health status in Central America (Lopez-Ruiz et al. 2017). Among a cross-sectional sample of 8680 nonagricultural workers, higher adjusted prevalence ratios for poor self-perceived and mental health are observed among women in informal employment who were previously married, had care responsibilities, worked long hours, or were employed part time (Lopez-Ruiz et al. 2017). Unpaid and paid work are drivers of health inequalities, which seem to interact with gender and informal employment (Lopez-Ruiz et al. 2017). Another aspect of informal employment in the region is related to that of immigrant workers. As revealed in a comprehensive editorial on employment and global health inequalities, the extant literature confirms that immigrant workers are at higher risk of sexual exploitation, violence, labor exploitation, and both mental and physical health problems (Benach et al. 2013).

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## East Asian Countries

Economies in East Asian countries such as China, South Korea, and Taiwan have a reliance and/or increasing dependence on a workforce characterized either by precarious employment or by increased insecurity in employment, derived from a movement toward increased labor market flexibilization. Economic changes in the USA and Western Europe have also affected the East Asian region. East Asian countries have industrialized unevenly, and the region has become the world's factory, leading to changes in patterns of work practice and production in Asia. In East Asian countries, a growing distinction between employees who are on a *formal or standard employment relationship* and those who have *informal nonstandard work arrangements* is observed (Lee and Eyraud 2008). In other words, precarious employment conditions increased across the whole region, although the level of development, historical trajectories, and cultural traditions are different among countries (Kalleberg and Hewison 2013).

## Labor Market Trends

There are five points in which these countries' experience with precarious employment converge. First, a growing informalization of the formal sector, resulting in *nonstandard employment relationships*, has emerged. Second, precarious employment relations in these countries have expanded following the adoption of (a) economic reforms as solutions to economic crisis or (b) specific policies influenced by neoliberalism and globalization. For example, South Korea enhanced flexibility of labor markets and restructured the financial market under the neoliberal reform urged by the International Monetary Fund in the financial crisis in 1997 (Kalleberg and Hewison 2013). As a result, the number of precarious workers increased

immediately and drastically, comprising a large proportion of labor markets in the South. Third, the demographic composition of non-regular workers has some similarities across countries and should be examined carefully. For example, migrant workers from Southeast Asia are more disadvantaged in Taiwan (Hsiao 2013). Fourth, an increase in precarious employment/work has led to a growth of social inequalities which, in turn, affects families and communities. In particular, similar to workers who have PE relations in the USA or Western Europe, precarious workers in East Asia lack social protection, earn low income, experience job insecurity, and have weak class power and unstable contracts. These might limit upward social mobility both inter- and intragenerations (Kalleberg and Hewison 2013).

Last, PE comes to the fore as an emerging social problem in the East Asia region. Since the early 2000s, several studies have analyzed employment-related health inequalities between nonstandard (precarious) and standard (non-precarious) employment conditions, particularly in South Korea. This review identifies three large topics. First, the majority of studies show that precarious workers have worse health than non-precarious workers. Precarious workers exhibited worse self-rated health and chronic disease, high level of depression and distress, and high risk of injuries. Second, gender differences in its effect on health were also identified. Female precarious workers report their health as worse and that they feel more depressive symptoms or psychological distress compared to male precarious workers. Third, fewer studies examined mechanisms regarding how precarious employment impacts on health in East Asia (Kim et al. 2008, 2013, 2016b, Jang et al. 2015).

## Precarious Employment: Regional Problems of Measurement

Most studies operationalize PE through a focus on work contract or arrangement, or a one-dimensional characteristic of it. Some forms of permanent contract or arrangement are deemed to be *non-precarious employment*, while others such as fixed, part time, temporary, dispatch, and daily are considered *precarious employment* (Cho and Koo 2018; Kim et al. 2008, 2011, 2016b, 2017; Seon et al. 2017; Ho et al. 2008; Khang and Kim 2006). In all studies, PE was associated with poor health status. In a study linking the number of working hours per week with employment status (permanent or precarious employment), workers in PE with long working hours exhibited higher odds of depressive symptoms than permanent employees working 35–40 h/week (Kim et al. 2016b). A study that identified PE based on a combination of contract duration (permanent, long term, short term) and type (parent firm or subcontract) estimated that parent firm and both short- and long-term contracts were positively associated with workplace attendance while sick (Kim et al. 2016a).

## Precarious Employment and Health

Depressive symptoms and psychological distress are the most frequently examined aspects of mental health in the field of epidemiology of PE and health.

For depressive symptoms, PE is linked to a deterioration of workers' mental health (Kim et al. 2012, 2013, 2016b, 2017; Han et al. 2017; Yoo et al. 2016; Jang et al. 2015). PE is more likely to be associated with the development of psychological distress than full-time permanent work. Workers in nonstandard employment conditions exhibited higher risks of suicide ideation and suicide attempts when compared with employees in non-precarious working environments (Yoon et al. 2017), and, among PE conditions, temporary employment was associated with more severe depressive symptoms than fixed-term employment (Kim et al. 2017).

Self-rated health is also well examined in relation to employment conditions, and PE is associated in particular with low self-rated health (Kim et al. 2006, 2008, 2011). Overall, PE is associated with worse health for workers than permanent employment, with several health status indicators significantly correlated to occupational status and conditions; such indicators include mortality (Khang and Kim 2006); chronic conditions such as musculoskeletal disorders, liver disease, and mental health disorders (Kim et al. 2008); high blood pressure (Seon et al. 2017); metabolic syndrome (Cho and Koo 2018); eye injuries (Ho et al. 2008); and irregular menstruations (Kwak and Kim 2018).

Several studies investigated associations between PE conditions and workers' access to health services. When compared to permanent status workers, dispatched workers and hourly workers received less (a) regular medical checkups; (b) stomach, cervical, and breast cancer screening; and (c) influenza vaccinations (Kim et al. 2018). Similarly, nonstandard employees, both men and women, were less likely to access screening services for conditions such as hypertension and diabetes (Seon et al. 2017), and workers in PE were more likely to report that they did not receive healthcare due to economic burden and timing/scheduling restraints (Min et al. 2016).

A number of studies tried to identify dynamic effects associated with changes in employment conditions. For example, in one study, the authors classified four categories of change in employment status: (a) those who maintained permanent employment, (b) those who changed their employment status from precarious to permanent, (c) those who changed their employment status from permanent to precarious, and (d) those who changed their employment status from precarious to unemployed (Kim et al. 2012). Compared to those who maintained permanent employment, workers who became precariously employed had higher odds of developing depressive symptoms. However, in gender-stratified analyses, among females, new-onset depressive symptoms were correlated with the change from precarious to permanent as well as the change from permanent to precarious; no significant associations between change in employment status and new onset of depressive symptoms were identified among males (Kim et al. 2012). In another study, the authors concentrated solely on the change in employment status from permanent to precarious employment (Jang et al. 2015). The transition from permanent full-time to precarious employment status was associated with the development of new-onset severe depressive symptoms in both males and females, with stronger effects among females (Jang et al. 2015). Another study – which employed nine levels of change in employment conditions – showed that the odds of having depression were significantly increased for workers who transitioned from (a)

permanent to both PE and unemployment and (b) PE to unemployment and for workers who maintained their PE or unemployment status; these associations were significant for men and for women who were in charge of their households (Yoo et al. 2016). Another study estimated that changes of employment conditions from permanent to both part-time and full-time PE increased the risk of suicidal ideation (Yoon et al. 2017).

Several gender differences were identified when estimating the relationship between PE and health. For instance, in a number of studies, female precarious workers reported worse overall health and higher rates of depressive symptoms or psychological distress when compared to male precarious workers (Jang et al. 2015; Kim et al. 2006, 2011, 2012). In addition, different health mechanisms by gender were identified. Thus, one study analyzed dynamics of health inequalities from 1995 to 2006 and showed that absolute health inequalities by employment status increased among women and decreased among men (Kim et al. 2011). A remarkable increase in relative health inequalities was also found among female temporary and daily employees but only among male daily employees (Kim et al. 2011). Further, employment status differences were identified among female workers. Thus, females in PE had higher blood pressure (Seon et al. 2017) and metabolic syndrome prevalence (Cho and Koo 2018) when compared to females holding full-time permanent employment.

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## Limitations of Available Studies

Despite numerous strengths, there are several limitations within the identified research. First, most studies only consider the association between PE and ill health. Second, very few comparative studies are conducted within and between countries. The use of longitudinal perspectives and a closer look at sociopolitical and historical contexts affecting individual countries and geographical regions could facilitate a better understanding of this complex topic. In addition, only a few studies use multilevel analyses to estimate the impact of economic crises and that of social and/or labor market policy changes. Furthermore, only a handful of studies provide detailed explanations of mechanisms of action. Several of these limitations are closely related to the substantive and methodological challenges of measuring PE and its impact on health and health equity as well as the lack of available indicators and comparable data across countries, regions, and time periods.

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## Conclusion

Given the multitude of possible health and social implications linked to PE and other forms of NSE, as summarized in this chapter, continuing to expand the breadth and depth of research on this topic would help move this meaningful field of inquiry forward. Progress on establishing agreed-upon indicators, data collection methods and sources, and multi-concept measurement tools will enable further research, not



only at national but also international levels, therefore facilitating both comparative and longitudinal studies.

In turn, empirical data could be used to strengthen advocacy efforts in order to create, reform, and continually evaluate social and labor market policies aimed at both decreasing the spread of PE and NSE and minimizing their harmful social and health effects. Intersectoral work, strong political will, and evidence-informed strategies are all needed to fight PE and the multifaceted harmful consequences derived from informal economies, deregulated or unregulated labor markets, and weakened welfare state services.

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## Cross-References

- ▶ [Job Intensity](#)
- ▶ [Social Distribution of Occupational Hazards](#)

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# Interactions of Work and Health: An Economic Perspective

# 3

Thomas Barnay

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## Abstract

A growing part of empirical microeconomics papers studies the interaction between employment and health. This literature tries to disentangle the two-way causal relationship. On one hand, the health status influences the employment position and, at the same time, working affects, positively or negatively, the health status. The literature concludes that a favorable work environment and high job security lead to better health conditions. Being employed with appropriate working conditions plays a protective role on physical health and psychiatric disorders. By contrast, nonemployment and retirement are generally worse particularly for mental health in reference to employment. In addition, overemployment has a negative effect on health. These findings stress the importance

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© Springer Nature Switzerland AG 2020  
T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_30](https://doi.org/10.1007/978-3-030-31438-5_30)

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of job sustainability for the health of workers. Thus, in most developed countries, labor-market policy has increasingly paid attention to job sustainability and job satisfaction. The literature clearly invites employers to take better account of the worker preferences when setting the number of hours worked. Overall, a combination of high employment protection, job satisfaction, decision latitude, and active labor-market policies is likely to have a positive effect on health.

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**JEL Codes**

I18 · I28 · J28 · J81

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**Keywords**

Working conditions · Employment · Job insecurity · Mental health

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## Introduction

Almost three quarters of OECD employees benefit from permanent employment which are stable and offer guarantees in terms of job security. Nevertheless, even these workers are being put under rising pressures by deep changes in labor-market trends. Job strain may have a large impact on health, and in return a deteriorated health status undermines employability. For example, among workers declaring a secure job, 25% of European report that work affects negatively their health (Eurofound 2017). The growing use of information and communication technologies and specifically computers contributes to this trend.

The interaction between health and employment is the subject of numerous research studies and can be understood as a two-way causal relationship. Employment has an impact on health and health has also an impact on employment (“*healthy worker effect*”) (Lindeboom 2006). Indeed, in a labor-market model, health status may be “endogenous” both in a structural sense (e.g., health and labor market outcomes are determined simultaneously and the causality is potentially bidirectional) and in a statistical sense (e.g., certain confounding factors can simultaneously influence both health status and socioeconomic status such as a present-biased preference or the degree of aversion to risk). This chapter reviews empirical papers dealing with this two-way causal relationship. The economic literature on the relationships between employment and health is sparse, compared to the vast number of studies published in other fields such as epidemiology, sociology, and psychology. Economists have long been very cautious on this issue because causal mechanisms are difficult to identify and subjective variables are tough to study.

More research on these issues would be important because inadequate working conditions and poor job satisfaction negatively affect health, with costly consequences both for individuals and for society at large.

Furthermore, faced with unsustainable pay-as-you-go pension systems, governments have raised retirement ages and/or increased the contribution period required to access full pension rights. Arduous working conditions and health capital degradation



contribute to lower productivity among older workers, increasing their take-up of sick leave and raising the risk of job loss. Thus a better knowledge of the complex interactions between work and health is necessary to promote the prevention of occupational health risk, through the quest for new forms of organization that are less harmful for health. This should be a key priority of labor-market and health policies.

This chapter, inspired by Barnay (2016), proceeds as follows. Section “[Effect of Employment on Health Status](#)” describes the main results relative to the effect of employment on health. Section “[The Effect of Health on Labor Outcomes](#)” presents the European literature relative to the effect of health on labor outcomes. In a final section, I conclude and discuss policy issues related to health at work.

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## Effect of Employment on Health Status

In microeconomic studies of labor supply, we traditionally distinguish both definitions of work: an *intensive margin* (working hours, job quality) and an *extensive margin* (employment status). In an *intensive margin* approach, since the emergence of the economics of happiness and subjective well-being literature, the quality of work could not be limited to a wage approach. According to Green (2006), the quality of work refers to skill level, effort and work intensity, autonomy, wages, the risk, the level of job security, and well-being of workers. In an *intensive margin* approach, a great deal of definitions has been studied in the epidemiological literature. *Working conditions* have been defined in seminal sociological and psychological papers. In particular, the Job Demand-Control (JD-C) Model, e.g., the imbalance model between perceived pressure (demand) and decision latitude (level of control), refers to concepts of *job decision latitude*, *job demand*, and *job strains* (Karasek and Theorell 1990). Strong job demand combined with low job control leads to a high-strain jobs. This situation called “*job strain*” is associated with a higher propensity to cardiovascular disease, as well as in mental health problems (Theorell et al. 2015). The situation becomes even more detrimental in the case of *social isolation* (i.e., lack of social support at work from the hierarchy and/or colleagues). An “*iso-strain*” situation is detected in the case of *job strain* combined with a lack of social support and leads to deteriorating physical health, notably cardiovascular diseases. Siegrist (1996) shows that high effort–low reward leads to increased cardiovascular risk and psychiatric disorders. Even if the scope is broader, the ERI model appears close to the prediction of the theory of compensating wages differentials. Workers with the same productivity should receive different wages if they perform tasks of different levels of difficulty in a pure and perfect competition model. This is the Hedonic Price Wage theory, proposed by Rosen in 1974, which reflects the size of the heterogeneity of wages. More recently, other concepts have emerged concerning psychosocial factors at work. From an economic standpoint, four dimensions were especially stressed: duration of working time, extended working time, job insecurity, and job satisfaction.

Timming (2010) showed that being supported by the hierarchy, being safe in the job, having a good balance between life and work, satisfaction with pay (Siegrist 2006), and having opportunities to “*learn and grow*” were significant factors of high

job satisfaction in most European countries. Another study from Sousa-Poza and Sousa-Poza (2000) added the importance of having an interesting job. Job satisfaction appears positively correlated with own earnings. It is also positively linked with the average earnings of all other workers within the same company (Clark et al. 2008). A specific part of the literature also focused on the importance of a good match between workers' skills and duties (a mismatch potentially leading to dissatisfaction and reduced well-being; Green 2011).

Bassanini and Caroli (2015), in an economic review, show that the effect of work on health changes according to individual preferences. Unwanted long hours and an obligation to stay in employment affect an individual's health status. The negative impact of work on health could correspond to the differential between the contractual number of hours and the desired number of hours. Employment affects health via a variety of potential channels, such as risk behaviors, health care access, material life or early-life conditions, and cumulative effects. Risk behaviors (tobacco, alcohol or drug consumption, sedentariness, etc.) are determining factors in the early occurrence of chronic disease. These behaviors are more widespread in disadvantaged environments. Access to health care could equally play a role in the causal relationship between employment and health status. Favorable socioeconomic conditions result in access to better health care quality through access to better information and a higher degree of preventative behavior. Furthermore, better professional integration improves the income level and thereby increases the opportunities to invest in one's health through sport, healthy diet, better housing conditions and even better working conditions. By improving one's material living conditions, the improved socioeconomic status leads to a better health status. The literature has shown that an improvement in living conditions is conducive to a better health status, whether it is defined in terms of income, employment status, working conditions, education level, sociodemographic factors, or living environment and neighborhood.

In following subsections, I focus on the health effect of working conditions (section “[Effect of Work and Employment Relations on Physical Health](#)”) – in a large sense – and unemployment/retirement, more specifically (section “[Job Loss and Physical Health](#)”). In section “[Impact of Employment and Working Conditions on Mental Health](#),” I describe the effect of working conditions on the specific topic of mental health.

## **Effect of Work and Employment Relations on Physical Health**

The interactions between work and employment relations and workers' health conditions have received considerable attention in epidemiology and health economics fields. Psychosocial factors, such as the feeling of hierarchical dominance or the loss of autonomy or deprivation, increase the probability of exposure to stress and psychological distress. An individual's socio-professional situation will thus favor (or not) the emergence of psychosocial problems that will lead to deterioration in health status. A favorable work environment and high job security lead to better

health conditions. The physical health of workers who have part-time jobs is worse than those who are full-time. For instance, Robone et al. (*op.cit.*) show that having a part-time job (as compared to full-time job) has an asymmetric impact on health for both men and women according to preferences for the number of work hours. Their results suggest that the impact of part-time work is positive only among upper social classes. Reversely, individuals with unsecure contractual conditions experience bad health if their jobs are associated with low levels of employability.

In order to identify the specific effect of the employment contract on health, it is necessary to consider that the choice of job allocation is unlikely a random experience (due to heterogeneity of individual preferences, risk aversion attitudes, working conditions, and health status among population). It is known that contract workers can be characterized by poorer physical and psychological working conditions. Considering unobserved heterogeneity and selection effects, studies find significantly reduced (indeed no) effects of the contract on the physical and mental health (Cottini and Lucifora 2013; Ehlerst and Schaffner 2011). Cottini and Lucifora (*op.cit.*) investigate the role of working conditions on mental health in 15 EU countries. They find that job quality (in particular job demands) affect mental health. Ehlerst and Schaffner (*op.cit.*) find no health differences between labor market entrants according to contract (temporary or permanent employment). However, they observe a negative effect of additional temporary employment on SAH (self-assessed health), in reference to a full employment contract.

Robone et al. (*op.cit.*) show that a preference for less working hours causes bad SAH among both the men and women population (the reverse is also true, but only for men who want to work longer). Combining a part-time job and preferences for less working hours is associated to bad SAH for women. However, long working hours increase psychiatric disorders (Cottini et al., *op.cit.*). Bell et al. (2012) analyze the effect that hours constraints (difference between actual working hours and desired working hours) have on different measures of workers' health (SAH and health satisfaction) in Germany. Overemployment seems thus cause negative effects on health status.

## Job Loss and Physical Health

Job loss is associated with bad individual well-being (Clark et al. 2008). A priori, the persistence of massive unemployment and recurrent forms of nonemployment has a deteriorating effect on health status.

Numerous studies focus on the relationship between unemployment and poor health (Kalwij and Vermeulen 2008 in Europe) and on the effects of retirement on health (Coe and Zamarro 2011, in Europe and for international comparison, see Rohwedder and Willis 2010). Once again, this relationship is subject to discussion; lower health in the unemployed than in the employed could be explained by reverse causality. To tackle this problem, Browning and Heinesen (2012) estimate the causal effect of job displacement due to plant closure on mortality and hospitalization

outcomes among the male workers population in the private sector by using propensity score weighting. They find that job loss increases the overall mortality risk and especially circulatory disease, suicide mortality, death and hospitalization due to traffic accidents, alcohol-related disease, and psychiatric disorders. These results converge with Kuhn et al. (2009) using Austrian data, which find a positive effect of job loss due to plant closure on public health expenditures generated by additional psychotropic drugs consumption and hospitalization cost due to mental problems and stroke among male population (matching procedure with propensity score).

The nature of the causal relationship between retirement and health is not obvious and can be bidirectional. Retirement may first free individuals from a job strain situation and may improve, in particular, short-term mental health. This positive dynamic will be sustainable as long as individuals have a capacity to invest in their health (via an income effect) (Grossman 1972). Conversely, a retirement shock can also cause a loss of a social role, a decline in human capital stock, and therefore a deterioration of health will be enhanced by a negative shock on living standards of the retiree. Retirement can then be desired by unhealthy old workers.

On one hand, a set of recent studies confirms this detrimental effect of retirement on health. In the UK, Behncke (2012) finds that retirement increases the occurrence of chronic health conditions. Using SHARE data, Celidoni et al. (2017) evaluate the causal impact of retirement on recall memory tests. They stress out that retirement has a long-term negative effect on cognition for individuals who retire at the statutory eligibility age. Mazzonna and Peracchi (2017) show that retirement is on average negative for both mental and physical health (depression and mobility limitation) and cognitive abilities (memory and fluency). Heller-Sahlgren (2017) investigated the short- and long-term effects of retirement on mental health (Euro-D scale) in ten European countries and found a negative long-term effect.

On the other hand, many international empirical studies show that retirement is beneficial to health status. For instance, Coe and Zamarro (2011) conclude that retirement decreases the likelihood of reporting poor perceived health (35%) after controlling for reverse causality. However, this effect cannot be found with both depression indicators. In the UK, Bound and Waidmann (2007) found a positive but transitory health effect of retirement, only in men. Based on German data, Eibich (2015) finds that retirement improves general and mental health status. Shai (2018) underlines that being in employment at older ages is related to poor general health in Israël. In France, Blake and Garrouste (2019) point out a negative effect of a pension scheme reform based on the increasing the duration of the contribution period on health, but exclusively focused on less-educated individuals.

This ambiguous effect of retirement might find an explanation in its timing, ultimately hinting towards the role of past exposures to working conditions. Thus, the positive effect of retirement on health is often related to early retirement, i.e., past employment in physically demanding occupations in the sense that individuals employed in low-skill jobs are overrepresented in early retirees (Mazzonna and Peracchi 2017).

## Impact of Employment and Working Conditions on Mental Health

Based on Australia data, Leach et al. (2008) show a strong correlation between physical and mental health, and particularly in the female population. This gender effect is confirmed by Barnay and Defebvre (2019) in a French study. We show that poor mental health in the male population decreases the probability of staying in employment after including physical health as control variables. In addition, omitted variables generate unobserved individual heterogeneity, which is also a potentially endogenous factor. Risk preferences, job involvement and satisfaction, family background and risk behaviors (smoking, alcohol, and overweight) are all related to both mental health and employment.

I examine three categories of determinants: employment, working conditions, and long-term effects of initial conditions.

Overall, being employed plays a protective role on psychiatric disorders. In the Netherlands, Plaisier et al. (2008) use cross-sectional data to measure various social roles (employee, partner, and parent) with the prevalence of anxiety and depressive disorders. Both having a job and working full-time were associated with a lower prevalence of anxiety disorders and depression among men, but not among women. The effect of employment on mental health is confirmed in a robust econometric study of the UK (Llena-Nozal et al. 2004). Gender differences are corroborated. Employment status is a determining factor for males but not for females. The effect of retirement on health status seems significant when considering mental health indicator. This mental retirement effect can be attributed to a decrease in human capital investment and an “*unengaged lifestyle hypothesis*” (Rohwedder and Willis 2010). Non-employed men have substantially worse mental health. From Spanish data, Artazcoz et al. (2004) show that nonemployment is associated with problems of mental health for men, and to a lesser extent for women.

In an intensive margin approach, the working conditions can be potentially pathogenic and provoke mental health problems. Using the UK, Switzerland, Australia, and Canada data, Llena-Nozal (2009) displays that nonemployment is generally worse for mental health than employment. In France, among men and women, constrained part-time work is associated with a higher depression. Santin et al. (2009) show that having a fixed-term contract is correlated with depression, but only for women. Workers on temporary contracts may suffer more psychological costs and stress due to exposure to job insecurity (Green 2011; Caroli and Godard 2014). Job insecurity is particularly widespread in Europe where 10% agree (or strongly agree) that they might lose their job within the next 6 months (Eurofound 2017).

Thus, Bildt and Michelsen (2002) show that exposure to difficult working conditions may have an adverse effect on mental health, with differences according to gender. Men are more affected by changes in tasks and a lack of pride at work. Among women, other drivers explain this effect, such as no training, low motivation, and weak social support at work. Men suffer from the omnipresence of work in their lives and the repetitiveness and lack of cooperation in the labor force. Women, in addition to the repetitive nature of tasks and lack of cooperation, identify starting

work before age 18 and involuntary interruptions during work as criteria impacting their health.

Finally, significant life events also play a role in determining the current state of mental health. Unemployment and nonemployment, during the beginning of working life, can induce depressive symptoms later. Workers who have higher risk of long-term unemployment suffer from feelings of job insecurity and face a higher risk of mental health than others. It has been shown that events such as illness or the death of a close relative or partner, marital separations, and serious quarrels also tend to impact mental health (Lindeboom et al. 2002 in the Netherlands). Past or present financial difficulties are also often associated with the onset of common mental disorders, such as depression and anxiety. Finally, a degradation in physical condition induced impairment of mental health, especially for women. Bad health or the presence of disability in childhood has negative consequences on mental health at older ages, as well as chronic diseases, regardless of the age of onset (Llena-Nozal et al. 2004).

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## The Effect of Health on Labor Outcomes

The *healthy worker effect* refers to the selection of workers in good health and reflects past personal experience having undermined health and professional paths. For instance, several studies attach importance to the cumulative effects of events experienced throughout an individual's life cycle having reinforced the selection effect. An individual's socioeconomic situation during childhood, or even in utero (according to the *latency hypothesis* or *latency model*), and labor market trajectory described as the *pathway model* (Case et al. 2005) are important determinants of health status in adulthood. Lindeboom (2006) show that the childhood environment influences the probability of experiencing occupational accidents and disabilities. A large body of literature equally acknowledges the role played by the social determinants of health.

Moreover, we can observe a self-selection of workers with a lower health status into, for instance, temporary employment or specific jobs. Tackling this selection problem can lead to invalidate the negative effect of temporary contracts on health status (Cottini and Lucifora 2013; Ehlert and Schaffner 2011).

## Effects of Disabilities on Work

In this main field, I select two topics: the effectiveness of legislative and fiscal measures relative to handicaps and the impact of disabilities on professional paths.

A first category of studies deals with the effects of disability insurance benefits programs (in terms of eligibility criteria and generosity), notably provisions seeking to maintain disabled persons in employment (Staubli 2011; Marie and Vall-Castello 2012). Vall-Castello (2012) evaluated the effects of a policy promoting employment among disabled women in Spain. The author studies the impact of reducing social

security contributions for employers who hired disabled women. The study shows a significant effect from the reductions of the social security employer contributions. Along the same lines, Staubli (2011) studies, in the case of Austria, the effect of linking the eligibility to disability insurance to return to work and disability enrolment. They identify a statistically significant positive effect for this type of measure on labor market participation (in the private sector) for disabled men aged 55 and over (an increase of 1.6–3.4 points). Marie and Vall-Castello (2012) look into the impact of establishing a more generous disability insurance program on the rate of labor market participation for claimants suffering from partial disability (who can combine disability benefits and job income) for individuals aged 55 and over (the only ones eligible for such benefit increases). Using Spanish data, the authors find that a 36% increase in the amount of disability pensions reduces the probability of being employed by 8%.

A second category of studies has to do with the impact of disability on labor-market outcomes, including professional careers.

Jones (2011) estimates the influence of different characteristics of disability (type, origin, duration, severity) on the probability of being employed and on labor-market earnings, using an ad hoc module of the 2002 UK Labour Force Survey. The study only includes people reporting disabilities and estimates are made separately for men and women. Selection effects due to only considering employees experiencing disabilities are taken into account. The results reveal a positive influence of disability at birth on employment, but only for men, as well as a positive influence of disability resulting from a traffic accident for both men and women. On the other hand, mental illness negatively affects employment both for men and women. Disability's form has far less influence on earnings than it has on employment.

Furthermore, two other articles are based on a rather similar methodology, using matching methods with temporal lag between the occurrence of the health shock leading to disability and the evaluation of outcomes in terms of vocational integration. Lechner and Vazquez-Alvarez (2011) estimate the effect of becoming disabled (officially recognized) on labor market outcomes: employment, unemployment, exiting the labor market, net annual earnings and per capita household disposable income, and average weekly hours worked. They use German panel data from 1984 to 2002 that they cut into sequences of four successive years and implement propensity score matching. The individuals belonging to the control group, the so-called “untreated,” are individuals not officially recognized as disabled over the 4-year sequence, while the “treated” are individuals officially recognized as disabled between the first and second years of the sequence, with the authors insisting on the objectivity of the disability measure. The matching was carried out on observable characteristics over the first year, and matching variables correspond to the characteristics susceptible of influencing the occurrence of a disability. They then compare the different outcomes (unemployment, employment. . .) between the treated and the untreated in  $t_2$ ,  $t_3$ , and  $t_4$  and obtain the following results: disability does not lead to a reduction in earnings nor in hours worked, at least during the 3 years following the occurrence of a disability, when the disabled person remains employed; becoming disabled reduces the probability of being employed by 9% and approximately 13%

for those with a high degree of disability 3 years after its onset. Nonetheless, this reduction in the probability of being employed is not accompanied by an increase in the probability of being unemployed, which could be interpreted in terms of a “voluntary” employment exit.

More than disability *stricto sensu*, Garcia-Gomez (2011) studied the impact of a health shock on labor-market outcomes in nine European countries on the basis of the ECHP. The author notably uses the propensity score method with two consecutive health state measures enabling an estimate of the occurrence of a health shock (the perceived health deterioration and illness prevalence) and targets test and control groups depending on the sequence during which the health shock occurred. She thus studies the health shock over 3 years, considering in  $t_1$  a person in good perceived health and in employment in  $t_1$  and  $t_2$ . The treated group is that which is in poor health in  $t_2$  and  $t_3$ , which implies that the shock lasts at least until  $t_3$  while individuals in this group were in good health in  $t_1$ . The control group is in good perceived health in  $t_1$ ,  $t_2$ , and  $t_3$ . The results, obtained by applying matching methods, suggest that health shocks have a significant causal effect on the probability of employment: persons suffering from a health shock are much more susceptible of leaving their job and transiting through disability.

In the Netherlands, on the basis of Dutch hospital and tax register data, Garcia-Gomez et al. (2013) perform matching combined with difference-in-differences to estimate the causal effects of acute hospitalizations on employment and income up to 6 years after the health event. Two years after the shock, an acute hospital admission leads to a decrease of employment probability by seven percentage points and five percentage points concerning loss of personal income. In France, Barnay et al. (2015) indicate that the occurrence of a disability exerts a strong detrimental effect on private employment but has no significant effect on public employment during the 5 years after its occurrence.

## Cancer Onset Effects on Labor Outcomes

In a meta-analysis based on 26 papers using US and European data, de Boer et al. (2009) estimate the relative risk of unemployment of cancer survivors to 1.37 in reference to a healthy population, all other things being equal. In a review of 64 international articles, Mehnert (2011) shows that the return to work of cancer survivors, on average, is equivalent to 40% 6 months after the diagnosis, 62% after 12 months, 73% after 18 months, and 89% after 24 months. Conversely, the onset of cancer leads to a transitory or permanent exit from the labor market. At a given age and gender in Finland, the relative risk of early retirement is 2.2 for survivors of cancer of the nervous system, 2 for leukemia, 1.9 for tongue, 1.2 for breast, and 1.1 for prostate (Taskila-Abbrandt et al. 2005).

The negative impact of cancer on the career path passes mostly through functional limitations that may be specific, such as arm pain for breast cancer as well as depressive episodes, disorders of concentration and memory, and more generally, more pronounced psychosocial risks (Bradley et al. 2002, USA). These dynamics are



more or less supported according to the nature of the initial endowments of human capital, the difficulty of working conditions before the illness but also the type of cancer (site, severity disease), and finally, the nature of the treatment. Past professional biography (unemployment or training episodes) can lead to stigmatizing effects on the careers of individuals and, for some social groups, predicts the occurrence of occupational cancers. The work environment also influences cancer onset effects on work. The importance of improvements in the workplace in terms of schedule flexibility, social support from colleagues, social climate, and job stress in order to protect work in cancer survivors is now demonstrated.

### Impact of Health on Sick Leave

Socioeconomic characteristics play a large role on sick leave determinants. Thus, women generally take longer and more frequent sick leaves than do men (in Europe Union – Frick and Malo 2008). They are thus more sensitive to economic incentives (compensation system effect) and are more influenced by unemployment (Ose 2005). Moreover, the length of sick leaves increases with age, without them occurring more frequently. This surprising result can be partially explained by the existence of a *healthy worker effect*; employed seniors are healthier than those who are not employed.

Indeed, health status is equally a determining factor. A degradation of the health capital could lead to sick leave by making the individual unable to work. In addition, the preservation of health capital can benefit from periods of preventive sick leaves in order to avoid more damaging consequences on the individual's occupational status (Grossman, *op.cit.*). Case and Deaton (2005) explain that manual workers self-report to be in the poorest health status.

In the Shapiro-Stiglitz efficiency wage model (1984), the individuals whose utility positively depends upon wages and negatively upon effort would be less inclined to be voluntarily absent (*shirking model*) when the probability of finding a new job is lower. Concerning the type of work contract, a permanent contract increases the probability of returning to work. In economic theory, absenteeism results from a work-leisure trade-off in a neoclassical model of labor supply (Allen 1981). Within this framework, sick leaves could correspond to the differential between the contractual number of hours and the desired number of hours.

Based on Shapiro and Stiglitz (1984), it is commonly argued that labor market uncertainty has a negative impact on absenteeism (in other words, absenteeism is countercyclical) but empirical evidence has to be more nuanced. We can assume that the unemployment rate constitutes a worker disciplining device and employees may fear losing their job if they report sickness. Nevertheless, the duration of sick leave is determining. Thus, Ose (2005) found that short-term absences (shorter than 3 days) do not depend on the unemployment rate while long-term absences do. Using micro-data from the EU 28, Livanos and Zangelidis (2013) showed that a higher proportion of disabled persons (inactive and unemployed individuals) is associated to lower sickness absence, probably due to the pressure active people may experience. The

positive relationship between the company's size and the probability of absence due to illness (Ose, *op.cit.*) seems to confirm the importance of working conditions. Nevertheless, this positive relationship could also reveal differences in checking policies or individual effort within the company.

It is essentially the Scandinavian authors who studied the impact of sick leave on professional paths. Hesselius's study (2007) in Sweden stresses that an increase of sick leave and their frequency enhances the risk of unemployment. More recently, Markussen (2012) in Norway establishes that an increase of one percentage point in the rate of sick leave decreases the probability of being employed 2 years later. For those remaining in employment, the author also observes a negative impact of sick leave on wages.

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## **Conclusion and Recommendations: Towards Job Sustainability and Satisfaction**

Keeping in mind what we know about the interactions between *health, work, and working conditions*, many policy targets should be implemented or reinforced. Promoting health at work involves leading comprehensive and global policies throughout the life cycle (employment, training, health care, . . .). Several channels could be simultaneously enlisted: prevention and lifelong training, adaptation and development of working conditions, and targeting populations or pathologies specific.

Thus, a first policy goal could aim to improve job sustainability and satisfaction by reducing the impact of unwanted professional shocks on health status and the exposure to arduous working conditions. This literature showed that long unemployment or nonemployment (mental retirement effect) can favor, in some cases, a faster degradation of health capital. OECD policies converge towards a single objective: job sustainability. This concept, referring to the ability of people in employment to maintain this situation throughout all of their career, is one of the key guideline for public policies. Job sustainability relies on key factors affecting participation in paid employment, such as health, training, lifelong learning, availability of a care infrastructure, marketable skills, and motivation. For this matter, several national policies have been implemented in high-income countries. Moreover, the empirical economic literature clearly invites employers to take better account of the worker preferences when setting the working time and the number of hours worked. This chosen flexibility could decrease the negative effects of work on health. Indeed, part-time working can be a worker's choice or it can be involuntary. The motivations for reduced working time can be explained by poor health status care needs, harsh working conditions, or concern for a better balance between professional and personal life. By contract, motivations for increased working time may come from an income effect, a high job satisfaction, or joint preferences inside the household. It seems that the use of free time is different according to social class preferences. Several hypotheses can be proposed. The upper classes has a better use of saving time. If they decide to work less they can consume care and invest in health

capital. They can also better reconcile private and professional lives. The effect of part-time work dominates the loss of health induced by a reduction in income. In contrast, among the disadvantaged classes, part-time work can appear more undergone. The negative effect of the loss of income on health effects dominates the other. A better understanding of these behaviors could be a support tool for health at work. Moreover, with the growth of specific strains on workers, such as organizational and psychosocial risk factors, the impact of work on mental health is becoming stronger. For instance, the global costs of mental health are estimated at more than 4% of GDP across EU countries. Mental health becomes a major issue owing to the development of new technologies, management methods, activity controls (quality standards, processes rationalization, etc.), as well as contacts with the public. Finally, within this specific topic on mental health, Cottini and Lucifora (*op.cit.*) show that the efficiency of health care systems (in terms of medical density, GP visits, beds available for psychiatric care, health care expenditure per capita) and labor market (e.g., employment protection legislation, unemployment benefits) seem to allow a better trade-off between job quality and mental health.

A second policy goal should be to increase the (re)integration of outsiders (healthy or unhealthy persons) by intervening at the beginning of professional career, to avoid permanent exclusion from the labor market and negative effects of unwanted nonemployment or nonemployment on health status. Literature review shows that selection effect can explain the role of work on health (Cottini and Lucifora, *op.cit.*; Ehlert and Schaffner, *op.cit.*). The *pathway model* (Case et al., *op.cit.*) underlines cumulative effects of unfavorable professional events on health. Thus it is necessary to invest in ongoing training from the beginning of a professional career to offset adverse health shocks. The literature review shows a negative impact of retirement on mental health. To avoid these adverse effects, retirement should be a gradual and chosen path. It should, therefore, develop opportunities to promote work after retirement and the reversibility of retirement. This phenomenon is growing in OECD. From 2005 to 2018, most OECD countries experienced an increase of employment rates among 55- to 64-year-olds from 51.6% to 61.4%. Flexible work arrangements have been identified as crucial in facilitating post-retirement work. A natural way to target work after retirement is to facilitate self-employment for after 65-year-olds. By and large, it seems desirable to combine flexibility and employment security by taking into account individual preferences. A search field is still largely under invested.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Social Inequalities in Health Among Older Adults After Retirement](#)
- ▶ [Social Inequality in the Transition from Work to Retirement](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress and Adverse Health Behaviors](#)

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# Work and Health

# 4

## A Gender Perspective

Lisa F. Berkman and Kathryn Treder

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### Abstract

While much research has been conducted on the relationship between psychosocial working conditions, particularly related to job demands and control, and health outcomes among men, less has been conducted on women. Globally,

The section on maternity leave policies is adapted from: Avendano M, Berkman LF (2014) Labor Markets and Employment Policies and Health. In: Berkman LF, Kawachi I, Glymour MM (eds) Social epidemiology. Oxford University Press, pp 212–214

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women have joined the workforce in large numbers over the past 50–70 years while still maintaining the lion's share of unpaid housework. This chapter explores the existing research that examines the health outcomes of women as it relates to their changing roles in the workforce. The traditional frameworks that model job strain and health among men tend to demonstrate strong and consistent results for men but very inconsistent results for women. Often the results for women in relation to cardiovascular disease and hypertension are weaker or null. This existing evidence would suggest that frameworks that incorporate family or home demands and control in addition to work demands would best model the experiences of women. In analyses of such frameworks, stronger results are found for women for a number of health outcomes. Furthermore, public policies related to family leave and flexible work arrangements also provide long-run benefits to women in terms of both employment experiences and health gains.

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**Keywords**

Job strain · Gender · Cardiovascular disease · Health

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**Introduction**

Over the last 50–70 years, the demography of the workplace has changed dramatically. This demographic shift has happened globally at different rates among low-, middle-, and high-income countries and even between Europe, North America, and industrialized Asian countries. In all countries, to various degrees, women have joined the paid labor force in large numbers. Today in many countries women have joined at early stages in the life course and continue to stay in the labor force at older ages than men. While women have joined the paid labor force in large numbers, they also continue to carry most of the unpaid home activities with only slight changes in the increased participation of men over the last years. Conditions about work/home strain as well as other issues related to job discrimination may compound to increase stress related to workplace conditions and being in the paid labor force. Thus, women may experience additional stress from the similar conditions to those experienced by men, or they may have additional sources of strain that compound to add to health risks.

This chapter considers that workplace stress is reportedly common and chronic for both men and women. In fact, between 15% and 20% of Europeans and Americans report high levels of workplace stress (ILO 2000). In spite of this high prevalence and the large number of women in the workforce, there is little consensus on whether the job stress exposures have the same impact on men and women or if there are specific workplace exposures that are particularly toxic for women. This chapter addresses important issues related to the potentially different health impacts of traditional job strain conditions for men and women. In focusing on this examination of a very specific issue of differential impact of similar job conditions, we also acknowledge the mitigating or exacerbating effects that other



specific workplace and labor policies and practices may have on women's health. These other conditions include specific forms of discrimination related to wages, hiring, and promotion, family leave, and schedule control. However, we do not focus on these in the review and acknowledge that they are critical areas for research and policy.

Gender inequality related to labor force participation and working conditions as many (Stamarski and Son Hing 2015) have noted is complex, insidious, and often challenging to identify. Furthermore, the literature on working conditions – particularly the job strain model related to job demands and control – while huge has not clearly identified whether the model predicts health outcomes, particularly cardiovascular outcomes, the same for men and women. Often passing comments and some reviews suggest that the job strain predicts cardiovascular events more consistently and strongly for men than women, but only a few reviews (Belkic et al. 2004) and several articles aim to examine gender differences directly. A critical look at this literature is the focus of this chapter. Other workplace conditions such as leave policies, practices built on flexibility and schedule control, and childcare policies designed specifically to even the playing field and enable women with family responsibilities have had positive benefits in many cases but sometimes have had unintentional consequences. This chapter aims to explore these policies and practices here. Finally, though wage, promotion, and hiring forms of discrimination are hard to identify, groundbreaking work has been done with regard to racial and ethnic forms of discrimination. And some practices have been put in place – see, for instance, Merkel's policy in Germany to equalize pay across gender lines that has been highly effective. As we noted above, this literature is not included in this review.

In the United States, women's health and life expectancy has stagnated over the last decades (Crimmins et al. 2011). Among lower and working classes, American women have experienced absolute declines in health with recent reports in increasing mortality. Increases in mortality in OECD countries are rare, and therefore this increase is notable. We hypothesize that the mix of low levels of social protection in the United States accompanied by precarious and stressful working conditions that do not provide women with enough control and flexibility in their jobs may lead to this increased mortality risk and overall lack of improvement in health compared to other industrialized countries. Because of these country-specific effects, we pay special attention to the geography in examining gender differences in job strain.

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## **Does Job Strain Have Different Health Impacts for Men and Women: The Gendered Effect of Job Strain?**

There is a vast literature documenting the impact of job strain on the health of men. A number of reviews, including outstanding systematic reviews (Kivimäki et al. 2006, 2012; Li et al. 2015; Madsen et al. 2016; Nyberg et al. 2013), show that job control and job demands, which form the classical elements of job strain

developed by Karasek and Theorell, still maintain their power to predict many health outcomes but particularly those related to cardiovascular risk. In addition, results often suggest that the job control domain of job stress is particularly toxic. What is of interest here is that for women, the findings are much less consistent – sometimes looking like risks only for men, sometimes null, and sometimes even reversed or moderated by other conditions, particularly those related to either home circumstances or to emotional stresses allied with relationships. We have looked extensively at the literature documenting gender differences in impact of these work-related strains. In view of the increased involvement of women in the workforce, we are particularly interested in the either harmful or beneficial effects of work and, more specifically, the differential effect of job strain on the physical and mental health of women (Evans and Steptoe 2002).

We attach particular importance to the demand/control model because it is not only among the most well documented of working conditions but also because we believe it has particular relevance to today's workforce, particularly for women. While earlier models emphasized demands and control related to physical working conditions, over time, jobs have changed and new elements related to schedule control and flexible work arrangements have become critical to the workforce of men and women. Because women often have so many additional non-work demands related to family, community, and the household, control may be a central component of risk or benefits related to work. We examine the literature here in some detail. In this section we review the evidence suggesting that job strain (composed of job demands and control) has a differential toxicity for men and women. We take into account country of the study so that we can better understand the underlying social, economic, and political context of these working conditions.

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## **Job Strain and Cardiovascular Disease in Men and Women**

There are a number of systematic reviews on job strain and cardiovascular disease. Most systematic reviews (Gilbert-Ouimet et al. 2014; Belkic et al. 2004; Kivimäki et al. 2006; Eller et al. 2009) concluded that a more consistent adverse effect of psychosocial working conditions on health has been found among men than women, and in studies with higher methodological merit. Occasionally, results of systematic reviews reveal common risk estimates for men and women (Kivimäki et al. 2012). Most recently, Kivimäki et al. (2018) reveal quite precise patterns for men and women with and without job strain and risk of mortality. Among those without baseline cardiometabolic disease, risks are small and gender differences are negligible. Among those with cardiometabolic disease, risks associated with job strain are substantial for men but not for women. Some meta-analyses suggest that much of the risks associated with cardiovascular disease is related to increased diabetes and other behavioral risks (Nyberg et al. 2013). In a US study of women, the Nurses' Health Study, Lee et al. (2002) found no increased risk of incident coronary heart disease (CHD)-related job strain. Again in a US study, the Framingham Offspring study, Eaker et al. (2004) found no association between job

strain and CHD for either men or women. In fact, they report an increased incident risk of CHD for women in active jobs (i.e., high demand-high control jobs) of 2.8 (CI 1.1–7.2) compared to women with high job strain (high demand-low control).

Turning to global studies, we find similar patterns, especially among those conducted in Europe. In the Women's Lifestyle and Health Cohort Study of almost 50,000 Swedish women aged 30–50, Kuper et al. (2006) found that job strain was weakly related to incident fatal and non-fatal CHD, though in most cases the modest risks (around 1.4) were not statistically significant. Furthermore, job strain, while significant, did account for much of the socioeconomic gradient in CHD. In another Swedish study of over 10,000 men and women in several counties in Sweden, Alfredsson et al. (2002) looked at risk factors for coronary heart disease among working men and women. In this study, men who reported job strain had lower levels of cholesterol and high-density lipoproteins (HDL) than others. Trends were similar though not as strong for women. For women, but not for men, job strain was associated with a higher prevalence of hypertension. The INTERHEART Study, a case-control study of men and women with and without first myocardial infarctions (MI) from 262 centers from around the world, Rosengren et al. (2004) looked at the general question of job stress and MI. The odds ratio for having permanent stress at work was 2.34 (CI 1.86–2.93) for men and 1.1 (CI 0.60–2.06) for women. Other stressors at home, more generally or related to financial or life events, were more similar for men and women. In a study of arterial stiffness and job strain in Thailand, Kaewboonchoo et al. (2018) found significant associations for men and none for women. In a very recent study of a multicohort of men and women on change in job strain and incident cardiometabolic disease, there were no significant effects for either men or women (Magnusson Hanson et al. 2019).

In looking at attributable risks related to job strain, gender differences become less pronounced, perhaps because the distribution of high-risk jobs is higher among women, even though relative risks generally seem smaller. Sultan-Taïeb et al. (2011) estimate 4.9–21.5% and 0–15.9% of cardiovascular disease (CVD) morbidity to be attributable to job strain for men and women, respectively. For CVD mortality, attributable fractions were estimated to be 7.9–21.5% for men and 2.5% for women. This is based on relative risks similar to other studies and a distribution of risk that shows the prevalence of job strain to be higher in women than in men (19.6% for men and 28.2% for women). The studies that go into these calculations include both samples and cohorts with a high prevalence of the disease as well as those without. Thus, we see that even with a higher prevalence of job strain exposure, the attributable fractions remain smaller for women.

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## Job Strain and Hypertension in Men and Women

Hypertension is a common disease in many industrialized countries with a growing recognition of the problem in many emerging middle-income countries. As a major risk factor for a number of other cardiovascular conditions, it is an

important disorder to understand. There have been several systematic reviews of job strain and blood pressure recently that stratify their analyses by gender. Gilbert-Ouimet et al. (2014), for example, explicitly examined gender differences in their meta-analysis. While there were more studies of men, there were a sizeable number of studies with women in them as well. The vast majority of studies included were cross-sectional, and some had office measures as well as ambulatory measures. They found that a higher proportion of cross-sectional studies reported deleterious effects among men than among women when examining blood pressure level, and in one study of hypertension, there was a risk reported for men but not for women (Gilbert-Ouimet et al. 2014). Prospective studies generally showed less consistent results for both men and women. In a systematic review conducted by Landsbergis et al. (2013), authors did not report gender-specific results, though they also note stronger effects among men and report that interactions by gender and education suggest that effects may be stronger for better educated women. However, they note that there may be strong bias in these studies since women with less education may have been excluded. Their concluding remark with regard to gender-specific risks is that because of the small number of studies in women, “further research is clearly required” (p. e69). Following the review by Landsbergis et al. (2013), a recent review by Trudel et al. (2018) focused on additional studies that have been published since the 2013 Landsbergis et al. review. Trudel et al. (2018) argue for expanding the model of job strain from the traditional demand/control model but unfortunately do not address issues of gendered differences in risk related to the models.

A number of individual studies discussed in the meta-analyses suggest interesting directions for research. In the WHO MONICA study of from Northern Italy, Cesana et al. (2003) undertook to ascertain gender-specific blood pressures taken in clinical settings of employed men and women. In the study, high job strain, particularly related to low job control, was significantly related to blood pressure for men with no differences found for women. They note that these associations may hold also for office measured blood pressures as long as the quality of ascertainment is high. In the Whitehall II cohort, Steptoe and Willemsen (2004) report that job control, though not overall job strain nor demands, is associated with ambulatory blood pressure monitored during the entire day. Women were more likely to be in low control jobs and to report being more stressed by low control than were men. Analyses control for gender but do not show gender-specific risks, so it is hard to evaluate whether the risks were different in men and women though the distribution. Additionally, stress reported by low control showed different patterns for men and women. A number of other studies, some of men only, suggest that low control is a more potent predictor of hypertension than job demands or job strain per se (Hattori and Munakata 2015). In another longitudinal study, Ohlin et al. (2007) found no association between decision latitude and high blood pressure among women, but did find a positive association among men.

There are roughly twice as many studies of job strain and blood pressure or cardiovascular disease with male cohorts than studies with both men and women, and very few are among women only. An important exception to this is the Quebec City Study of female white-collar workers (Laflamme et al. 1998; Brisson et al. 1999). This study was launched with the rationale that an increasing number of women are in the paid workforce, especially in white-collar jobs, and that women appear to be more likely to work in job with high levels of job strain than do men. The Quebec City Study drew on a larger earlier study of men and women where job strain was associated with increased systolic blood pressure with stronger findings for men than for women (Guimont et al. 2006). In the study of women (Laflamme et al. 1998), women with a university degree who had high levels of job strain had higher mean levels of blood pressure over a 24 h period. Among those without a university degree, no significant differences were found. Others have questioned whether bias in selection and follow-up may have biased the findings in those with less education toward the null. Nonetheless this is a valuable study highlighting the importance of job strain in well-educated women working in white-collar jobs. Notably, Feaster and Krause (2018) have documented increases in ambulatory blood pressure in lower-income women, actually finding the opposite; high job strain was found to be positively associated with blood pressure. More studies focusing on the effects of job strain on health in female cohorts are needed to paint a clearer picture.

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## Job Strain and Health Outcomes

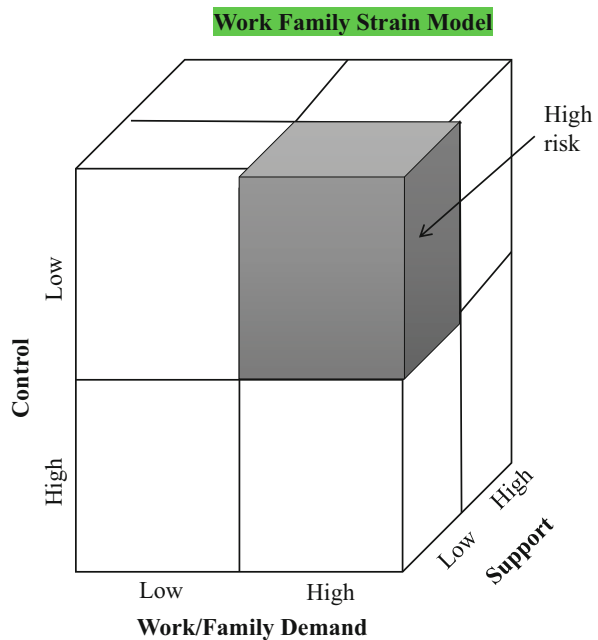
A growing number of studies have examined a broad range of health outcomes and multiple outcomes in a single study. In CONSTANCES, a cross-sectional study of 43,593 men and women at the time this study was completed, work stress was associated with higher BMI, waist circumference, waist-hip ratio, white blood cell counts, and lower high-density lipoprotein cholesterol in men and higher BMI and white blood cell count in women (Magnusson Hanson et al. 2017). The authors point out the relevance of these biomarkers for metabolic syndrome and increased inflammation. A number of other studies add to the literature that job strain is related to metabolic outcomes, sickness absence, and musculoskeletal and functional outcomes. However as with the literature on cardiovascular disease and hypertension, most studies report stronger findings for men than for women. These findings challenge us to ask why the findings might be weaker for women than men across so many different outcomes. We suggest that women's working lives are so enmeshed and dependent on home and family conditions that we must take a broader perspective in understanding the ways in which work intersects with family and community to fuller understand the ways in which gendered impacts on health for work-related conditions are modelled.

### A Broader Perspective on Stressful Working Condition with More Relevance for Women’s Lives: A Work and Home Demand/Control/Support Framework

Over the last two decades, an emerging body of work has come into play broadening the vision of what constitutes a stressful working life for women. These new models hold the potential to explain why the traditional models of workplace job strain frequently predict weaker outcomes for women than for men. Many articles on job strain related exclusively to conditions at work have started to incorporate home demands into their models. About 10 years ago, a model of job strain that incorporated home demands and control into the strain model was developed. In this model, the conditions of both home and work are incorporated as potential stressors in women’s lives as well as potential resources and sources of resilience. Early models of work/family balance, for instance, identified competing models for producing well-being. In one model, demands between home and work life created tension and stress, but in the other model, it was hypothesized that multiple roles would add richness to people’s lives and serve to moderate otherwise stressful conditions. To date there is some support found for each of these frameworks (Sabbath et al. 2015). Below is a figure of the model (Fig. 1).

This model incorporates the growing understanding of the health impacts of work/family demands (Allen et al. 2000; Frone 2000; Frone et al. 1997) developed

**Fig. 1** Work/family demands, control, and support model – a three-dimensional framework. (Reproduced from Berkman and O’Donnell 2013)



in the late 1990s and 2000s and several research findings identifying work-home interference and health (Van der Heijden et al. 2008; Peeters et al. 2004; Demerouti et al. 2004). We and a number of others (Ertel et al. 2008) hypothesize that home demands in terms of family obligations for both young children and older adults interact with job strain as it is traditionally measured to impact the health of women and men with heavy home obligations. An early study in this area (James et al. 1989) suggested having children at home and home stress had a marked effect on diastolic blood pressure over the day, while job stress also had an effect on systolic blood pressure. Others have also found that increased parity was associated with increased risk for CVD, an association not attenuated by either job strain or job insecurity. Since the majority of work at home is done by women, even as they have entered the paid labor force, these risks should be especially apparent for women and may even give us insight into why job strain alone does not predict poor health as well for women as for men. For instance, in a study in which we examined the impact of family demands and job demands/control and support, we found that the association between depressive symptoms and job strain was moderated by social support and the presence of a child. There was a positive association between job strain and depressive symptoms among participants (majority of whom were women) with low social support and a child (Ertel et al. 2008). In several French studies of gas and electricity workers, sickness absence was found to be strongly related to work and family demands (Sabbath et al. 2012). In other studies of domestic overload (Portela et al. 2013), women exposed to domestic overload (defined as responsibility for household tasks and number of household beneficiaries) and high job strain had higher systolic blood pressure at home than the workplace. In the Quebec City Study, similar interactions are reported (Brisson et al. 1999; Gilbert-Quimet et al. 2017) where among women with a university degree, those with large family responsibilities and high job strain or effort-reward imbalance tended to have higher blood pressure levels than those with only one of those risks. These double exposures to home and work overload tend to be interactive although they may not be additive.

This framework on incorporating both workplace conditions with home conditions is easily extended to scheduling practices which can be seen as a dimension of demand (long working hours, just-in-time scheduling in which employer develop schedules based on need or job control, flexibility decisions to work compressed workweeks, work at home, flexible hours, etc.). Issues around alternative work schedules and schedule demand and control will be particularly salient for those who are balancing home demands as well as working conditions. Since the vast majority of those with home responsibilities are women, these issues deserve special attention. In one study in Korea, Lee et al. (2019) report that self-report of a history of cardiovascular disease is related to long working hours among women only and wage workers. As this framework develops, it provides new approaches to understanding both workplace practices within employment settings as well as examining public policies that shape work and family balance.

## **Maternity Leave Policies and Health: Can Social Protection Buffer Gendered Risks in the Work Environment?**

In this section, we focus on two specific areas of employment policy that are aimed at ensuring long-term employment especially for working mothers. These policies as they extend to working families may also serve to improve working conditions for both men and women as gender roles in care of children become shared among mothers and fathers. Policies on maternity leave have attracted attention recently, especially in European countries, where social protection policies during times of demographic change are conceived of as central to successful societies and labor markets. Maternity leave and family leave more generally may influence health in multiple ways, since it is likely that such policies influence a broad set of outcomes and work through multiple channels.

Much has been written about the impact of unemployment on health, but less is known about how other forms of leave from employment relate to health. Parental leave, and particularly maternity leave, may be especially relevant to the health of working mothers. During the second half of the twentieth century, high-income countries witnessed a remarkable increase in female labor force participation. Women with children were no exception to this pattern. In the United States, for example, 65.3% of mothers with children under the age of 6 were in the labor force in March of 2016, as compared to 33% in 1975 (Ruhm 2011; US Bureau of Labor Statistics 2018). In response to these trends, some countries enacted comprehensive maternity leave policies during the second half of the twentieth century to help households with children cope with the competing demands from work and family.

Maternity leave legislation extends women the right to take a period of leave from work around childbirth and, in many countries, to receive income support compensation during maternity leave. Initially, maternity leave policies were motivated by concerns about the health of the child and the mother in the period around birth. Since the end of the 1960s, however, maternity leave has also become a job-protected period out of work to care for newborns and young children. Recent evidence suggests that by protecting employment among mothers in the period around birth, maternity leave leads to better long-term labor market outcomes after maternity including wage level and growth, career prospects, labor market attachment, and employability (Brugiavini et al. 2013; Rossin 2011; Rossin-Slater et al. 2013; Ruhm 2011; Klerman and Leibowitz 2000). An important question, therefore, is whether these policies also affect the health of mothers and their children both in the short and the long run.

### **Maternity Leave and the Health of Children**

There are several reasons why maternity leave policies may lead to better health among mothers and their children. Ruhm (2000) argues that the health of young children depends on the “health stock,” the level of medical technology, the price and access to health care, household income, and time investments of parents.



Among all these mechanisms, he argues that time investments of parents might be of particular importance to the health of children. Raising children is a time-intensive activity, and time investments even before birth – in the form of better nutrition and prenatal care – are likely to deliver better outcomes for children in the short and long run. An example comes from the literature showing high returns of investments in breastfeeding behavior on children’s cognitive development. Similarly, the time available during the early weeks of life may be crucial to the prevention of accidents or other health problems with long-lasting consequences.

Evidence of the impact of maternity leave legislation on the health of children comes from two sources. First, cross-national comparative studies have examined whether differences in reforms introduced over the last decades affected the health of children across high-income countries. In a pioneer study, Ruhm (2000) used aggregate data to assess the impact of parental leave laws on infant mortality in 16 European countries over the period from 1969 to 1994. He used a country fixed effect model that related the weeks of parental leave entitlement to infant mortality over this period. While based on aggregate data, an advantage of this approach is that exposure is based on “exogenous” changes in legislation on the number of weeks that affect all women and births that happened to occur after the introduction of the law. By comparing affected and unaffected cohorts within each country, the study is able to examine the overall effect of legislation on infant mortality. His results provide one of the most important pieces of evidence suggesting that more generous paid parental leave substantially reduces deaths of infants and young children. Evidence was stronger for post-neonatal mortality and child fatalities than for perinatal mortality, neonatal deaths, or low birth weight. Rights to a year of job-protected paid leave were associated with around 20% declines in post-neonatal deaths and 15% decline in fatalities between the first and fifth birthday.

Based on a similar design, Tanaka (2005) uses aggregate data to examine the effects of job-protected paid and other leave on child health outcomes from 1969 to 2000 in 18 OECD countries, including Japan and the United States. Consistent with the earlier work of Ruhm, he finds that extending the number of weeks of job-protected paid leave has significant effects by decreasing infant mortality and also by improving birth weight outcomes. Importantly, he does not find this effect for unpaid maternity leave, suggesting that lack of adequate payment and job protection during leave will not deliver the same health benefits.

A review of the literature by Staehelin et al. (2007) examined 13 original studies examining whether maternity leave policies influenced the health of children and their mothers. They found that a positive association has been found between the length of maternity leave and the duration of breastfeeding. Maternity leave was also associated with lower perinatal, neonatal, post-neonatal, and child mortality. It pointed out, however, that these findings come primarily from “ecological” studies, while there is less evidence of impact on other health outcomes. In a separate review, Ruhm (2011) discusses some of the potential mechanisms through which maternity leave may improve health outcomes. Among these, maternity leave is a potentially promising explanation, given the

potential benefits of breastfeeding on child health. To assess this question, a study by Baker and Milligan (2008) examined the effect of a major increase in maternity leave mandates in Canada by comparing the health of mothers giving birth before 31 December 2000 and entitled to a maximum of approximately 6 months of job-protected compensated maternity leave, to that of mothers to children born after that date, whose benefit entitlement and job protection benefits were extended to about 1 year. Results suggest that extended maternity leave mandates led to large increases in the attainment of critical breastfeeding thresholds, although they find no effect of mandates on most indicators of child and maternal health. Recent evidence from a different policy provides some indication of the potential impact of providing time for parents to breastfeed. Using differences in the enactment of breastfeeding laws across US states, Hawkins et al. (2013) finds that breastfeeding initiation was 1.7% higher in states with new laws to provide breaktime and private space for breastfeeding employees, particularly among Hispanic and Black women.

In conclusion, the studies above provide convincing evidence that paid maternity leave benefits have the potential to improve child health and reduce infant mortality. Further research is needed, however, to understand why only paid benefits seem to impact health and to determine the specific number of weeks of maternity leave that would optimize child health.

## **Maternity Leave and the Health of Mothers**

As discussed in the initial sections of this chapter, maternity leave may also improve the health of mothers by diminishing the human capital loss associated with a period out of the labor market around childbirth. Maternity leave increases job protection and female labor market attachment by enabling women to return to their employer after a short period of leave (Ruhm 2011; Brugiavini et al. 2013; Klerman and Leibowitz 2000), increasing job continuity, and preventing the erosion of firm-specific skills. By protecting mothers' career prospects, earning's accumulation, and labor market attachment (Brugiavini et al. 2013; Rossin 2011; Rossin-Slater et al. 2013; Ruhm 2011; Klerman and Leibowitz 2000), maternity leave may improve the socioeconomic circumstances of mothers, with potential long-lasting health consequences.

Research on the health impact of maternity leave legislation has primarily focused on health in the years around birth. In a systematic review, four out of six studies reported a positive association between the length of maternity leave and mental health in the postpartum period (Staehelin et al. 2007). A study using cross-sectional variations in maternity leave entitlements across US states before 1993 found that mothers entitled to 8–12 weeks' leave after childbirth had fewer depressive symptoms than women entitled to only 6 weeks (Chatterji and Markowitz 2012). Another study found that maternity leave of 12 weeks or longer is associated with lower depression scores in women with marital concerns, and lower depression and less anger among women with low work rewards, compared

to maternity leave of 6 weeks or less (Hyde et al. 1995). Two studies found that general mental health at 7 and 9–12 months after childbirth, measured by depression, anxiety, general positive affect, and life satisfaction, was better in women with maternity leaves beyond 15 weeks and 24 weeks, as compared to women with less than 9 weeks of leave (Gjerdingen et al. 1991; McGovern et al. 1997). No effects were found in the other two studies included in this systematic review.

The study by Baker and Milligan (2008) referenced above on the maternity leave mandates in Canada, which extended benefit entitlement and job protection benefits to about 1 year, found no evidence that these extensions led to improvements in maternal health. In a separate study, Chatterji and Markowitz (2012) used variations in state maternity leave entitlements before the introduction of the federal level by the Family and Medical Leave Act (FMLA) in 1993. They found that maternity leave shorter than 12 weeks was associated with increased depressive symptoms, while maternity leave shorter than 8 weeks was associated with poorer overall self-rated health.

There are three important considerations in regard to these studies. First, the strength of these studies is the focus on the impact of maternity leave policies, rather than associations between the length of leave and maternal health. This focus enables us to understand the potential benefits of introducing a specific policy, but it also improves causal inference by comparing cohorts that “happened to” experience different policy regimes. While the evidence is not all consistent, there would seem to be some indication that maternity leave policies can improve mental health in the period after birth, with less clear benefits on physical health outcomes. A second consideration is the fact that most studies on this area have been based on data for North America. Important to note is the fact that in the United States, maternity leave benefits are unpaid, while in many European countries generous paid maternity leave benefits are offered to working mothers. Whether paid maternity leave benefits will show stronger effects remains to be explored in future studies.

A final key consideration is the fact that most research has focused on the impact of maternity leave on the health of mothers in the period around childbirth. However, the mechanisms through which maternity leave might influence a mother’s health are likely to operate in the long run. The impact of protected maternity leave on a mother’s wage level and growth, career prospects, labor market attachment, and employability (Brugiavini et al. 2013; Rossin 2011; Rossin-Slater et al. 2013; Ruhm 2011; Klerman and Leibowitz 2000) is likely to bring health benefits only measurable as women reach older ages and face the cumulative toll of exposures over the life course. The current literature, however, narrowly focuses on the short-term benefits of maternity leave. The crucial question is whether a policy that potentially improves the socioeconomic position of women and reduces gender differences in labor market trajectories also generates health capital. This line of enquiry offers a promising avenue for research on the long-run effects of parental leave policies on working mothers’ health and, increasingly, on the health of working fathers as well.

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## Conclusion

Since women have entered the workforce in large numbers around the world while continuing to carry most of the household duties, it is imperative to understand the ways in which working conditions influence the health of women. While there is strong and consistent work done that details the impacts of psychosocial working conditions on men, the research on women has been sparser and less uniform. However, the evidence to date would suggest that frameworks incorporating both working conditions such as job strain and conditions at home have a stronger impact on women's health and well-being than a framework that focuses only on conditions of the job. Evidence is growing that maternity leave policies have a strong impact on women and children's health and well-being not only during the period of childbirth and child rearing but also in the long run. Such policies may have long-run health impacts for women for multiple reasons including reducing stress and enabling women to stay in the paid labor force. Public Policy efforts related to family leave and other working conditions thus appear to be important in addition to workplace redesign.

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## Cross-References

- ▶ [Childhood Determinants of Occupational Health at Older Ages](#)
- ▶ [Financial Gains, Possibilities, and Limitations of Improving Occupational Health at the Company Level](#)
- ▶ [Psychosocial Safety Climate and Occupational Health](#)
- ▶ [Shift Work and Occupational Hazards](#)

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# Climate Change, Occupational Heat Stress, Human Health, and Socioeconomic Factors

# 5

T. Kjellstrom, E. Oppermann, and J. K. W. Lee

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## Abstract

Workplace heat is an important occupational health hazard. It has attracted new attention in recent years due to ongoing climate change and projections of future increases of heat in most parts of the world. This chapter provides an overview of the physiological basis for this occupational health hazard and related serious

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health and social effects that may develop. While outdoor jobs in the sun create particular risks, many millions of workers in factories in tropical areas are also exposed to excessive heat because effective air-conditioning cooling systems are not installed. Excessive heat exposure in workplaces can cause heat exhaustion and heat stroke unless the worker is able to take action to reduce thermal strain, such as by reducing work intensity or taking frequent breaks. These protective actions reduce health risk and affect hourly productivity and the economic output from the work done.

The social and economic factors that contribute to health risks include social norms and attitudes concerning basic low-skill work that is particularly risky in hot situations. Gender-based employment also has implications for occupational heat-health risk given sex-based differences in vulnerability to heat. For instance, some physically intensive jobs are traditionally very male-focused, and mass production garment works in hot factories of tropical areas are very female-focused. In some ways women are more sensitive to heat, and pregnancy is a period of particular heat exposure risks. The workforce in many countries is ageing, and older people are more vulnerable to heat than younger people. Another risk group is migrant workers who often are provided with little occupational health protection. The increased risk of health impacts also has important social and economic impacts, such as reduced daily income, when heat slows work output. At the community level, the increasing heat due to climate change can also undermine traditional customs and degrade social well-being. Our analysis indicates the need to develop policies that limit the ongoing heat increase due to climate change and to implement protection in situations of excessive heat.

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**Keywords**

Heat · Health risks · Productivity loss · Economic loss · Community impact · Climate change

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**Introduction**

Climate change is associated with a number of negative impacts on health, including extreme weather-related injuries, malnutrition, diarrheal diseases, and vector-borne diseases, described in reports from the World Health Organization (McMichael et al. 2003; World Health Organization 2014) and the Intergovernmental Panel on Climate Change (Smith et al. 2014; IPCC 2014). Environmental heat is a well-known occupational health and comfort hazard (Parsons 2014) creating challenges to millions of people due to the increasing temperatures caused by climate change (Collins et al. 2013). This chapter will briefly describe the mechanisms behind the health threats from heat to working people and will explore how excessive heat exposures currently affect well-being. Recent reports from the International Labour Organization, International Organization for Migration, and the United Nations Development Programme (ILO 2019; IOM 2017; UNDP 2016) highlight the

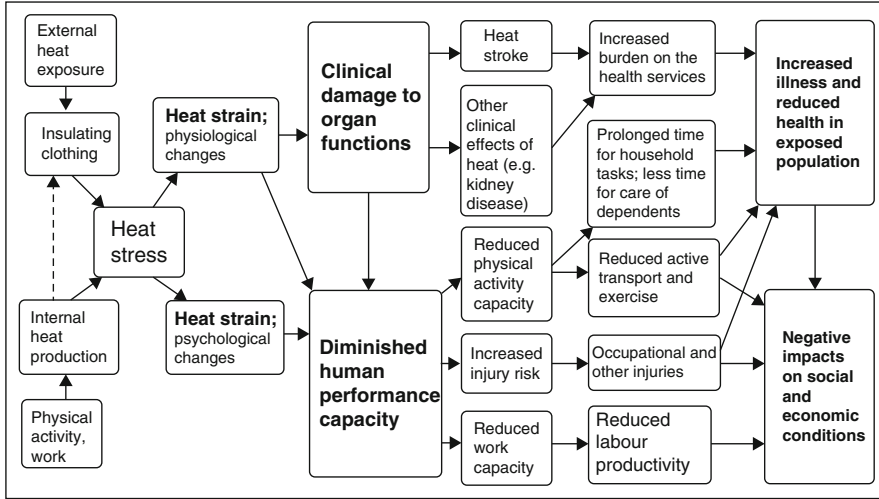
importance of increasing heat as an occupational health threat and as a condition undermining labor capacity and economic output. While some economic aspects of occupational heat-health impacts are widely considered in the literature (namely, in terms of productivity losses), the wider socioeconomic effects of occupational exposures, for workers, their families, and their communities, are, as Nunfam et al. (2018) argue, significantly under-researched, and not sufficiently incorporated into adaptation strategies and policy responses to climate change. Such impacts are also likely to be magnified as a result of climate change and have not been given enough attention in the international assessments of climate change impacts.

The human body is attuned to a limited range of temperature and humidity conditions: when it is too cold, suitable clothing is used for protection, while when it is too hot, even very limited clothing cannot protect a person, and other methods for protection are essential (Parsons 2014). High temperatures and heat stress can arise due to a combination of the ambient environment (e.g., outdoor agricultural work during summer, ultra-deep mining), metabolic heat production from physical work (e.g., construction, wildland firefighting), and also the insulation from protective clothing (e.g., urban firefighting and hazardous waste disposal). Body core temperature needs to be kept within normal range for a person to stay healthy and comfortable (Parsons 2014). When air temperature is higher than normal skin temperature (35 °C), heat will transfer from the environment to the body, and evaporation of sweat is then the main way that the body tries to maintain core temperature. The higher the water vapor level in the air, the less evaporation occurs, in spite of sweat emerging on the skin, and then the cooling effect is reduced. As such, those in tropical regions can be particularly at risk. Heavy sweating has been shown among hardworking agricultural workers in Central America to have led to serious daily dehydration contributing to fatal chronic kidney disease (Wesseling et al. 2013).

With a combination of behavioral and physiological responses, humans are able to maintain a reasonably constant body core temperature of 36–38 °C throughout their lives despite a wide range of ambient temperatures (Parsons 2014). People who perform physical activities such as work or sports activities create internal heat in the body, which adds to the heat exposure from the surrounding environment. They are therefore at a higher risk of incurring heat injury (Lee et al. 2010; Kjellstrom et al. 2009).

Figure 1 indicates the physiological pathways from external heat exposure and internal heat load to the clinical and socioeconomic impacts in communities. A common behavioral adjustment to heat is the use of occupational work-rest cycles to alternate between periods of work and rest to limit excessive accumulation of body heat storage (Lee et al. 2013). Several physiological strategies such as increased aerobic fitness, heat acclimatization, cooling, and fluid ingestion (Lee et al. 2015) are often used to optimize work productivity and health in the heat.

Heat indices that describe the heat level from a health risk perspective are a combination of temperature and humidity and may also include air movement (wind speed) and heat radiation (outdoors, usually from the sun) (Parsons 2014). The most widely used index in occupational health is the Wet Bulb Globe Temperature



**Fig. 1** Pathways for heat impacts on a person and the community

(d'Ambrosio Alfano et al. 2014; Budd 2008) for which safety threshold guidance is available both at international (ISO 2017) and national level, for example, in the USA (Jacklitsch et al. 2016).

## Perceived Heat Problems in Daily Life Reported in Historic Literature

The problems caused by heat have long been in evidence. It is noteworthy that both the Bible and the Koran mention environmental heat as a health and social hazard that people should avoid. The comfort challenges from heat are also often referred to in literary works, and excessive heat is often described as a threat to daily life routines. In the eighteenth century, Baron de Montesquieu described in his *The Spirit of Laws* book how the heat in tropical areas of the world was a major restraint on economic and social development.

Alexander von Humboldt, a German nobleman and science enthusiast at the end of the eighteenth century, became the first systematic explorer of different aspects of nature (Wulf 2015) based on his experiences from lengthy trips to South America and Central Asia. One of his conclusions was that actions by people, such as clearing woods for agricultural development, could degrade the local climate. His experiences with heat and cold also highlighted the extremely negative effects such as climate extremes could have on daily activities and personal health.

Many literary works use descriptions of heat effects on people's lives as a way to create an atmosphere of the readers' presence in the fictional environment. Numerous examples could be mentioned, and most readers can relate to their own experiences when problems occur: heat causing exhaustion, profuse sweating, lack of

sleep, etc. We will provide examples from published reports in this text, but we should emphasize that the apparent lack of detailed statistical data on social effects of heat may in fact be due to the consideration by many scientists that the heat problems are so obvious that no detailed research is needed.

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## Documented Problems in Daily Life

The most dramatic health effect of environmental heat exposure is mortality, and each year dramatic heat waves create epidemics of heatstroke deaths, particularly among people living in low-income conditions and with limited or no capacity to protect themselves from the heat. The first published heat wave mortality epidemics occurred in New York and Chicago in the 1970s (Koppe et al. 2004), and the lack of air conditioning and poor mobility among low-income elderly people was a common reason for their heat vulnerability.

Since then further heat waves have been significant enough to lead to published reports, and two of the largest scale events occurred in southwestern Europe in 2003 (Larsen 2006) and in Russia in 2006 (Revich and Shaposhnikov 2008). In France, August 2003 saw approximately 15,000 additional deaths during the 2-week heat wave compared to the average of the 3 preceding years (Hemon and Jouglu 2003) and another 20,000–30,000 deaths due to heat occurred in other European countries (Larsen 2006). These mortality spikes affected primarily elderly people, but other age groups were not spared. In France, for instance, the daily mortality rate was increased in a similar way (a doubling) in younger age groups (Hemon and Jouglu 2003).

To die due to heat is of course the highest possible impact for an individual, but it also affects their family and wider community, through mourning and practical and economic implications, so the heat mortality risk should be a major concern during climate change. Methods to cool people's living and working environments are available. For example, the Enterprise Mine at Mt. Isa in Australia has implemented refrigeration systems that cool the air and reduce the ambient temperature in the mine (Brake and Fulker 2000). However, such measures are costly and are not easily applied in many occupations where environmental conditions cannot be controlled (e.g., firefighting, construction, agriculture, and military work). A few reports of heat mortality in working populations show the risks occurring in agriculture in the USA (Centers for Disease Control and Prevention 2008) and in construction in Qatar (Pradhan et al. 2019).

Much of the analysis of health impacts of heat during climate change has been limited to the mortality issue. However, there is evidence about increase of morbidity and use of health services in certain disease categories, particularly cardiovascular and kidney disease hospital admissions (Knowlton et al. 2009; Hansen et al. 2008b), mental health-related admissions (Hansen et al. 2008a; Williams et al. 2012), and use of ambulance services (Dolney and Sheridan 2006). Each case of morbidity creates important stress and practical socioeconomic issues for the family, employers, and the community. The extent of these issues will of course depend on the actual heat levels and other local conditions, but the problems can be substantial for the affected community.

Beyond the clinical health issues, daily activities are also affected in ways that could have negative social consequences (Banwell et al. 2012). Interviews with elderly people living independently in Sydney, Australia, showed that during hot days physical activity was reduced and some people just stayed indoors. Heat waves can therefore contribute to isolation and loneliness, reducing mental well-being. The study highlighted a number of preventive actions taken by the heat-affected people, including going to air-conditioned shopping malls and walking inside such cooled areas for a long time each day (Banwell et al. 2012).

Another survey-based study of 179 workers in Australia's tropical north (Carter et al. 2020) demonstrated the trans-domain impacts of occupational heat exposure. While heat stress symptoms often occurred while working, there were also negative impacts outside of work (in home environment): lack of sleep at night, reduced appetite, reduced physical activities and sport, and negative effects on well-being and social relationships. The study points out that these social effects can further have a negative impact on mental health. High frequencies of physical discomfort and other negative effects of heat stress may have wider socioeconomic impacts, ultimately impacting on the viability of settlement and the economy (Zoellner et al. 2017; Zander et al. 2016), particularly in chronically exposed regions, and as climate change progresses. A weakened economy would likely reduce overall adaptive capacity, while, particularly in labor-intensive adaptation-critical roles (such as repairing housing, utilities networks, or sea defense walls), there would be direct impacts on productivity and the likelihood of retaining staff.

Other negative social effects of environmental heat that have been documented include the reported impacts on the health and well-being among Indigenous communities in northern Australia (Green and Minchin 2014). In addition to the heat-health and social impacts mentioned above, this paper also notes that Indigenous definitions of health encompass the health of their country, and excessive heat in the environment is therefore understood also as impacting on individual and community health and well-being and can be a significant source of stress. Broader heat effects therefore need to be considered in order to develop effective climate adaptation and health strategies for these communities.

Another example of the health impacts of heat being magnified by social context is in India, where heat exposure is compounded by dehydration, particularly for women due to the unavailability of clean and safe toilet facilities (Venugopal et al. 2016). As a result, women avoid drinking water or other drinks during hot times as they decide that this is a way to reduce the need to go to the toilet during the day when they are working or carrying out other daily tasks away from the home. Apart from the health risk due to dehydration, these concerns considerably reduce the comfort of daily life.

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## **Work as a Vulnerability Factor**

Due to the additional metabolic heat created during physical activity, people are particularly vulnerable from heat stress during work. Only a limited number of studies have described the extra health risk in a quantitative way. The most detailed

studies were carried out by a gold mining company medical doctor in South Africa during the 1950s and 1960s (Wyndham 1969). The aim of the studies was primarily to develop and test methods to reduce the severe heat risks during heavy labor 1 km underground in a mine with 200,000 mine laborers. Before the detailed studies started, as many as 50 workers each year died from heat stroke while working underground. A screening and acclimatization process at ground level for all newly recruited workers involved exposing the workers to the same heat as underground, while they carried out intensive gym procedures for several hours each day over 2 weeks. Only the workers that could maintain this activity for the full 2 weeks were engaged in the heavy underground labor. The heat mortality during underground work reduced to two per year as those workers who were sent underground were better acclimatized to the conditions, and heat-sensitive workers who could not cope with the full 2-week procedure were excluded from such work (Wyndham 1969).

Another detailed study of heat effects on groups of rice-harvesting workers in India (Sahu et al. 2013) showed in a quantitative way the significant reduction of actual work productivity as maximum daily heat levels increased (5% reduction per degree C of increase of WBGT). The workers are paid in accordance with the actual output of each groups' work, which is likely to create a situation where less heat-tolerant persons have difficulties in being welcomed to stay in their work team. In other occupations that require heavy labor in hot working conditions (e.g., construction work), similar selection processes will take place with negative social consequences for the more vulnerable workers.

The loss of individual work capacity related to high heat exposure at work often creates economic losses for the individual worker, which in turn creates mental stress and risk of serious clinical health effects. Analysis of cases of heat mortality among agricultural workers in the USA (Centers for Disease Control and Prevention 2008) showed that those who died continued to work in spite of warnings about the heat and the symptoms in the affected individual because the loss of income overshadowed the perceived need for health protection. This loss of income, if the workers take action to protect themselves from heat, can be a serious problem for the workers' family in Central America who relies on the money sent from the worker in the USA. "Self-pacing of the work intensity" has been promoted as a solution to the heat risk (Miller et al. 2011), but economic pressures are likely to undermine this solution in practice.

Another worker category with extreme heat exposure in heavy labor situations is migrant construction work in Qatar and other Middle East countries. During the hot summer months, hundreds of migrant workers from Nepal have died due to heart disease, and the most likely reason is that they continue heavy labor even during the hottest parts of the year (Pradhan et al. 2019). The work processes during each day may have been organized so that protective self-pacing was not possible. A news report highlighted that these heart-related deaths can occur during sleep in workers without any preceding heart problems; the heart just stopped, and the cause of death was stated as "cardiac arrest." These workers from Nepal were screened when selected for good health before they were allowed to travel to Qatar for work, so it is very unlikely that preceding heart disease was a cause of the high summer heart-

related mortality. Apart from the sad loss of a young family member, the socioeconomic impact of these deaths is income loss for the families in Nepal. Approximately 100,000 migrant construction workers in Qatar come from Nepal. Many more workers in such jobs come from Pakistan, India, and Bangladesh, but mortality studies are not available. As climate change makes the environment hotter, these health and socioeconomic risks for construction workers and their families will increase.

West Africa is one of the high-risk areas for excessive heat at work (Smith et al. 2014), and the social impacts of the local conditions are substantial as highlighted in studies from Ghana (Nunfam et al. 2019) and a review of 25 studies from around the world (Nunfam et al. 2018). Interview data from 320 mining workers showed clear concerns among the workers about the excessive heat exposures during work, which negatively affected their incomes and comfort in daily life activities.

Additional studies in Europe carried out as a part of the European Commission-funded HEAT-SHIELD project have also indicated losses of labor capacity and reduced comfort during hot periods (Ioannou et al. 2017). These effects can occur both in outdoor work and indoor work, particularly in low- and middle-income countries where many factories and workshops are not air conditioned, and heat protection may be impractical or too expensive. It should be pointed out that many of the consumer products available in high-income countries (such as clothes, furniture, toys) are produced in and exported from low- or middle-income countries with much hotter climate than the importing countries. One example from Cambodia (Kjellstrom and Phan 2017) shows the potential loss of productivity related to daily heat in garment factories. The external temperature in the shade was above 40 °C, and inside the factories temperatures were as high as 38–39 °C in spite of “wet wall” systems for cooling. The discomfort and labor output loss is a daily challenge for the workers in these jobs; often they are young women, and through South-East Asia, India, and China, there would be many million workers exposed to these heat hazards. A particular health risk would be a high body core temperature during pregnancy, which causes fetal tachycardia and increased risk of fetal distress (Herbst et al. 1997). In men, heat stress can negatively affect semen parameters, which may decrease fertility rates among heat-exposed workers (Hamerezaee et al. 2018).

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## Social and Economic Factors

Overall health of the population and the workforce is a critical aspect of the socioeconomic determinants of heat stress. General physical fitness is a key enabler of the ability to physically manage hot conditions (Parsons 2014). Workers can suffer from chronic conditions or temporary illnesses that reduce their physiological ability to thermally regulate or to remain hydrated. Workers in places that receive generally poor health care or have limited access to health care for financial, legal, or other reasons (such as logistics, distance from a health-care professional, or poor labor health and safety systems) are at risk (ILO 2019). Examples of the links between health effects and social and economic factors are shown in Table 1.



**Table 1** Examples of potential social and economic impacts of excessive heat exposure at work

Underlying factors	Direct impacts	Follow-on or indirect impacts
Clinical health effects	Access to health services Cost of treatment Lost income due to absence	Extra work and cost for health services Economic burden on family
Reduced work output and slower daily activities	Loss of income More night work and inconvenient work times Excluded from work Daily chores take longer	Family loses income, less opportunities for children Difficulties in sleeping during hot parts of day Social tensions due to inconveniences Less time for family care activities (children and elderly get less attention)
Labor protection principles/norms	Insufficient Occupational Health and Safety (OHS) systems Work intensity-related to piece-pay Subcontracting to transfer responsibility to workers Informal employment	Lack of monitoring and protective systems Exhaustion beyond work period Increased risk of work-related injuries
Social norms, gender issues	Attitudes to gender roles in workplaces Clothing norms for women Access to toilets and other facilities Effects of heat during pregnancy	Higher vulnerability for women Cost of facilities for men and women
Ageing workforce	Reduced ability to thermoregulate Higher sensitivity to heat exposure Increase of comorbidity that creates heat hazards Interactions with medications	Higher health risks Need to adjust work management systems
Access to technology	Mechanization to reduce risks Robots replacing jobs Improved monitoring of hazards	Cost of providing equipment and systems Risk of losing job opportunities
Migrant workers	Attitudes to heat sensitivity among migrant workers Lack of safety organization	Ill health and death due to lack of basic OHS Lack of payments to family Trauma and loss of loved ones

Health regulations, and the extent to which they are enforced, play a crucial role. In many countries or sectors with better enforced labor laws, pre-employment medical examinations and certificates of “fitness for work” are one of the ways in which companies reduce the risk of injuries and downtime in labor-intensive roles.

This is not always, but can be, related to the severity of environmental conditions. In hot areas of Australia, for example (Williams et al. 2012), good cardiovascular and respiratory function are key to the management of heat stress, and identified pre-existing conditions would – at least in theory – prevent workers from being allowed to assume labor-intensive roles. As such, regimes of medical management of workforces can significantly change the makeup of the working population, ensuring it is less vulnerable in terms of underlying conditions that predispose workers to heat illness (Epstein and Yanovich 2019).

However, another impact on occupational heat-health is the duration and intensity of exposure – not only as a result of environmental conditions but as a result of employment conditions (Oppermann et al. 2020; Heal and Park 2016). Workers often feel unable to rest, change the pace of work, or take sick leave when they are economically insecure – for example, when they are on temporary contracts or engaged in piece-rate work contracts, which are common across the agriculture, mining, and manufacturing sectors globally. For recent reviews of the evidence, see Spector et al. (2019) and Schulte et al. (2016). Forced laborers (modern slavery) are also likely to be at high risk of heat stress (Lundgren-Kownacki et al. 2018; Ter Haar 2018; Ronda-Pérez and Moen 2017). However, it doesn't take informal employment or undocumented workforces to produce such conditions. In Australia, where jobs in the mining sector are known as very well paid, “good jobs” have over time led to legally entrenched, often union-backed long working hours with little recovery time and long distance travel (Peetz and Murray 2011), all of which seem likely to increase negative heat-health outcomes, although further research is needed to quantify these relationships in practice.

The gender balance of the workforce or sector is often socially prescribed and may have implications for the likelihood of heat illness. In the female workforce, the luteal phase of the menstrual cycle raises core temperature and changes autonomic thermoregulation, but not perceived temperature (Nagashima 2015), while pregnancy and other hormonal shifts are also significant (Lundgren et al. 2013; Sett and Sahu 2014). This may be significant for how women perceive and therefore behaviorally respond to hot environmental conditions. However, it is known that social norms also shape the behavior women use to prevent or manage extreme heat, for example, by drinking less in the absence of sufficient toilet facilities (Venugopal et al. 2016) and where social norms around dress requirements can increase vulnerability to heat stress (Lundgren-Kownacki et al. 2018).

Another aspect of social conditions to consider is that the labor-intensive and/or heat-exposed workforce in many countries is ageing. This is highly significant given that age is generally an indicator of reduced capability to effectively thermoregulate (Parsons 2014) and is further associated with a number of comorbidities which can exacerbate or increase the risk of heat-health impacts directly (Kjellstrom and Lemke 2017; Notley et al. 2018). This includes, for example, the increased likelihood of heart and regulatory conditions and associated with this the use of medication that may also inhibit effective thermoregulation (possibly for diabetes and other conditions as well) (De Blois et al. 2015). As such, an ageing workforce increases the overall risk of projected heat exposures and the need for the consideration of policy

interventions to provide sufficient protections, including physical protection from environmental heat and mechanized support to reduce exertion.

For all working populations, regardless of age, there are also significant technological changes that influence heat risk. The centuries-old historical trend of the mechanization of physical labor forms the major – if often assumed – backdrop against which exertional heat stress unfolds. As machines become ever more specialized, they are increasingly able to replace or at least support ever more tasks carried out through human labor, reducing exertion and therefore potentially also thermal load (Kenny et al. 2012; Burdorf et al. 2007). Rapid increases in computational power and connectivity have enabled physical processes to be shifted increasingly to remote-controlled, autonomous, and artificial intelligence (AI) systems. This trend has partly been driven by a desire to improve productivity and reduce the likelihood of mistakes but has also been driven by a need to avoid putting workers at risk – that is, where the working environment is considered too dangerous (Hermanus 2007; Donoghue 2004). Given that extreme heat creates both a dangerous environment and in turn reduces productivity and increases the likelihood of mistakes and accidents (Morabito et al. 2006; Rowlinson and Jia 2015) and that much “hot” work occurs in industries that are already mechanizing fast (industrial production, resource extraction, and agriculture in particular), it seems very likely that increased mechanization/automation will rapidly reduce the number of humans engaged in physical work and therefore exposed at least to exertional heat stress. Technological change also includes improved equipment and systems to monitor heat stress and provide warnings, as highlighted, for instance, in the European Commission funded HEAT-SHIELD project ([www.heat-shield.eu](http://www.heat-shield.eu)).

A major caveat to both of the above points is that they occur in an economic context. The cost of employing older people and of mechanizing work, especially outside of wealthier economies, may be prohibitive. One of the factors that connect to the cost of workers is the labor market and its relation to migration flows. There are already powerful climate analogues in place that demonstrate how socioeconomic status (including caste, ethnicity, race) both enable a form of adaptation, by bringing in workers prepared to tolerate poorer conditions, in order to keep an industry functioning as we have seen, for example, above in agriculture examples from the USA, brick kilns in India (Lundgren-Kownacki et al. 2018), and several Gulf states, and indeed across the world (Sönmez et al. 2011).

Utilizing migratory populations for their supposed heat tolerance, whether physiological or economically driven, has deep and disturbing historical precedents. The slave trade to the Americas was in part built on such an assumption (Peard 1999), and so too were the huge migrant labor movements encouraged, or enforced, through the British and other empires, utilizing “coolie” labor from analogue climates on different continents. The institutionalization of racialized or ethnic hierarchies in labor, supposed heat tolerance and heat exposure in contemporary contexts, should be assumed to be limited to history. Recent examples are the fatal heat effects on migrant agricultural workers in the USA (Centers for Disease Control and Prevention 2008) and on migrant construction workers in Qatar (Pradhan et al. 2019).

## Cultural Factors

The relationship between heat and how we live our lives is so crucial to human health and survival that it has been a mechanism of our evolutionary development as a species. At a less expansive time scale, everyday ways of responding to and managing heat are shaped by cultural practices that have evolved over very long periods of time, often centuries or millennia. As such, they are typically well-adapted to the historical climatic norms of the regions in which they developed (Hulme 2016). These deeper “cultures of climate” play a role in shaping the everyday practices – including occupational practices – through which thermal comfort is managed, directly and indirectly. For example, Spain is well-known for its historical practice of “Siesta,” or resting in the hottest part of the day, while Venice/Murano glass workers have traditionally not worked in August due to the late summer heat (d’Ambrosio-Alfano et al. 2018). During hot and humid periods in tropical countries, e.g., Singapore, local people avoid carrying out intensive physical activities outdoors.

In addition to avoiding exertion and additional heat exposure in hot conditions, there are also examples of using work to actively produce bodily heat in cold conditions. In the Indian Himalayas, physical labor is not only understood as producing bodily heat as a by-product but is actively conceptualized as part of the “energy mix” (including firewood and kerosene) villagers use to keep warm in remote mountain areas (Jerstad 2016). Such thermal management has its limits, particularly in extreme conditions. In northern Australia, two recent studies of utilities workers and workers at a mine site found practices were partly adapted to reduce and manage thermal load but that there was also a high degree of normalization of the negative impacts of heat stress. As such, workers both “worked the weather” and “weathered work” (Oppermann and Walker 2018; Oppermann et al. 2018, 2020).

Long-established cultural practices, such as those of Indigenous communities in northern Australia, are already being curtailed as a result of increasing temperatures (Bird et al. 2013). These practices do not always fit neatly into a western “occupational” model but are nonetheless defined socially expected roles that are critical to social and economic well-being, including through such critical activities as fire management (Whitehead et al. 2008).

At the population scale, socioeconomic characteristics are frequently noted as having a significant impact on heat-related illness outcomes between countries (Green et al. 2019; Hansen et al. 2013; Karner et al. 2015) and within them. Social capital and familial relations are known to significantly impact survivability during heat waves (Yardley et al. 2011; Zhang et al. 2013). One of the key areas in which the complex interaction of socioeconomic status, including complex intersectional vulnerabilities, interacts with extreme heat is in migrant communities, where migrants, including undocumented workers, work in highly exposed roles, often with poor occupational health protections. Related to this are the different impacts of heat on areas where racial discrimination also shapes health outcomes of heat wave events (O’Neill et al. 2003), sedimented via access to quality health care and housing. Poor

neighborhoods tend to house not only the most socially disadvantaged but often also the most migrants. These locations are also, in hot cities, usually the hottest areas as a result of dense housing with little green infrastructure, lack of public facilities such as pools or malls, and with poor transport links that increase time spent on hot roadways (Harlan et al. 2013; Gronlund 2014).

The ability to adapt to heat, as the above example indicates, is thus not only physiological and economic, but also to do with the management knowledge that populations have, which is linked to wider social and cultural values and behavior (Banwell et al. 2012). While not typically the domain of demography, it is worth noting that not only might populations be younger/older, richer/poorer, more or less educated, and more or less healthy, they also have different levels and types of heat management expertise (Maller and Strengers 2015, 2018; Strengers and Maller 2017) that can render them more or less vulnerable than might be expected, shaping how we assess the socioeconomic factors in vulnerability to, and impacts of, environmental hazards including extreme heat.

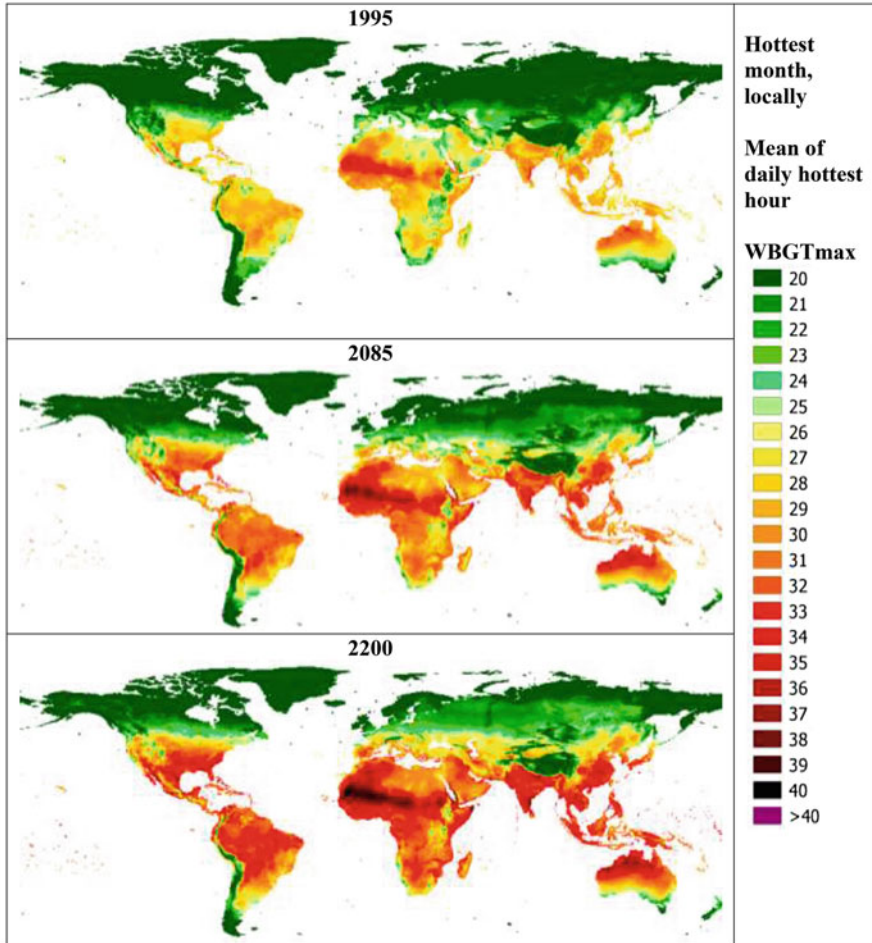
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## Increased Impacts Due to Climate Change

Climate change has already led to increased number of heat waves and extreme weather conditions in many parts of the world (Smith et al. 2014). As it continues, the challenges to population health and socioeconomic conditions described above will most likely increase. Without effective cooling systems in workplaces, residences or community facilities will become uncomfortable and, in some locations, unbearable.

The three maps in Fig. 2 below indicate the areas of the world with the highest risks of serious effects of heat. We use the heat index WBGT as an indicator of likely heat impact level during the hottest hours in the hottest month. The estimates are for the monthly average of the daily hottest hours in a recent 30-year period (1981–2010, labeled 1995) and for the modeled future heat levels in 2085 and 2200. When areas are green, these hottest parts of the month will not exceed a WBGT of 25 °C, and work and other daily activities are not likely to be affected in a significant manner. As the colors progress to yellow, orange, red, or purple, the heat impacts on work and daily life will increase.

Current heat problems (1995) are most severe in West Africa, India, China, South-East Asia, and Northern Australia, as climate change progresses to the end of this century based on this pathway (RCP8.5, Representative Concentration Pathway 8.5, which assumes little action to reduce greenhouse gas emissions) and beyond the high-risk areas are spreading. The USA and Brazil and countries in Central America and the Caribbean will also be affected. The heating trend based on this pathway increases further in the twenty-second century (Fig. 2). Numerous publications with heat maps show similar patterns, and a key remaining question is to what extent major countries, like India, China, and the USA, will be affected on a large scale. Then adaptation to heat may not be enough to avoid the social consequences, and mitigation of the actual climate change is needed for protection.



**Fig. 2** Heat levels around the world, before and after uncontrolled climate change. (Based on RCP8.5 and GFDL model, which is at the lower end of model results)

## Conclusions/Summary

This chapter has provided a wide-ranging overview of some of the many ways in which occupational health is affected by the increasing heat exposures that climate change will contribute to in large parts of the world. Current evidence about heat effects on health and physiology highlights the risks of heat exhaustion, heat stroke, and even death that working people in different parts of the world experience. In order to protect health, heat strain should be reduced through physiological and technological methods; working people should slow down and take breaks. However

this review has particularly sought to pay attention to socioeconomic challenges, of heat and its management, including tensions with productivity and income for the worker and the enterprise. Furthermore, it has considered important but difficult to quantify aspects of culture which are essential to mental health and well-being and the survival not only of people but of rich ways of life embedded in rapidly changing landscapes. In engaging with social, cultural, economic, and technological contexts in which heat exposures occur, the chapter has also sought to go beyond socioeconomic impacts of climate change, to also consider the more novel question of the emerging socioeconomic and socio-technical context which shapes heat-health risk alongside changing environmental conditions. While this chapter is far from a comprehensive framework for considering such questions, it hopes to illustrate their significance in order to encourage further research efforts on heat as a threat to health and socioeconomic development. Impact assessment at country level can stimulate new efforts to mitigate climate change and in this way protect working people in the targeted country and beyond.

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## Cross-References

- ▶ [Interactions of Work and Health: an Economic Perspective](#)
- ▶ [The Paradoxical Health Effects of Occupational Versus Leisure-Time Physical Activity](#)

**Acknowledgment** Financial support for this work was provided by the HEAT-SHIELD Project (European Commission HORIZON 2020, research and innovation program under the grant agreement 668786), and a grant from the Global Asia Institute at the National University of Singapore (NIHA-2019-001). The maps in Fig. 2 were prepared by Dr. Bruno Lemke and Matthias Otto, Nelson-Marlborough Institute of Technology, Nelson, New Zealand.

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# Social Inequalities in Health Among Older Adults After Retirement

# 6

## The Influence of Occupation and Related Factors

Akizumi Tsutsumi

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### Abstract

We are experiencing an aging society. Current evidence suggests that low occupational position, financial difficulty, and adverse psychosocial factors in working age are associated with a range of health problems after retirement (e.g., mortality, poor self-rated health, physical conditions, and reduced cognitive function). Generally, adverse conditions related to occupational position, financial situation, and workplace psychosocial factors (i.e., high job demands and low control) predict physical and mental health problems after retirement. Although there are some exceptions, the literature suggests that high work complexity and high psychological demands as well as high job control have a protective effect against declining cognitive function and development of dementia. Structural/contextual social determinants of health cannot be changed easily. It is therefore reasonable that countermeasures should target the workplace psychosocial environment that mediate structural/contextual social determinants of health. Providing employees

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_33](https://doi.org/10.1007/978-3-030-31438-5_33)

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with enriched work environments may have beneficial effects for retirees' physical and mental conditions, thereby reducing social inequalities in health in later life. Further research is needed to disentangle various confounding/mediating factors and establish a clear theoretical framework. However, a challenge is how to implement necessary countermeasures.

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**Keywords**

Cognitive function · Life course perspective · Occupational position · Psychosocial work environment

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**Introduction**

Occupation and related factors are relevant social determinants of health (SDH). These factors influence health among older adults as well as among workers, meaning social inequalities in health among those of working age persist or even widen after retirement. As reviewed in the following sections, evidence of associations between occupation factors and SDH across the life stages (from working age to old age after retirement) has been accumulating. Wahrendorf et al. (2013) distinguished four types of working conditions in mid-life that may affect mental health in older age: (1) stressful workplace psychosocial environments, (2) disadvantaged occupational positions throughout the whole mid-life period, (3) experience of involuntary job loss, and (4) exposure to job instability. These conditions may also affect physical health in later life.

Workplace psychosocial factors are closely associated with socioeconomic status (SES) and function as mediator or modifier of the association between SES and workers' health (Hallqvist et al. 1998; Hoven and Siegrist 2013). It is difficult or impossible to change structural SDH (e.g., occupational position and economic changes); however, adverse workplace psychosocial environments can be improved. This offers potential to reduce the impact of occupation and related factors on the health of people after retirement.

This chapter presents a life course perspective and reviews the effects of socioeconomic factors related to occupation on older adults after retirement. It reviews the literature with a focus on two research questions: whether working conditions (e.g., Wahrendorf et al. 2013) affect health among older adults after retirement and whether health inequality among older adults can be resolved within the scope of the mid-life work environment.

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**Findings****Structural/Contextual SDH and Health After Retirement**

There is a large body of research discussing the association between occupational position and health inequality after retirement. In the first Whitehall study that followed 18,133 male civil servants, Marmot and Shipley (1996) showed that

employment grade was a strong predictor of mortality before and after retirement. Participants in that study were aged 40–69 years when they were screened at baseline (1967–1970) and were followed for over 25 years. Among men, the lowest employment grade had 1.86 times the mortality of the highest grade after retirement (95% confidence interval [CI]: 1.6–2.2) (Marmot and Shipley 1996). Those authors observed that socioeconomic differences in mortality increased in magnitude with age; the absolute difference in death rates between the lowest and highest employment grades increased with age from 12.9 per 1000 person years at age 40–64 years to 38.3 per 1000 person years at age 70–89 years.

The long-term effects of employment grade on self-reported illness in old age were later investigated by resurveying survivors from the first Whitehall cohort. Breeze et al. (2001) identified differences in self-reported poor health and functional limitations (mobility) in old age by employment grade. In 1997–1998, 8537 survivors of the first Whitehall cohort were identified; 6168 (72%) completed a full questionnaire including four measures of self-reported morbidity (general poor health, poor mental health, poor physical performance, and disability). In that study the median age of respondents at resurvey was 77 years, and the median follow-up interval was 29 years. After adjustment for baseline risk factors, men in low employment grades had an almost fourfold risk of physical performance limited by health (odds ratio 3.7, 95% CI: 2.2–6.2), a threefold risk for poor health (2.5, 1.4–4.5), and a twofold risk for poor mental health (1.9, 1.2–2.9) and disability (2.1, 1.4–3.1) (Breeze et al. 2001).

In a study involving retirees from the French GAZEL occupational cohort, higher occupational grade in mid-life was associated with better quality of life 16 years later (Platts et al. 2015). Data for that study were collected from former employees of the French National Gas and Electricity Company. In total, 11,293 retired men and women participated. Their occupational grade in 1989 was measured using company records, and associations between employment grade and self-reported quality of life in 2005 were examined. The findings showed a graded relationship between occupational grade in mid-life and quality of life after retirement (Platts et al. 2015).

Several prospective studies have shown that occupational position in mid-life affects mental health in later life. Using data for 2789 men and 1150 women from the Whitehall II study, Virtanen et al. (2015) showed that low occupational position was associated with symptoms of depression postretirement (two decades later). The study population included participants from the Whitehall II study (1985–1988) who were retired at follow-up (2007–2009). Participants' average age was 67.6 years. There was a strong association between low occupational position and postretirement depressive symptoms (measured using the Center for Epidemiologic Studies Depression Scale), with an odds ratio of 1.7 (95% CI: 1.2–2.5) after adjustment for sociodemographic and health-related covariates at baseline and follow-up.

Another study used data from the Survey of Health, Ageing and Retirement in Europe (SHARE), which was conducted across 13 European countries. Wahrendorf et al. (2013) reported that those who had low occupational positions during mid-life had a significantly higher prevalence of depressive symptoms during retirement. The SHARE study analyzed data for 4822 men (mean age 71 years) and 3787 women (mean age 70 years) born between 1908 and 1947. Information on health from the second wave of the SHARE study (2006–2007) was linked with information on

respondents' working life, which was collected retrospectively in SHARELIFE interviews (2008–2009). Depressive symptoms were measured with the EURO-D depression scale. Compared with those with a very high mean occupational position during mid-life, retirees with a disadvantaged (very low) occupational position throughout mid-life had an almost twofold risk for depressive symptoms (adjusted odds ratios 1.77 for men and 1.92 for women).

The abovementioned study also examined associations between depressive symptoms and involuntary job loss (being laid off) and job instability (unemployment and fragmented careers) (Wahrendorf et al. 2013). There were stronger associations among men than among women. Involuntary job loss and job instability during mid-life were significantly associated with later increased depressive symptoms only among men. After adjustment for age, childhood social position, and childhood health, the odds ratios were 1.5 for those that were laid off and 1.7 for those with a period of unemployment or discontinuous/fragmented careers.

A recent study (Hessel and Avendano 2016) examined whether economic downturns experienced during mid-life had long-term effects on physical functioning, based on representative data from the SHARE study. Those researchers linked data on economic fluctuations from 1945 to 2010 in the 11 studied European countries with longitudinal data from 3 waves of the SHARE study. They showed that experiencing economic downturns at ages 40–44 and 45–49 years increased the risk for onset of new functional limitations in instrumental activities of daily living in older age (55–80 years). The research group also assessed whether exposure to economic downturns around retirement age led to poorer cognitive function in later life. They linked longitudinal data for 13,577 individuals from the US Health and Retirement Study to unemployment rates in respondents' states of residence and examined whether downturns at age 55–64 years were associated with cognitive functioning and decline at age  $\geq 65$  years, using random- and fixed-effect models. The results indicated that longer exposure to downturns at age 55–64 years was associated with lower levels of cognitive function at age  $\geq 65$  years, but was not associated with rates of cognitive decline (Hessel et al. 2018).

Some conflicting findings have also been reported. Coe et al. (2012) did not find reduced cognitive function after retirement among male white-collar workers but to the contrary increased working memory and calculating ability after retirement among male blue-collar workers. That study used data from the US Health and Retirement Study and analyzed associations using offers of early retirement windows as an instrument variable. Simple ordinary least squares estimates showed negative associations between retirement duration and cognitive functioning measures, but the instrumental variable estimates denied the causality of the associations (Coe et al. 2012).

## Mediating SDH and Health After Retirement

Workplace psychosocial factors are risk factors for depression among workers. The same seems true after retirement. The SHARE study showed that those who

experienced psychosocial stress at work had a significantly higher prevalence of high depressive symptoms during retirement (Wahrendorf et al. 2013). In that study, experience of psychosocial stress was evaluated using the Demand-Control-Support Questionnaire. All adverse job characteristics during mid-life (i.e., high job demands, low job control, and low social support) were associated with an elevated risk for reporting depressive symptoms after retirement among men and women, with the strongest associations for men with a low level of job control and women with a low level of social support at work (Wahrendorf et al. 2013). Virtanen et al. (2015) also reported prospective data that job strain (combination of high job demands and low job control) was associated with symptoms of depression post-retirement. The observed odds ratios in these studies ranged from 1.3 to 2.0.

Associations with health functioning after labor market exit have also been investigated. In the French GAZEL prospective cohort study, data for psychosocial work stress were assessed using two major occupational stress models: the Demand-Control-Support model (in 1997 and 1999) and the Effort-Reward Imbalance model (in 1998). Health functioning outcomes were assessed with mental and physical component scores from the Short Form 36 Health Survey in 2007 (Wahrendorf et al. 2012). Overall, adverse psychosocial job characteristics measured according to the Demand-Control-Support model and the Effort-Reward Imbalance model were prospectively associated with reduced health functioning, particularly mental health functioning. The multivariate regression analyses indicated that psychological demands had strong effects on both physical and mental functioning and highlighted the importance of workplace social support for mental functioning after retirement. In the Effort-Reward Imbalance model, the three single scales (effort, overcommitment, and effort-reward imbalance) showed the strongest effects for mental functioning. Effort-reward imbalance was found to be an important predictor of reduced physical functioning (Wahrendorf et al. 2012).

Many studies have examined associations between psychosocial job characteristics and cognitive function after retirement. Investigations of global cognitive functioning showed those engaged in jobs characterized as highly mentally challenging (e.g., complexity with people and data, complex calculating ability) had a slower rate of cognitive decline than those with jobs characterized as minimally mentally challenging. Fisher et al. (2014) analyzed 18-year panel data for a large nationally representative sample of US adults (US Health and Retirement Study: 2091 men and 2091 women) to examine trajectories of cognitive functioning during adulthood and old age. They assessed mental work demands using ten items from the Occupational Information Network (O\*NET) database regarding work activities, and the level of various mental processes required by respondents' jobs. After adjustment for educational attainment, income, and health status (which are known to be related to cognitive functioning), they showed that those with high psychological demands had a lower degree of decreased cognitive function (e.g., level and rate of change of episodic memory) after retirement compared with those with low psychological demands.

Similarly, using longitudinal data from the Maastricht Aging Study, Bosma et al. (2003) analyzed the association between psychosocial job demands and composite



cognitive test scores. They followed 630 men and women aged 50–80 years who exhibited no cognitive impairment at baseline for 3 years and showed that participants in jobs with high job demands were less likely to have low composite cognitive test scores (odds ratio 0.79, 95% CI: 0.65–0.96). Using panel data from the National Survey of Japanese Elderly ( $n = 4238$  at baseline), Kajitani et al. (2017) examined associations between eight dimensions of the longest-served job using information listed in the US Dictionary of Occupational Titles (DOT) and the cognitive functioning of male older adult workers in Japan. Workers who were engaged in jobs that needed more complex calculating ability showed slower decline in cognitive function after retirement than those in jobs without complex calculating ability. Another study (Potter et al. 2008) used the modified Telephone Interview for Cognitive Status with participants who received an assessment of intelligence based on armed services testing in early adulthood ( $n = 1036$ ). That study collected occupational information by telephone interviews to assign specific occupational classifications from the DOT. Multivariate regression models indicated that jobs with high intellectual demands were associated with preserved cognitive functioning (Potter et al. 2008).

High job control and the combination of high job control and job demand may have positive effects on global cognitive function in old age. An del et al. (2011) analyzed 827 participants from a nationally representative Swedish sample of individuals aged 77 years and older. They confirmed that low job control (measured by self-report or inferred by occupation) was consistently associated with a low level of cognitive function. They also found beneficial effects of active jobs (high demand and high control) on levels of overall cognitive function but failed to find effects related to job strain (high demand and low control). In a more recent study that analyzed 3779 men and women from the nationally representative US Health and Retirement Study (baseline age 57.3 years), An del et al. (2015) found that low job control and job strain were associated with steep episodic memory decline after retirement, with the magnitude of the associations being comparable with age and education. In their analyses, job control and job demands were estimated using ratings from the O\*Net (An del et al. 2015).

There is also evidence of associations between psychosocial job characteristics and risk for dementia. Previous studies reported significant associations between reduced dementia risk and high work complexity with people (Karp et al. 2009; Kroger et al. 2008) or high work complexity with data (Karp et al. 2009). A protective effect of high work complexity on dementia risk has also been reported (Kroger et al. 2008). A population-based follow-up study involving 931 non-demented participants aged 75 years and over conducted in Stockholm examined participants twice over 6 years (Karp et al. 2009). Primary occupations were assigned categories according to the Nordic Occupational Classification and matched to 1970 US Census data to score the level of work complexity using a matrix. That study found that complexity of work with both data and people was associated with lowered dementia risk (by 15% and 12%, respectively). The population study by Kroger et al. (2008) analyzed 3557 participants from the Canadian Study of Health and Aging, which included a representative sample of those aged 65 years or older. Job complexity scores were estimated

by lifetime job history. The fully adjusted Cox regression models showed an association between a reduced risk for dementia and high complexity of work with people (hazard ratio 0.66, 95% CI: 0.44–0.98) or things (0.72, 0.52–0.99) (Kroger et al. 2008). Using a dementia-free cohort of 913 community dwellers, aged 75 years and over from the same project used by Karp et al. (2009), Wang et al. (2012) showed low job control and high job strain were associated with significantly increased risks for developing dementia and Alzheimer's disease (diagnosed by the third revised Diagnostic and Statistical Manual of Mental Disorders). In that study, job control and job demands were estimated for the longest period of occupation as well as for all occupations using a validated psychosocial job exposure matrix. Cox proportional hazard models revealed low job control was associated with higher multivariate-adjusted risks for dementia (hazard ratio 1.9, 95% CI: 1.2–3.0) and Alzheimer's disease (2.2, 1.2–3.9). High job strain (combination of low control and high demands) and passive job (combination of low control and low demands) were also associated with these outcomes, but low job demands had no significant effect on dementia (Wang et al. 2012).

Findings regarding the effects of workplace psychosocial factors on declining cognitive function in later life are inconsistent. Gow et al. (2014) found that individuals who had an intellectually stimulating job performed worse on cognitive tests than those whose jobs involved manual labor, after adjusting for general cognitive ability at baseline. They also found that having a cognitively stimulating job had an effect on changes in level of cognitive function. Those authors assessed job characteristics in the Glostrup 1914 Cohort ( $n = 450$ ) when aged 60 years and followed participants' cognitive ability using four cognitive ability tests at ages 60, 70, and 80 years. Although they followed participants over 20 years, it should be noted that job characteristics were assessed near retirement age. Using a cohort of adopted twins, Finkel et al. (2009) examined how occupational complexity affected cognitive decline after retirement. They examined 462 participants (mean age 66 years) who completed in-person testing during a 4-h visit and measured cognitive aging across 4 latent components: verbal, spatial, memory, and speed. High complexity of work with people appeared to facilitate cognitive function, but improved performance in verbal skills was only found until retirement. Retirees from jobs with highly complex work scored higher on tests assessing spatial ability, but this ability declined rapidly after retirement. There were no significant differences in decline of verbal and processing speed after retirement (Finkel et al. 2009). The researchers argued that only participants in high complexity jobs experienced decline after retirement. Anel et al. (2007) analyzed 386 participants from the Swedish Panel Study of Living Conditions of the Oldest Old, which included a nationally representative sample aged 77 years and older, to clarify the association between complexity of primary lifetime occupation and cognition in older adulthood. They found an effect of work task complexity on global cognitive functioning and showed significant associations between higher complexity of work with data and people and better MMSE scores. However, adjustment for occupational status explained the association between complexity of work with people and global cognitive functioning.

## Mechanisms

Various mechanisms operate between SDH in working age and health problems in later life that need to be considered. An individual's mid-life social position may dictate their area of residence, social status and wealth (financial situation and pension provision), and social participation in later life (Blane et al. 2012). Social position (including financial situation) may also be associated with favorable access to medical care (Virtanen et al. 2017) and good treatment adherence, although there may be some exceptions for the latter (Haynes et al. 1996). Retirement is considered an adjustment process (Atchley 1976), and wealth may limit adjustment difficulties. If retirees have no financial constraints, they may be able to participate in more social and leisure activities than those with limited financial resources. Educational attainment may also support retirement adjustment, as educated individuals may have the necessary social skills to prepare for life after retirement (Rijs et al. 2012). According to the ecological model of life course (Corna 2013), SDH has structural or contextual functions; that is, employees with higher SES may have greater financial resources and enjoy better health after retirement than those with lower SES. Employees with lower SES may also have fewer resources, which may induce rapid health decline after retirement (Donaldson et al. 2010). Hessel and Avendano (2016) suggested that an increasing risk for low incomes persisting from mid-life to older age explained the association between economic downturns at age 40–49 years and poorer health in older age. This was because economic downturns experienced around mid-life were associated with significantly greater risk for lower incomes in older age (Hessel and Avendano 2016).

Unfavorable health behaviors are another mechanism that may mediate the relationship between SDH in working age and health in later life. Economic downturns experienced around middle-age are associated with significantly increased risks for smoking and excessive alcohol consumption in older age. Exposure to an economic downturn at age 40–49 years is associated with poorer health in older age, possibly by increasing the risk for unhealthy behaviors that persist into older age (Hessel and Avendano 2016). It has also been observed that body mass index increased after retirement among people who retired from physically demanding occupations or who retired with low wealth status. Weight gain with retirement was most prominent among people with physically demanding occupations *and* lower wealth, suggesting widening disparities in obesity after retirement (Chung et al. 2009). Pathways in which adverse psychosocial work environments (e.g., low job control and low social support) increase the risk for dementia may involve the incidence of cerebrovascular diseases (i.e., vascular dementia). However, to date, associations between workplace psychosocial factors and cognitive functioning have not been fully explained by cardiovascular risk factors (Then et al. 2014).

Biological mechanisms are often discussed in the context of stress theory. For example, exhaustion during working age may accelerate the biological aging process (Ahola et al. 2012). Chronic exposure to stress hormones affects brain structures involved in cognition and mental health (Lupien et al. 2009). Inconsistent findings have been reported in terms of effects of psychological demand, which merit

discussion because of the relationship between psychological demand and countermeasures in the workplace.

Higher mental work demands and higher work complexity have often been found to be associated with high cognitive function, slow cognitive decline, or reduced dementia risk in later life (Bosma et al. 2003; Fisher et al. 2014; Then et al. 2014). Intellectually demanding occupations may train cognitive abilities and build cognitive reserves, which delay the onset of clinical manifestation of poor cognitive function. Higher work demands are necessary to ameliorate and maintain higher cortical function, which in turn preserves cognitive abilities into old age (Then et al. 2014). This perspective is consistent with the “use it or lose it” hypothesis (Coyle 2003), which postulates that challenging and complex mental activities may stimulate molecular, cellular, and cortical networks and promote an individual’s functional adaptation (Valenzuela et al. 2007).

Conversely, higher work demands are likely to have detrimental effects on both physical and mental (cognitive) condition (Gow et al. 2014), which may explain the lack of effect reported in some previous studies (Andel et al. 2012). There may be an optimal level of work demands for individuals, or the effects of work demands may emerge in relationship to job control (Gow et al. 2014; Karasek and Theorell 1990).

Some studies have reported unexpected findings, such as a higher prevalence of health problems among retirees that had higher prestige jobs than among those that had lower prestige jobs, or higher educated persons being less likely to attain excellent or good self-perceived health after retirement compared with lower educated persons. Westerlund et al. (2009) observed that persons with low employment grades seemed unaffected after retirement, whereas those with intermediate and high employment grades were more likely to experience sub-optimum self-perceived health (Westerlund et al. 2009). Retirement adjustment theory (Atchley 1976) suggests that people who retire from a high-prestige job and experience a great loss from leaving work may find it difficult to adjust to their new retirement situation. Persons with low-grade occupations may not be affected after retirement because they are relieved from the health burden of low-grade occupations (Rijs et al. 2012).

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## Countermeasures

The literature suggests there are practical implications of understanding the relationship between SDH and health in later life, as several potentially modifiable socioeconomic and psychosocial risk factors for late-life health problems can be detected in mid-life. Structural or contextual SDH cannot be changed easily, but psychosocial job characteristics can be changed. A focus on workplace psychosocial factors has been suggested by various empirical studies that showed the effectiveness of improved workplace psychosocial environments on health (Lamontagne et al. 2007; Montano et al. 2014).

Improving workplace psychosocial environments is a promising measure to prevent cognitive decline. A previous study (Potter et al. 2008) found that work in more intellectually demanding jobs was associated with higher levels of cognitive

functioning in later life, even after controlling for cognitive ability in early adulthood. That study also suggested that individuals with a lower level of intelligence earlier in life benefited more from performing work that was characterized as intellectually demanding compared with individuals with higher ability levels earlier in life. Bosma et al. (2003) argued that the difference in cognitive decline may be reduced with an increase in mentally stimulating work for those with lower levels of education. Research on the brain also suggests an individual's level of cognitive function can be improved by experiences later in life, such as education or a mentally challenging job (Stern 2012).

Earlier intervention (i.e., in mid-life) for workplace psychosocial factors appears to be more effective than later intervention. The effect of time since labor market exit on associations between SES and retirees' health has been examined in a previous study (Hyde and Jones 2007). That study analyzed retirees from the English Longitudinal Study of Ageing to clarify the effects of different indicators of socioeconomic position (socioeconomic class, income, wealth, education, tenure, area deprivation, and subjective social status) on health. For both men and women, most socioeconomic position measures were associated with poor self-rated health, but the effects were attenuated by time since labor market exit (Hyde and Jones 2007). There are two possible explanations for this phenomenon. One is that the effect of work-related SES on retirees' health may only persist for a short time after retirement. The second is the survivor effect related to selective mortality; vulnerable persons with disadvantaged status may pass away earlier. In a prospective study of retired employees from the French GAZEL occupational cohort, higher occupational grade was associated with better quality of life 16 years later (Platts et al. 2015). In that study, the association between occupational grade and quality life was attributable to individuals' more recent circumstances, particularly their social status, mental health, physical functioning, and wealth.

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## Future Considerations

Etiologically, associations among SES and confounding and/or mediating factors should be clarified to develop good theoretical frameworks. In terms of cognitive outcomes, a detrimental effect of retirement was observed for people that were previously in more complex jobs (Gow et al. 2014). Earlier retirees that had more complex occupations may include retirees whose cognitive function declined earlier (Finkel et al. 2009). Therefore, candidates for measurement include intraindividual measurements of cognitive change, for example, cognitive ability during employment and examining changes in job characteristics (including work demand or complexity) (Nexo et al. 2016).

The mediating role of cardiovascular risk factors remains inconclusive (Then et al. 2014). Kroger et al. (2008) showed high complexity work with things had a protective effect against vascular dementia. However, vascular disorders did not mediate the associations between adverse psychosocial job characteristics and

dementia (Wang et al. 2012). This is an interesting research topic because there is robust evidence of predictive effect of psychosocial job characteristics on cardio-cerebral vascular diseases. Whether different workplace psychosocial factors can protect against cognitive decline remains inconclusive (Nexo et al. 2016). Methodologically, repeated measurements of exposure, potential outcomes, and confounding/mediating factors may increase the reliability of longitudinal research. Biological mechanisms should also be elaborated in further studies.

There are several important questions that need to be investigated. For example, “what level of job complexity is appropriate to prevent cognitive decline after retirement?” and “what are the appropriate proportions of job control and job demand?” The literature suggests that providing people with more cognitively complex job duties may enhance cognitive functioning. In addition, increasing the amount of mental activities involved in work characterized by lower mental demands is beneficial for workers’ cognitive functioning in later life. As higher work demands have detrimental effects on health, further research is needed to obtain intervention references for the criteria of job complexity (demand) and control in terms of quality as well as quantity. People who may benefit most by the provision of enriched work environment should also be clarified (Fisher et al. 2014).

There appears to be some sex-based differences in how SES in mid-life and interaction with psychosocial factors at work affect health in later life. When examining the effects of work stress characterized by the Demand-Control-Support model on complex health problems, Nilsen et al. (2014) observed the effects of job demands, job control, and the combination of these two variables differed between older men and women. They also found the possibility of interaction between SES (educational attainment) and work stress existed between the sexes (Nilsen et al. 2014). As few studies that assessed health past working age have explored sex-based differences, this topic merits further study.

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## Conclusion

Current evidence suggests that structural/contextual SDH (i.e., lower occupational position and financial difficulty) in working age are associated with health problems after retirement. Adverse workplace psychosocial factors also affect people’s health after retirement. In particular, evidence showing associations between psychosocial job characteristics and cognitive function in later life has been accumulating. With a few exceptions, the literature indicates high work complexity and high psychological demands as well as high job control have a protective effect for health in later life. In terms of mediating factors, it is feasible to modify psychosocial job characteristics to prevent the effects of structural/contextual SDH from leading to health problems in later life. A future challenge is how we implement any such interventions, in addition to the sophistication of the theoretical framework for occupational and related factors and health in later life.

## Cross-References

### ► Regeneration and Anabolism: The Good Perspective

**Acknowledgment** This study was supported by KAKEN Challenging Research (Exploratory): Exploration of methods of measurement and analyses of theory-based social class classification for health research in Japan (Project/Area Number 18 K19699) and the Ministry of Health, Labour and Welfare, Japan (Industrial Disease Clinical Research Grants 2018, Grant Number 180701-01).

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# Social Inequality in the Transition from Work to Retirement

# 7

Hans Martin Hasselhorn

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,

Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_32](https://doi.org/10.1007/978-3-030-31438-5_32)

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**Abstract**

This article investigates social inequalities in the transition from work to retirement in times of extending working lives and political activation policies. Basic mechanisms of policies aimed at extending working lives (EWL) include penalizing early exit from employment and incentivizing later retirement, the latter by increasing fixed retirement ages and by rewarding employment at higher ages. Evidence from different fields of academic research indicates that each of these EWL mechanisms bears substantial risks for exacerbating social inequalities. Current empirical studies confirm these concerns with recent data. The inequalities discussed concern the workers' health, finances, and social participation, factors that are strongly interrelated. Social groups at specific risk include those with lower educational achievements, with adverse working conditions, and with personal financial hardship (vertical social inequality) but also women and migrants (horizontal social inequality).

There is agreement that current EWL strategies, instead of exacerbating social inequalities, ought to consider and buffer them, which today is not the case. Based on their analyses and findings, some authors propose policy measures, most frequently differentiated retirement ages opening financially sustainable exit pathways for those with poor health. Others recommend the potential of life course views when implementing measures aimed at extending working lives. Also, policy measures such as improvements of work quality, qualification, and job security are recommended. Concerns have been expressed that EWL policies might fall short if they do not consider the group of older workers that cannot comply with the increased demands imposed on them.

Many scientific disciplines are investigating the transition from work to retirement. Occupational health research should add to how current EWL policies directly affect the older workforce with respect to health, finances, and employment and how they create and shape trajectories from work to retirement in later working life.

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**Keywords**

Social inequality · Work-retirement transition · Health · Employment · Gender · Finances · Migrant status

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**Introduction**

Retirement is not a natural law, but a social construction. In most countries, the understandings, arrangements, and the formal regulation of “retirement” are determined by power relations of public and social stakeholders. The often immense intensity of public debates about retirement regulation does not surprise, as it is about the distribution of social as well as individual resources: first and foremost of capital, but also of self-determination of lifetime, access to work

and education, social participation, social esteem, and, finally, health and well-being. This combined makes “retirement” a normative and ethical issue – and thereby a sensitive issue to academic research including occupational health sciences.

## Demographic Challenge

Population aging constitutes considerable challenges to European welfare states now and in the coming decades. As a consequence, many European states have implemented policies to extend the working life (EWL), often by restricting access to early exit routes and increasing state pension age, some by 10 years. Seen purely from an employment perspective, these measures may already be denoted “successful,” as they may be assumed to have contributed to the substantial increase of employment at higher working age (together with further influential factors, Beach and Bedell 2019): in the European Union (28 countries), the employment rate of workers aged 50 to 64 years has increased from 2009 to 2018 by ten percentage points from 56.2% to 66.2% (Eurostat 2019a).

The extension of working lives has not yet come to an end. One reason is that the implementation of retirement system reforms takes time. For example, in Germany, statutory retirement age will increase gradually until 2031 when those born in 1964 will be the first birth cohort to enter retirement at a legal retirement age of 67 years. Other countries, e.g., Denmark and the Netherlands, have linked their regular retirement age to the ongoing increase of life expectancy. Another reason is that the cultural transition from early-exit cultures to late-exit cultures takes time. Above all, public and political debates about further increases of the legal pension age continue in many countries.

This politically induced societal development may be interpreted as part of an active aging strategy in the European Union (European Council 2010, for an overview see Walker and Maltby 2012) and even globally (for an overview see Hyde and Higgs 2017, 166ff). In 2010 the European Council concluded that “active ageing means creating opportunities for staying longer on the labor market, for contributing to society through unpaid work in the community as volunteers or passing on their skills to younger people, and in their extended families, and for living autonomously and in dignity for as much and as long as possible.” Today, three decades after aging became a European policy issue (Walker and Maltby 2012), two decades after most of the European countries started to develop and implement regulatory EWL strategies, and about one decade after these began to show effects, there is an increasing discussion about the potential for EWL policies to exacerbate social inequalities in their countries (Beach and Bedell 2019; Phillipson 2019; Hasselhorn et al. 2019).

The aim of this contribution is to compile scientific evidence on social (in)equalities among older workers during the transition from work to retirement at times of politically induced extended working lives from an occupational health science perspective. Not included is the analysis of social inequality past retirement age.

## Retirement and Retirement Research

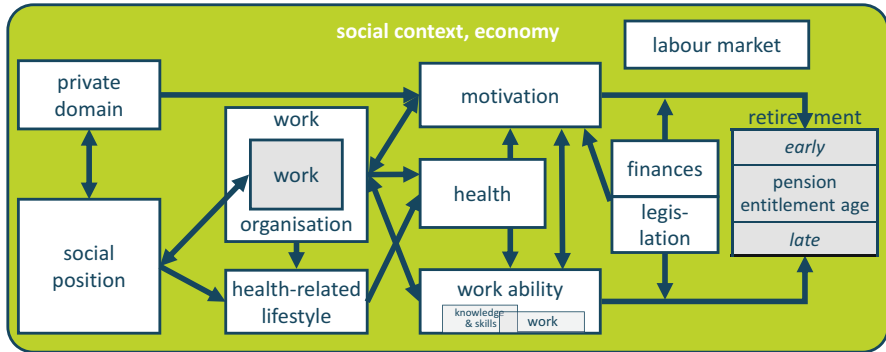
### Retirement Research

The societal development described above is accompanied by fast growing retirement research communities worldwide. Numerous disciplines are involved, such as gerontology, economics, psychology, sociology, and occupational health, often operating silo-like in separated research communities (Hasselhorn and Apt 2015). One major approach is to find determinants of early or late departure from work, for example, the role of the workers' health, working conditions, or financial status. Another, more recent approach is to investigate the pathways out of work, applying a life course perspective. Qualitative studies contribute to this perspective (e.g., Brown and Vickerstaff 2011), as well as increasing numbers of large national and international cohort studies, not least *retirement cohort studies* such as SHARE, covering numerous European countries (Börsch-Supan et al. 2013) and ELSA in the UK (Banks and Smith 2006). Some of these studies have a specific focus on *work, health, and retirement*, such as STREAM in the Netherlands (Ybema et al. 2014) and lidA in Germany (Hasselhorn and Ebener 2018). Finally, researchers increasingly take advantage of national register data (e.g., employment, health claims, sometimes linked with own questionnaire data); see, for example, Kadefors et al. (2019) who analyzed policy effects on early exit pathways from employment.

In retirement research findings, social differences turn out to be the rule rather than the exception. A frequent observation is that low-qualified workers tend to exit work and employment much earlier than highly qualified professions and that different predictors for employment are found for different social groups. However, the explicit focus on social inequality in the transition from work to retirement has long been the exception (e.g., Radl 2013), but has recently found more specific attention: It was, for example, the focus of the European research project EXTEND (Beach and Bedell 2019), for a special issue in a gerontological journal in Germany (Hasselhorn et al. 2019) and for recent scientific publications (e.g., Ardito and d'Errico 2018; Phillipson 2019). Today, many contributions that focus on social inequality in the work-retirement transition in times of EWL policies are summarizing narratives (Beach and Bedell 2019; Ardito and d'Errico 2018; Phillipson 2019), while empirical analyses still constitute notable exceptions (e.g., Kadefors et al. 2019; König et al. 2018; Radl 2013; Hofäcker and Naumann 2015).

### Understanding of Retirement

What is retirement? A straightforward view on "retirement" would be the complete withdrawal from paid working life. However, the stylized situation of working right up to statutory retirement age and moving into full time retirement from one day to the other is the exception and not the norm. Instead, retirement occurs gradually, and the concept of retirement is "not only fuzzy, it is also complex" (Denton and Spencer 2009). In this contribution, "retirement" is viewed not only as the timing of the full



**Fig. 1** The “lidA conceptual framework on work, age and employment” (Hasselhorn and Ebener 2018) indicating domains of relevance for employment participation among older workers and their interrelatedness

exit from working life but also the process and pathways leading to retirement including un-retirement and re-retirement.

Based on the lidA conceptual framework on work, age, and employment, Hasselhorn and Ebener (2018, Fig. 1) define four basic characteristics of the transition from work to pension among the older working-age population: Retirement is *complex*, a *process*, *individual*, and embedded in *structures*.

- (a) Retirement is *complex* entailing aspects from 11 so-called domains whose influences are interlinked – often causally, such as social status, private domain, work, health, work ability, motivation to continue working, finances, retirement regulation, and the labor market (Fig. 1). The authors hypothesize that a retirement decision is never based on a single factors’ impact, but that it is the result of numerous influences from different factors.
- (b) Secondly, retirement is a *process* whose shape is often laid down early in life. Major studies show the influence of social origins on the choice of profession, with consequent impact on work exposures, job satisfaction, health, and work ability. At a higher working age, both these distant and proximal factors may cause the individuals to evaluate their own employment outlook and to consider continuing working or withdrawing from the labor market. The final decision-making also constitutes one stage of the work-retirement transition process, which all in all may often last for years.

In the past decades, profound changes in processes and also conception of retirement are found. Today, the transition from a career job into retirement often proceeds gradually and in multiple steps within and outside the labor market. In the USA, bridge employment is today the rule rather than the exception (Cahill et al. 2017). In many European countries, the implementation of EWL strategies limits the possibilities for early retirement and redirects interested older workers into alternative exit routes. Multiple pathways out of work and into retirement are indicative of the “fragmentation of retirement”

- (Hasselhorn and Apt 2015), such as bridge perceptions of retirement as well as different combinations of employment, unemployment, sickness benefits, disability pensions, retirement, and un-retirement.
- (c) Further, the model illustrates the important *individual component* of retirement. Some of the domains comprise very personal aspects that impact the work-retirement transition differently for each individual, such as work, health, work ability, and motivation to work. Another aspect of individuality is the “subjectivization of retirement.” In times of EWL policies, the retirement planning and management increasingly becomes the individuals’ responsibility (Phillipson 2019), which may constitute challenges in times of fragmented retirement. Also the multi-pillar model of pension reform (Hyde and Higgs 2017: 154ff) reflects this subjectivization by transferring the responsibility for adequate financial old age provisions to the individuals – at best early in their career – by adding private and occupational pillars to the public pillar of retirement income. The fourth pillar, continued employment in retirement (Walker and Maltby 2012), is in line with this notion.
- (d) Finally, retirement among the older working-age population is embedded in a strong *structural context* mainly represented by social policy and regulation, financial factors, and the labor market, but also by social institutions, such as the arrangement of health-care provision, including home care. Legislative and regulatory factors, not least retirement schemes and social and labor market policies, effectively shape retirement behavior.

Undoubtedly, retirement is currently strongly affected by substantial changes in modern societies. This not only concerns current developments in macro level social policy but also includes the effects of economic globalization and never-ending advances in information and communication technologies, affecting and modifying work content, work arrangements, work organization, and the labor market. In addition, the workforce itself is changing, exhibiting an increasing heterogeneity with more women, migrants, and a higher proportion of older workers today. Simultaneously, societal norms, values, and attitudes are changing and contributing to population changes, for example, family formation with more divorces and single households. Finally, average health has improved at a higher working age, and mean life expectancies continue to rise.

The above short elaboration on retirement gives reason to reflect on whether and how such developments differently affect different social groups – and whether and how these differences may contribute to social inequalities in the societies.

## **Understanding of Social Inequality in the Context of EWL**

Social inequality exists, when advantages or disadvantages with respect to access to knowledge, resources, and opportunities are unequally distributed in different social positions or groups in a society. Most often, the term is used to describe inequalities between hierarchical groups along social strata, such as social class, education,

position, income, or power. This “vertical” social inequality is complemented by “horizontal” social inequality, which describes social disadvantages along levels that are equally ranked, for example, gender or migration status (Mielck 2000). Often, both patterns coincide (Mielck 2000). Both concepts are applied in this contribution.

With respect to the work-retirement transition, research has identified a range of groups of workers at risk of systematic disadvantage, such as workers with lower educational achievements and adverse working conditions including manual work, all often going along with personal financial hardship. Furthermore, this includes those with fragmented careers and people entering socially insured employment late in life, such as migrants. A special emphasis lies on workers with disabilities and poor health. A focus of the discussion is also on women, not only because of traditionally higher caring obligations. Finally, workers belonging to specific occupations such as miners or fire-workers are discussed. Again, these groups often largely overlap, but not always.

The distant outcomes considered in academic writing when discussing social inequality in the transition from work to retirement usually comprise unequal chances with respect to health, the current and future financial well-being, and, finally, fairness in the relation of years working and expected years in retirement.

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## **Social Inequalities Among Older Workers in Their Way from Work to Retirement**

### **Applying a Life Course View on the Transition from Work to Retirement**

Current life of the baby boomer generation strongly reflects advantages and disadvantages (Dannefer 2003) from childhood and early adulthood until today. For example, in a Finnish 35-year follow-up investigation, Hakanen et al. (2011) have shown that socioeconomic status in adolescence was associated with educational level more than 20 years later, educational level was related to the quality of working conditions and this, in turn with burnout risk 13 years later – all in the expected direction. In another Finnish study, Harkonmäki et al. (2007) found that the risk for disability retirement in adulthood increased with the number of adversities experienced in childhood. Finally, Fahy et al. (2017) investigated 55-year-old participants of a long-lasting UK child cohort finding that those who were abused or neglected in childhood were more likely to be permanently sick at the age of 55. Furthermore, childhood factors were associated with part-time employment and early retirement at 55 years of age.

The baby boomers’ transition to retirement may be regarded as just another step in the life course, shaped by the earlier conditions and experiences over the individuals’ life span and, of course, shaping the upcoming life in retirement itself.

When discussing conceptual tools for understanding life course influences on inequalities in later life, Kendig and Nazroo (2016) review three conceptual models: the *accumulation model* “considers the way in which cumulative insults or



exposures during the life course impact on later life outcomes, without much attention placed on the timing of these events” (Kendig and Nazroo 2016). This life course mechanism is termed “cumulative advantage/disadvantage” and explicated by Dannefer in 2003. It implies that (social) inequalities widen with time. To give an example, continued exposure to hard physical work may lead to poor health in a worker, which, in turn, is expected to lead to reduced attainments at work, job insecurity, job loss, and consecutively financial hardship. In 2003, Dannefer already related this process to “questions of fairness in the distribution of opportunities and resources” (2003).

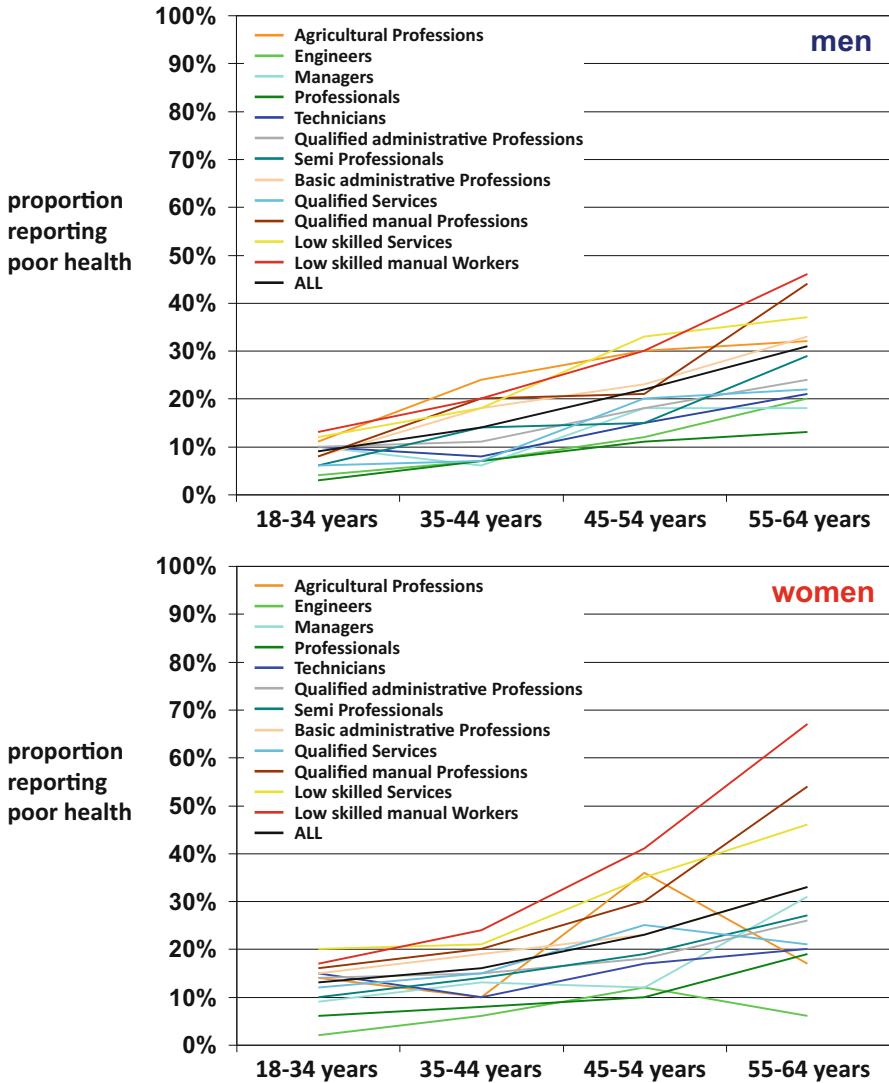
The second model discussed by Kendig and Nazroo (2016) is the *critical period model*. It denotes that influences (only) during a specific “sensitive phase” in life affect outcomes later in life. One example for such a sensitive phase may be the transition into retirement, denoted as a “critical life event” by König et al. (2018). During the retirement transition process, decisive factors such as perceived control over this process constitute factors determining how well individuals adjust to retirement thereafter (Wang et al. 2011; König et al. 2018). Kendig and Nazroo (2016) emphasize that the *critical period model* also implies the potential for the placement of meaningful interventions with the aim to benefit later stages in the life course.

Finally, Kendig and Nazroo (2016) point at “pathways through which events and circumstances at one point in the life course might indirectly influence those at a later point,” the *pathways model*. Again, the transition period from work to retirement constitutes a good example, when multiple decisions are made and frame future steps and pathways into retirement. The authors emphasize factors with the potential to mediate the relations between circumstances earlier and later in the life course (e.g., financial hardship) and again point at the potential to influence these mediating factors (Kendig and Nazroo 2016).

In the following section, recent evidence concerning social differences in health and employment at a higher working age is presented. Even if not made explicit, the findings compiled below should be considered to represent intermediate stages of life courses following pathways and mechanisms as those described above.

## **Social Inequality in Health and Life Expectancy in the Older Workforce**

Good health is regarded to be key for extending working lives today and in future generations. Socioeconomic gradients in health are widely known. Low-qualified professions and qualified manual professions show poorer health than high-qualified white-collar professions such as professionals, managers, and engineers, both among men and women, and this difference is highest among older workers. The robustness of this observation with respect to both health measure and type of measurement was demonstrated by a joint effort of different author groups in a special issue of a



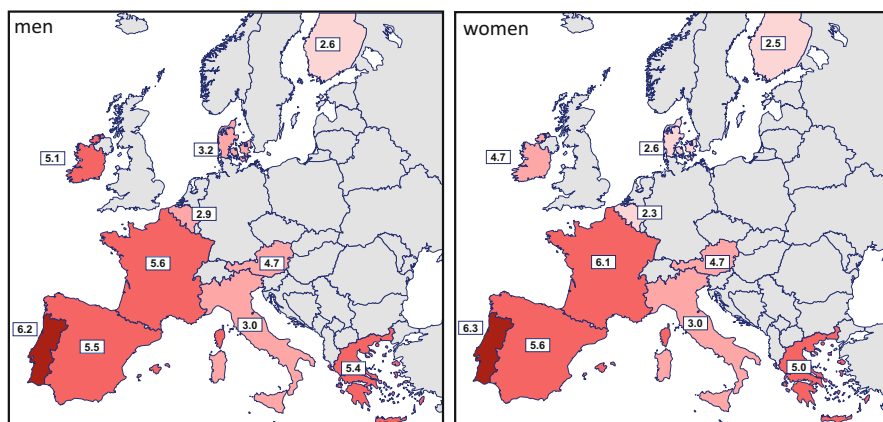
**Fig. 2** Prevalence (%) of poor self-reported general health in the working population from 18 to 64 years by a professional group in 2009 and 2010 (N = 26,303, data source: Burr et al. 2013)

scientific journal all confirming this pattern (Hasselhorn and Rauch 2013). In one of these contributions, Burr et al. (2013) showed in cross-sectional analyses of a large representative population survey that the social gradient in self-reported health across professional groups already exists for young workers and increases strongly with increasing age group with a statistically significant interaction effect of professional group (Fig. 2). To give an example, poor health was reported by 6% of all

working female engineers aged 55 to 64 years and by 67% of all low-qualified female manual workers of the same age (Burr et al. 2013).

The social health gradient translates into a social gradient in life expectancy (LE). No matter which measure is used, the expected social gradient appears clearly. On the basis of 29 European studies, Mosquera et al. (2018) reported LE differences between three educational categories for 10 to 15 European countries. With respect to LE at age 50, they found differences ranging from 2.6 to 11.6 years of life for men and from 1.6 to 6.9 years for women – all in the expected direction. LE differences at age 65 ranged from 1.1 to 3.8 years (men) and 0.6 to 5.2 years (women). Differences in disability-free life expectancy at age 65 are visualized in Fig. 3 for some selected European countries (Mosquera et al. 2018). To summarize, in Europe, people of higher socioeconomic position may expect to live longer and to spend more years in good health and less years in poor health, and they spend a smaller proportion of their lives in poor health. This issue will be taken up below when the effects of pension reforms are discussed.

Whether or not the social gradient in life expectancies is expanding is not clear. The authors of a recent narrative research report state that life expectancy was increasing faster in higher educated groups than in lower, an effect even more pronounced for healthy life expectancy (Beach and Bedell 2019). Bosworth (2018), in his review on disparities in mortality by socioeconomic group, documented a worrying development in the USA: a growing number of studies are reporting increasing mortality among low educated white non-Hispanics ongoing since the late 1990s. This development is not found in Canada (Bosworth 2018) or in Europe. In a register-based study of several European countries, Mackenbach et al. (2016) found that substantial mortality declines had occurred in the past 20 years mainly in lower socioeconomic groups in most European countries, especially in men, thereby narrowing the socioeconomic gap.



**Fig. 3** Social differences (in years of life) in disability-free life expectancy at age 65 in selected European countries. Differences between three educational categories (low vs. high) are shown. All findings are in the expected direction. Data source: Mosquera et al. (2018)

## Social Inequality in Employment Participation

Throughout working life, age, socioeconomic status, health, and employment are closely intertwined. This is particularly prominent at higher working age and indicates substantial socioeconomic divide.

Workers in poor health exit earlier from paid work and employment and thus retire earlier (see the systematic meta-analysis by van Rijn et al. 2014). This mechanism, however, is not similar for all socioeconomic groups. Those with lower education are at increased risk of health-based selection out of paid employment as Schuring et al. (2013) observed in her study of workers in the Netherlands, no matter whether disability retirement, further forms of early retirement, unemployment, or other forms of becoming economically inactive were used as outcome.

Socioeconomic status is linked to lifetime duration of employment. A frequent observation is that low-qualified workers exit work and employment much earlier than high-qualified professions (for the UK, Banks and Smith 2006; for Sweden, Kadefors and Wikman 2011; for the Netherlands, Visser et al. 2016; for Germany, Brussig and Ribbat 2014). Working life expectancy (WLE) is an indicator for years in employment. Comparing data from 11 European countries, Loichinger and Weber (2016) found that WLE at age 50 differed substantially by educational attainment (ISCED 97 classification: completed lower education vs. tertiary education). According to their findings, better educated men (and women) at age 50 in Denmark can expect to work 3.2 (3.0) years longer than lower educated; the respective figures for Estonia were 8.2 (9.8) years. The values for nine further countries were in between. Still, based on the exemplifying analysis of five countries, OECD summarized that high socioeconomic groups can expect to spend a longer time in retirement relative to work. For example, in the USA, men in the lowest-income group have to work 2.8 years for each year spent in retirement and men in the highest-income group only 2.1 years; for women the differences were usually smaller (considering different work entry ages, OECD 2018).

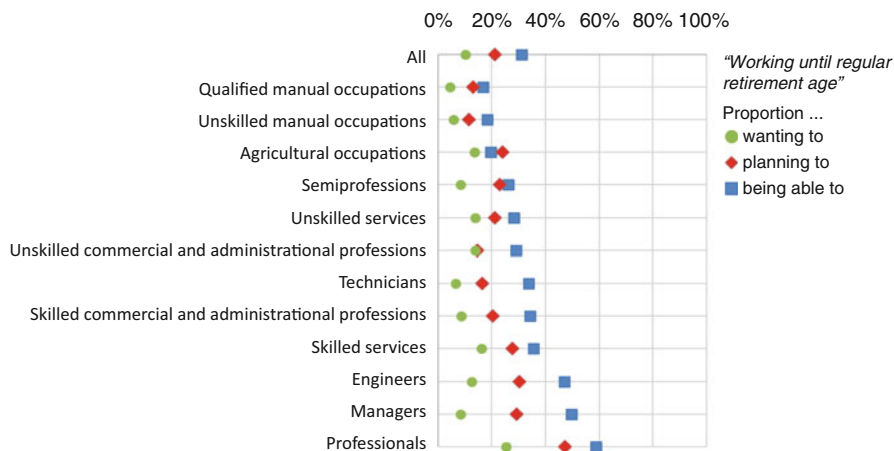
This social difference in WLE and retirement age might to a considerable degree be explained by “involuntary” early exit from employment, namely, by disability retirement and unemployment. Radl (2013), when analyzing SHARE data from 11 European countries, found that the occupational class effects for involuntary early retirement are stronger for workers between 50 and 59 years of age and that they diminish after the age of 60 years. This indicates that workers of low socioeconomic status who “survive” the pitfalls of disability pension and unemployment until the age of about 60 continue to work to a similar extent as workers of higher occupational class. One reason for continued working of lower occupational groups may be good health and work ability, yet another may be that they cannot afford to stop working for financial reasons (see below).

The social gradient in disability pension is well recognized (Haukenes et al. 2011; Leinonen et al. 2012). Workers with lower educational level (Støver et al. 2013; Leinonen et al. 2012) or lower occupational class (Haukenes et al. 2011; Leinonen et al. 2012) and – to a lesser extent – with lower household income (Leinonen et al. 2012) have a higher risk of receiving disability pension. The effects were found to be

greater for younger age groups, but still considerable at higher working age (Leinonen et al. 2012). The smaller social gradient in higher age may be due to alternative work exit routes for the age groups approaching retirement (see below). Adverse work exposure and poorer health in lower socioeconomic groups may only explain a part of the social difference in disability retirement (Haukenes et al. 2011).

Disability pension is regulated differently in each country, but typically, both entry age and pension are low, thus going along with a substantial risk for economic deprivation. To give an example, for the around 175,000 new disability retirees annually in Germany, median age at entry is 54 years (personal communication). Their risk for future financial hardship is high. According to a report from the German Federal Pension Fund, 36% of all disability retirees in Germany were at risk of poverty (in total population 14%), 21% were at risk of severe poverty (7%), and one out of four needed additional social welfare support in the household. Poverty risk was doubled among those without any occupational qualification (Märting et al. 2012).

Also, the workers' individual retirement perspectives follow a social gradient. Like in many European countries, an "early-exit culture" prevails in Germany. Own findings indicate that only few older workers feel ready to work until the statutory old age retirement age (66 to 67 years). Only 10% want to do this, 21% plan to do so, and 31% state that they are able to work until that age (Fig. 4). The social gradient is most pronounced and very strong for "being able to." Almost 60% of all professionals say that they are able to work until regular retirement age, while this was the case among less than 20% of the three manual working groups. A social gradient is



**Fig. 4** Subjective employment perspective by occupational group in a representative sample of older workers in Germany (53 or 59 years old, N = 3327). The marks indicate the proportion of participants in each group reporting wanting to, planning to, and being able to work until the individuals' statutory old age retirement age (age 66 for those born in 1959 and 67 for those born in 1965). Data source: lidA-Study, wave 3, 2018, n per group from 50 to 741, own data

also visible for “wanting” and “planning,” but it is less consistent. The measure, which may be assumed to predict later work exit behavior best, is “planning.” Engstler (2019) found in longitudinal data analyses that earlier retirement timing plans were realized among about 50% of all older workers. However, groups with reduced chances for exiting working as planned were women (worked longer than planned) and workers with poor health (earlier). Workers with lower educational level more often left employment earlier than other groups (e.g., for health reasons), or they worked longer than planned, indicating that financial needs may have tied this group to continued working (Engstler 2019).

For about 10 years, the impact of retirement itself on health has increasingly been investigated. König et al. (2018) summarize that workers in low-status and low-quality jobs show an improvement in health and also cognitive functioning following retirement, thus indicating a higher pre-retirement workload and a relief effect in this group, an effect not found among workers in high-quality jobs. Whether early or late retirement has positive effects on health – even when taking pre-retirement health into account – remains controversial as there is evidence for both. König et al. (2018) assume that these contradictory findings may be due to a lack of socioeconomic differentiation in the analyses. Indeed, in their Swedish HEARTS study, the authors found later retirement ages among lower educated individuals to be related to worse health – an effect not found among higher educated retirees (König et al. 2018). Again, this finding may indicate that a significant proportion of workers of low socioeconomic status continue working despite poor health, presumably because they are tied to work and employment. König et al. (2018) label this as “unhealthy older worker effect,” adding to the accumulation of health adversities over the life course.

After having summarized a range of socioeconomic inequalities in health and retirement at higher employment age, the question is whether and how current EWL policies are influencing this fragile system.

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## **Impact of EWL Policies on Employment and Health at Higher Working Age**

### **EWL Policies**

In the 1980s and 1990s, political strategies focused on helping people to leave employment early, long before statutory pension age. The period since then has seen a paradigmatic political change with a rapid growth of policies to support an extended working life (Phillipson 2019). Policymakers regard EWL strategies as key ways to address current demographic developments and socioeconomic challenges; the two underlying basic mechanisms of EWL policies are incentivizing longer working lives and penalizing early exit from employment. The EWL measures include:

- *Reduction of early exit*
  - Abolishment of early exit incentives and regulations
  - Reduced access to disability retirement, early retirement schemes, and long-term sickness benefits
- *Increase of pension eligibility age*
  - Fixed higher exit ages
  - Adjustment to national development of life expectancy or age dependency ratio
- *Implementation of incentives for continued employment*
  - Reductions in pension value by changes in the pension indexation mechanism
  - The shift from defined benefit pensions to defined contribution pensions, where an extended amount of the pension payments are directly related to the duration of working life
  - Allowing those who postpone taking the state pension to receive a larger pension in the future, for example, by exempting them from paying certain social contributions (taxes, insurances)
  - Easing earnings limits for income while receiving a state pension
  - Higher annual pension accrual rates for working at a higher age
  - Abolishment of mandatory retirement age

Naturally, not all OECD or European countries have adopted all these strategies. In some few instances, regulations not in line with EWL have been introduced, such as the possibility of full retirement 2 years earlier than regular retirement age for those who have been in socially insured employment for at least 45 years in Germany. For a history of the recent approaches to reforming the pension systems around the world and of reforms to national retirement income systems since 1990, see Hyde and Higgs (2017; 152ff).

In academic research, EWL policies receive increasing attention as social consequences become apparent. EWL policies are usually national one-size-fits-all regulations based on the “homogenous notion of the older workforce” (Krekula and Engström 2015). Thus, they do not differentiate between social groups differently equipped with resources and risks in the workforce. If group specific retirement age regulations exist, these are mostly defined by occupational exposure (see section “Occupational Risk-Related Early Retirement”). Concerns are expressed that social inequalities exacerbate and bring around increased risks for those of lower socioeconomic position with respect to health, finances, and employment (e.g., Phillipson 2019; Engstler 2019; Beach and Bedell 2019; König et al. 2018).

## **EWL Policies: Impact on Health**

EWL policies are directed toward increasing employment participation. In many countries, early exit today is more penalized by reduced social and financial safeguarding than before. As indicated above, workers of lower socioeconomic status are more likely to be in poor health and – consecutively – to leave work

early for health reasons. Possible exit routes are not only disability retirement but also further ways of early retirement such as early old age pension. If these early exit options are obstructed by EWL policies, the only option to prevent financial hardship, the social and economic fall into unemployment, or – even worse – non-employment is to continue working in spite of poor health. Considering the typical work these professional groups perform, it may be assumed that continued working adds additional risks to their already reduced health and also to their work ability, with the consequence of increasing job insecurity – all in line with the *accumulation model* described above.

Financial hardship (or threat thereof) is known to tie the poorest to continued employment – irrespective of health. Szinovacz et al. (2013), for example, found that people with debts expect to work longer. In consequence, the relationship of financial status to employment participation is usually not linear (Brown and Vickerstaff 2011). At higher working age, groups of *low* as well as *high* financial status tend to show the highest attachment to work and employment. The groups least attached are the middle-income groups. Meadows (2003) described this phenomenon as follows: “Those who are likely to want to continue working tend to fall into two distinct groups: those who are better qualified, and who have or can obtain intrinsically enjoyable jobs which are not too stressful or challenging, and another, generally poorer group who are motivated mainly by financial factors.”

This pattern was confirmed by recent data from a representative German work and retirement study among older workers (Fig. 5). Motivation to Work (MTW) measures the motivation to keep working. MTW was highest among men and women in the lowest-income group and showed the expected u-shaped distribution among men. What the graph does not show is that the low-income groups were



**Fig. 5** Mean scores for Motivation to Work by income group among older workers in Germany by gender. Household equalized net income. The Motivation to Work (MTW) score indicates the subjective attachment to labor market and continued working. “1” indicates absent and “5” highest motivation to continue working (workers aged 53 or 58, N = 3175, lidA 2018, own data)



additionally burdened with the worst health scores and most adverse exposures to work. Interestingly, health was significantly associated with MTW in all income groups – but not in the lowest (Hasselhorn et al. 2020, submitted). This confirms that in some occupational groups, problematic health conditions prior to retirement may be subjectively recasted as “tolerable” due to the financial imperatives, as Brown and Vickerstaff (2011) formulate. In times of EWL policies, the number of older workers being tied or “locked” to their jobs can be expected to increase.

### **EWL Policies: Distributive (Un)fairness**

An issue indirectly related to health is that of distributive fairness of EWL policies (Bosworth 2018; Phillipson 2019; Mosquera et al. 2018). The two core EWL mechanisms, the increase in retirement age for all workers as well as increased financial deductions for those exiting early, financially affect socially disadvantaged groups more often and more intensely than those better off. Bosworth (2018) described for the USA: the “public retirement system is highly progressive in redistributing income from high-income workers to lower-income retirees. However, a substantial portion of the redistribution is negated on a lifetime basis if lower-income retirees have a shorter life expectancy and collect benefits for an abbreviated period. The issue takes on added importance today because of proposals to raise the retirement age in line with increased average life expectancy as a primary means of controlling the system’s costs. Yet, if life expectancy is increasing only for those at the top of the income distribution, an increase in the retirement age seems unfair to lower-income groups with unchanged or even reduced life expectancy.” In line with this is what Phillipson (2019) writes: “Essentially, raising pension ages entails a ‘cross-subsidy’ from the poor to middle-income and wealthy groups.”

Another often overlooked aspect of distributive fairness is the fact that those leaving employment early, i.e., most often those with lower socioeconomic status, will not benefit from the financial incentives for longer employment, such as higher annual pension accrual rates for working at a higher age or granted exemptions from paying social contributions. The scientists involved in the EXTEND project describe this notion from the opposite perspective: “In summary, there is growing evidence that the groups who are best equipped to take advantage of the extending working lives agenda are more highly educated, more highly skilled, and better paid” (Beach and Bedell 2019).

### **EWL Policies: Alternative Exit Ways**

As indicated earlier, the immediate transition from the first career job into full retirement is the exception. Today more than ever, retirement can be considered as “fragmented.” Workers who feel that they are no longer able to meet the work demands will take alternative exit routes if EWL policies impede access to disability and other early retirement options. These alternative exit routes include periods of

precarious nonstandard employments, unemployment, sickness benefits, or further forms of economic inactivity and as a last resort social security – pathways associated with substantial financial losses. It can be assumed that those mostly affected belong to lower socioeconomic groups.

This indeed was confirmed by a recent Swedish study. In a register-based follow-up study of the total Swedish workforce population of 55–64-year-olds, Kadefors et al. (2019) compared retirement figures from 2004 and 2011. In 2006, new restrictive disability pension guidelines were issued in Sweden. The authors found a reduction in disability pensions by 70% in the observation period and a compensatory doubling of early old age pensions in the age groups investigated. The reduction in disability pension affected blue-collar professions more than white-collar professions and women more than men. Instead, these groups showed increased claims of early old age pensions, even though this negatively affects the lifelong pension value. The authors conclude that the restrictive terms for awarding disability pension will increase the social inequalities (Kadefors et al. 2019).

## Occupational Risk-Related Early Retirement

In some European countries, special pension privileges for workers in specified hazardous jobs exist. The underlying rationale is that workers exposed to physically or psychologically arduous jobs should be compensated for risks to current or later health and reduced work ability and/or life expectancy. Typical professions include miners, firefighters, airline pilots, teachers, and members of the police force. The compensation may be provided by earlier retirement options, by a wage bonus, and by both (Zaidi and Whitehouse 2009). The specific schemes, the defined occupational groups affected, and the justifications provided differ between countries. Often such regulations are historically rooted and may reflect what was regarded as a risk profession at the time retirement regulations were set up, to win political favors or to boost specific sectors. Today, they often owe their continuance to “institutional resistance to change” (Zaidi and Whitehouse 2009).

What these regulations have in common is that the designation of those eligible is based on job descriptions, occupations, or industries (Zaidi and Whitehouse 2009). Workers belonging to those groups will benefit from the compensations – no matter whether the jobs still bear the increased risks anticipated at the time the regulations were set up.

In a few countries, individual regulations for early retirement exist for workers with strenuous work (Brussig et al. 2011). In Austria, workers exposed to defined minimum lifetime levels of night shift work, or working in cold or hot conditions, with chemicals or adverse physical exposures, such as vibrations, and heavy physical work may retire early at the age of 60. In each case, an individual evaluation is required to determine eligibility. A similar system has been introduced in Hungary (Brussig et al. 2011).

The early retirement options described above are intended to compensate for long-lasting intense occupational exposure, which is one of the determinants for

increased vulnerability in these groups. However, many more determinants contribute to the higher vulnerability of the social groups, often lifelong structural disadvantages and individual factors such as genetics and fate. To prevent unintended distributional individual and social consequences, further measures than those in place need to be taken as a complementary part of the EWL strategies.

## **Impact of EWL Policies on Horizontal Inequalities: Gender and Migration Status**

While most of the aspects summarized above deal with vertical inequalities, horizontal inequalities also need to be looked at when investigating social inequality in the transition from work to retirement.

### **Gender**

Historically, women have been “invisible retirees” (Denton and Spencer 2009) and for very long been “virtually ignored” by retirement research (Zimmerman et al. 2000). Both circumstances have changed as the group of older women has been discovered “as an untapped potential for increased employment and employment participation” (Hasselhorn and Apt 2015). Today, the role of older women finds considerable attention in retirement research, acknowledging that “retirement may mean very different things for women and for men” (Loretto and Vickerstaff 2012).

Gender differences in retirement contribute to concerns that EWL policies affect women more than men. One major concern is that the pension entitlements earned in the life course are substantially lower among women than among men, this for a number of reasons: The employment rate of older women aged 50 to 64 years is still substantially lower than that of men, but it is strongly increasing (EU 28, from 48% in 2009 to 60% in 2018; men: 64% to 72%, Eurostat 2019a). About one in three women aged 55 to 64 works part time (Eurostat 2019b). Earlier life of today’s older women is characterized by interrupted work careers due to higher engagement in domestic and caregiving responsibilities. Even today, gender segregation of work prevails with many low-status and physically demanding jobs being female dominated, such as care and cleaning work, and accordingly, there is a considerable overlap with vertical social inequality discussed above. On average, women’s wages are lower than those of men. Also, among married women, the timing of the (usually older) husband’s retirement often leads to the women’s early exit from employment. All these factors contribute to lower pension entitlements and women’s higher dependency in later life. Furthermore, societal changes in family formation, more divorced single adults, and a greater number of people living alone at higher working age increase the older women’s financial risks in later life.

In times of alignment of retirement ages for men and women in most European countries, EWL policy does not consider, not to mention recompensate, the underlying socially structured patterns of gender inequality in lifetime work and employment. In consequence, EWL policies are likely to increase the financial pressure to a higher degree among older women than older men, increasing the probabilities for

financial hardship at the end of their working life and/or involuntarily extended working life with the health and financial risks indicated above. In fact, Engstler (2019) found women to have a higher probability of working longer than planned.

### **Migration Status**

In contrast to older women, the issue of “migration and retirement” has so far received only very limited scientific attention (Hasselhorn and Apt 2015). In several European countries such as Germany, policymakers are encouraging immigration and also increased employment participation of migrants to compensate for demographic shortages in labor supply. In the coming years, large groups of migrants in Europe will reach pensionable age.

The term “migrant” is not specific and implies, besides having foreign citizenship, being foreign-born or having one or both parents who are foreign-born. Migrants are a highly heterogeneous and multifaceted group, in respect not only to origin and tenure in the country but also to educational attainment, along with social as well as physical and mental health factors. This certainly needs to be considered when looking at the transition from work to retirement. On average, however, the group can be expected to be more vulnerable compared to non-migrants, from a health perspective, but also from a social, employment, and economic perspective. In Germany, for example, migrants tend to be overrepresented in jobs affected by economic restructuring, such as manual industrial jobs and jobs with increased employment and health risks (Hasselhorn and Apt). Foreign-born migrants in Canada have been found to start – on average – late on the labor market and to bear higher risks for lower income, unemployment, and disability retirement; apart from that, they tend to work longer than other groups, probably due to higher financial vulnerability (Bélanger et al. 2015). Similar risks have been reported from the UK including higher risk of unemployment (Phillipson and Smith 2005).

Another aspect brought forward by Phillipson and Smith (2005) is that the idea of extending working lives may be interpreted differently by groups of different cultural background. For some migrant groups, early or late exit represents cultural norms. For example, in Germany, many migrant retirees of Turkish origin may tend to partially or fully remigrate after (early) retirement.

It seems rather obvious that current EWL policies relocate additional health and social risks to different groups of older migrants. The risks should be even higher among migrant women, where migrant, gender, and socioeconomic risks accumulate.

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## **Role of Research**

### **Positioning of Scientists**

The number of academic publications explicitly expressing serious concern about adverse individual and social consequences of today’s EWL policies is high. To summarize, the worries are that EWL policies impose additional risks to socially

disadvantaged and vulnerable groups in terms of health, financial well-being, social participation, and – overall – respect, dignity, and social fairness.

A large part of the criticism is the widespread rigid one-size-fits-all increase in legal retirement age – whether indexed to life expectancy or not. Mosquera et al. (2018), for example, proposed a differential pension age in pension policies. To summarize, some argue that early exit options should be provided for older workers in poor health who are no longer able to perform their work or where continued working may imply additional risks to their health. These should be implemented in addition to any existent disability pension, which is a last resort for those who already have severely reduced health and functioning. Importantly, these options should not put additional financial risks to the lives of those affected.

The life course perspective is at the center of further considerations. Phillipson (2019) proposes work and retirement policies acknowledging the processes of cumulative advantage and disadvantage operating over the life course. Based on this notion, Kendig and Nazroo (2016) emphasize the potential that policy-driven investments could have in breaking the typical negative trajectories into later life. The precondition is that policies reflect an understanding of social processes leading to inequalities over the life span and of effective points in the life course for building resources and interventions that generate benefits for the workers and societies (Kendig and Nazroo 2016).

To offset the negative effects of the expected increase of precarious forms of work in times of EWL policies, Phillipson (2019) recommends matching this development with corresponding rights for vulnerable groups of older workers – for example, through guaranteed access to trade unions, guaranteed working hours, and regular training. Further, authors consider the improvement of work quality as well as job security as preconditions for policies aimed at extending working lives. Also Schuring et al. (2013) emphasize the need for policies that protect workers with health problems against exclusion from the labor market. Krekula and Engström (2015) miss the promotion of lifelong learning on the EWL agenda.

Interestingly, no positive country cases with respect to socially sensitive interventions aimed at extending working lives were identified in the literature viewed for this manuscript. Although acknowledging that some countries do better than others, the European EXTEND project concludes that “so far policymakers have failed to find mechanisms to address the unequal impacts of decisions to raise the retirement age or otherwise extend working lives.” And the authors warn that “the ambition to extend working lives could stall because some people – and, in some cases, whole sectors of employees – are simply not able to respond in the way intended by such policies and reforms” (Beach and Bedell 2019).

## **Scientists’ Reflection of the Own Role**

In current times of aging populations in combination with public financial austerity, there is high pressure on policy and the public to reconsider “retirement,” its underlying understandings, and not least its regulation. However, as we know,

retirement is a complex phenomenon (Hasselhorn and Apt 2015) and not easy to understand, neither for the societal stakeholders nor for policy. Here, the research gets into the focus of public interest: it shall explore, describe, and explain “retirement” and, finally, predict and produce future scenarios. Yet all societal groups involved have their particular interests in this ethically loaded issue. One consequence is that retirement research is easily exposed to external normative expectations. It is the author’s concern that the quantitative and qualitative intensity of the public debate around retirement and retirement policy bears the risk of (more or less) subtly influencing retirement researchers’ premises, questions, and views and by that – as a consequence – modifies the quality of this research domain. Three questions shall elucidate this:

- *Should retirement research support policy to solve demographic challenges by extending working lives?*  
 Extending working lives is one of the several possible strategies to solve current demographic challenges. It is often commonly perceived as the “best” solution. Here, retirement research is at risk of mirroring dominating societal interpretations. The consequence is that in many retirement studies, the exit age is the only outcome of interest and is sometimes regarded by researchers as a measure of “success.” Such a conception may overlook potential costs of the extension of working lives. Such costs include risks for the individual workers’ health, financial well-being and self-determination, risks for the organizations’ productivity, and, not least, hidden social costs which may impose as health-related expenses as well as intergenerational conflicts in the society.
- *Should retirement research support “active aging” policies?*  
 In the past decade, “active aging” has become a politically popular concept that also guides research funding. The WHO defines “active aging” broadly as “continuing participation in social, economic, cultural, spiritual and civic affairs, not just the ability to be physically active or to participate in the labour force” (WHO 2002). This concept was adopted by WHO in the late 1990s to be more inclusive than the formerly used concept “healthy aging.” Nevertheless, it is a normative approach that wants individuals to “plan and prepare for older age, and make personal efforts to adopt positive personal health practices at all stages of life” (WHO 2002). As indicated above, this is not possible for all people at higher working age in the same way. Thus, the concept is socially selective and discriminating. While WHO points out this aspect, neither the broad public discourse nor EWL policies consider this. The German sociologist van Dyk (2015) warns that thinking exclusively positively about old age may generate pressure on those not being able to comply with the positive images of capability, independence, and productivity. Her interviews with older people in Germany indicate that “beliefs and practices incompatible with productive ageing persist.” She disclosed a deeply rooted retirement culture, which did not comply with productivity claims.
- *Is retirement “good” and a recompense for the working life?*  
 There is a risk for retirement research to regard the retired status per se as “good” for the individual and as a recompense for a negatively connoted working life.

From that point of view, the extension of working life imposes as a threat and penalty. In Germany, about 45% of the workforce belong to the group of low and unqualified workers and manual workers. This group bears substantially increased risks for poor health, especially at a higher age (Burr et al. 2013). As summarized in this article, for many (but not all) older members of this group, work may constitute a continued threat for health, and retirement may indeed be a necessary and “good” step in life. Yet, the author is also aware of the basic conclusion which Waddell and Burton draw in their review. “Is work good for your health and well-being? (2006, page ix): “There is a strong evidence base showing that work is generally good for physical and mental health and well-being.” Epidemiological studies indicate that large groups of employees have substantial health resources even at higher working age. In Germany, these are professionals, managers, engineers, and technicians (see Fig. 2, Burr et al. 2013), which constitute about 20% of the working population. Many of the people belonging to them have enjoyed work throughout their working life and have personally benefitted from the diverse health and quality of life-enhancing effects that work can have. For these groups the prolongation of the working life would have a completely different impact than for the first. In consequence, evaluative and normative statements on the timing of retirement (“success,” “reward,” “failure,” “threat”) need at least to differentiate between social and occupational groups.

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## Conclusions

This article investigates social inequalities in the transition from work to retirement in times of extending working lives and political activation policies. Broad evidence from different fields of academic research clearly indicates that current EWL policies bear substantial risks for increasing social inequalities and current empirical studies confirm the concerns with recent data. The inequalities discussed concern health, finances, and social participation, factors which are strongly interrelated. There is agreement that current EWL strategies instead of exacerbating social inequalities ought to consider and buffer them, but that this is not the case. Based on their analyses and findings, some authors propose policy measures, most frequently differentiated retirement ages opening financially sustainable exit pathways for those with poor health. Others recommend the potential of life course views when implementing measures aimed at extending working lives. Also, policy measures such as improvements of work quality, qualification, and job security are recommended.

Whether such suggestions will be considered in future EWL regulation remains open. The evidence collected in this article implies substantial additional social costs to be expected in the case of continued disregard of the impact of EWL on the social divide. In a recent European research report, concerns were expressed that EWL policies might fall short if they did not consider the group of older workers that

cannot comply with the increased demands imposed on them (Beach and Bedell 2019).

Occupational health, gerontology, and sociology share a wide overlap of interest when observing the social inequality in the transition from work to retirement. However, not surprisingly, most publications on the issue stem from sociology, gerontology, and social epidemiology and traditionally not from the occupational health research community. Nevertheless, occupational health will increasingly have to deal with the consequences of extended working lives on enterprise level – not only in practice but also in research. Occupational health research will have to put more emphasis on prevention of disintegration, on reintegration, and not least on the increasing number of older workers involuntarily tied to their work although they cannot work, don't want to work, and/or shouldn't work. This article summarizes the researchers' evidence and view on the underlying and ongoing societal conditions and processes. Future contributions by occupational health research should also add evidence on how EWL policies translate into practice in organizations and into trajectories of work and employment in later working life. In either case, the issue of social inequality should be in the focus of attention.

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# From National Labor and Social Policies to Individual Work Stressors

# 8

## Multilevel Concepts, Evidence, and Challenges

Thorsten Lunau, Mariann Rigó, and Nico Dragano

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### Abstract

Although national labor and social policies influence the labor market and, thus, the employment relationships of entire populations, there has long been a lack of research regarding the possible influence of these policies on health-threatening work stressors. In recent years initial studies have been published providing results on the relationship between policy measures and work stressors. So far, some evidence has been obtained that labor and social policies could have a direct impact on work stressors. This impact was particularly evident among socially disadvantaged persons, such as people with a low level of education. In addition to these direct effects on working conditions, initial results have shown that the company level plays a significant role in translating policy measures into

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_34](https://doi.org/10.1007/978-3-030-31438-5_34)

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operational practice. Along with these effects of policy measures on the distribution of work stressors, first studies have also provided evidence that policy measures can mitigate the adverse health effects of psychosocial work stressors.

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**Keywords**

Macro-level · Labor and social policies · Reconciliation policies · Welfare state · Work stress · Cross-national studies

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**Introduction**

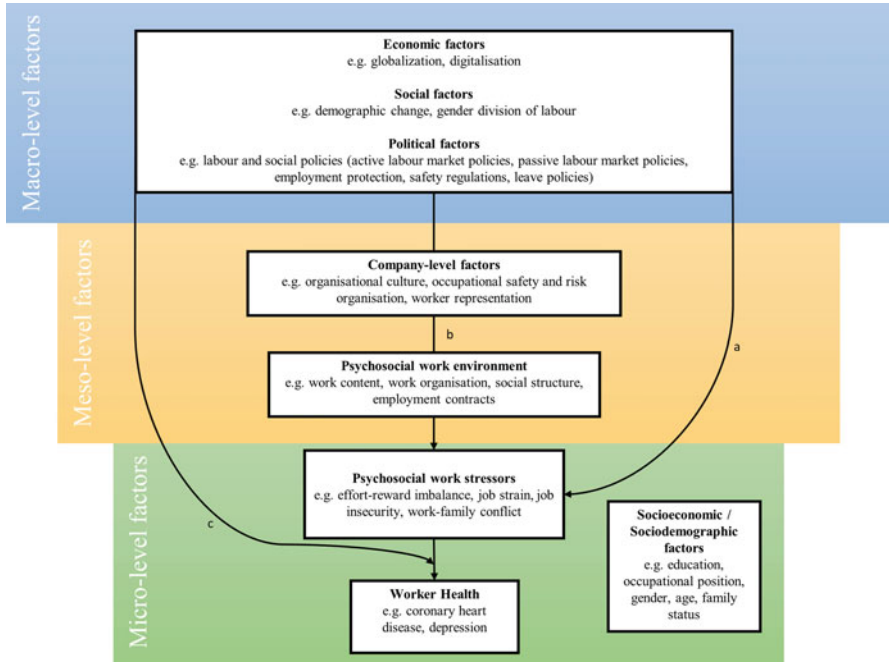
Psychosocial work stressors can cause stress reactions and stress-related diseases such as cardiovascular diseases and depression (Dragano et al. 2017; Kivimäki et al. 2012; Rugulies et al. 2017). Against this background, it is of high interest to understand how such conditions emerge and what can be done to promote less demanding work environments. A common view which underlies most strategies of workplace health promotion is to focus on the affected person and on factors close to the person such as employee-supervisor relations, the particular work tasks, or characteristics of the micromanagement such as work organization or work time regulations. Recently, this narrower framework has been extended to a broader view which additionally comprises higher levels of societal macrostructures.

So far, the impact of societal macrostructures on health and health-related risk factors has primarily been investigated in public health research about general issues of population health (Bambra 2011; Bergqvist et al. 2013). This line of research has revealed that complex links between macro-level factors and individual health exist. It is plausible that this is also the case for occupational health in general and for work-related stressors (and the respective health outcomes) in particular (Bambra 2011). In this chapter we will give a short introduction into this new field of research with a focus on psychosocial work stressors and on labor and social policies as macro-level factors. In a first step, we will discuss general considerations on how macro-level factors influence psychosocial work stressors at the individual micro-level. We will then discuss the research methods that are used to empirically study cross-level associations and summarize results from the small number of empirical studies conducted so far.

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**A Conceptual Framework of Macro-Meso-Micro Links in Work Stress Research**

In this chapter, possible connections between macro-, meso-, and micro-levels will be discussed. To structure this attempt, we propose a model of level-specific factors and their cross-level associations in the context of work stress research. The model is a simple – yet preliminary – conceptual framework which illustrates the complex relations between the different levels. It is based on general theories on micro-macro



**Fig. 1** Conceptual framework of macro-meso-micro links in work stress research

links in public health and in particular on frameworks for research on psychosocial work environments and health (Bambra 2011; Rugulies 2019). Macro-level factors highlighted in the upper field of Fig. 1 include economic, social, and political factors, which may have an influence on meso- and micro-level factors. In this text we will exclusively investigate the influence of political factors, specifically national labor and social policies. These policies are of interest due to their explicit aim to regulate the labor market, improve living and working conditions, and provide adequate social protection in critical situations, e.g., in case of job loss. This does not imply that economic, social, or technological global trends are not important. However, in view of the complexity of the whole cross-level approach and the lack of research about several aspects, we decided to focus on political factors, which are directly determined by national policy-makers.

At this point four different types of labor and social policies seem to be of particular relevance: protective policies, integrative policies, labor legislations, and reconciliation policies.

*Protective policies* provide financial support in critical life situations. Examples of protective policies are passive labor market policies (PLMP). Those refer to public expenditures aiming to compensate individuals, e.g., in case of wage loss in a period of unemployment. In countries with a high compensation, individuals and families can maintain a normal and socially acceptable standard

of living regardless of their market performance. This is referred to as “decommodification” in the literature (Esping-Andersen 1990).

*Integrative labor policies* attempt to integrate disadvantaged people into working life. Central measures in this area are active labor market policies (ALMP) with the aim of preventing unemployment and promoting employment. Examples of ALMP expenditures are vocational training programs, which can lead to a better match between job seekers and the job vacancies (Immervoll and Scarpetta 2012). The possibility of expanding one’s own skills and knowledge over the course of the working life is important in order to cope with the changing demands of the labor market (e.g., digitalisation processes).

*Labor legislations* include legislative regulations at the supranational (e.g., European Union) or national level. In this chapter we will focus on employment protection legislations and occupational health and safety regulations. Employment protection legislations (EPL) comprise rules and procedures concerning the ability of companies to recruit or dismiss employees. EPL regulations are country specific. Occupational safety and health (OSH) regulations deal with aspects of health and safety in the workplace and have a strong focus on primary prevention of hazards including strategies to prevent psychosocial stress at work.

*Reconciliation policies* have the goal of improving the balance between work and family life. They are usually grouped into three broad categories: leave policies (maternity, paternity, and parental leave), public childcare provision, and the use of flexible work arrangements. These macro-measures aim to integrate women into the labor market and promote combining work and family responsibilities. Leave policies enable parents to care for children while allowing them to keep their jobs. Public childcare possibilities take over caring responsibilities while parents work. Flexibility policies concerning working time enable parents to adjust their working hours to family responsibilities (den Dulk and Peper 2016).

The field positioned in the middle of Fig. 1 refers to the company level (meso-level) where the owners and/or the management decides about contracts and modes of employment and determines how work is organized, how social relations are shaped, and to what extent specific national policies relevant for psychosocial working conditions are implemented (e.g., safety regulations, work time regulation). Importantly, decisions at company level directly affect the working conditions of the employees.

Although objective working conditions are determined at company level, the way they translate into perceived work stressors occurs at the level of the individual. Besides, individual perceptions are possibly influenced by demographic characteristics (e.g., educational background or family status). Therefore, we included psychosocial work stressors at the micro-level in Fig. 1.

The following sections will present some thoughts on how the different levels may link up and provide examples of the pathways delineated in Fig. 1.

First, labor and social policy measures may have a direct effect on the individual level (**Path a**). For instance, protective policies (e.g., unemployment benefit) provided by the welfare state may have an impact on the individual perception of

working conditions (Dragano et al. 2011). In countries with high decommodification, it should be easier to quit a job with a high burden of work stress compared to countries where this security is provided only to a limited extent. On the other hand, in countries with low decommodification, the individual depends strongly on gainful employment, and the person may even be forced to accept unfavorable working conditions (Esping-Andersen 1990). In countries where workers are trained and integrated better into the labor market (integrative policies), there should also be a better match between skills and job requirements. This may also have an influence on psychosocial work stressors as higher levels of control and gratification can be expected under these conditions. In addition, job security perceptions can be hypothesized to be higher in countries with more pronounced integrative labor market policy measures (Chung and Mau 2014; Chung and van Oorschot 2011). These measures improve workers' skills, employability and provide search services to find a suitable job in case of job loss. Another example is strict EPL that should make it more difficult for employers to dismiss employees. The intended aim is to create greater security for employees, and this may reduce subjective feelings of job insecurity – which is a well-studied stressor and risk factor for health. Furthermore, reconciliation policies with the goal of improving the balance between work and family life are directly related to working conditions that may lead to work-family conflict. The aim is to integrate women into the labor market, promote combining work and family responsibilities, and, therefore, diminish work-family conflicts.

It has been documented in the literature that the impact of the above-defined national policies might be more pronounced among certain demographic or employee groups. For instance, it is possible that socially disadvantaged groups (e. g., employees with a low level of education or a low occupational status) particularly benefit from labor and social policies (Lundberg 2009). Some studies have shown that especially persons in low socioeconomic positions (SEP) report high psychosocial work stress (Brunner et al. 2004; Wahrendorf et al. 2012), and it can be hypothesized that certain labor and social policies could reduce these socioeconomic differences by improving working conditions.

The influence of the labor and social policy context on working conditions is not always direct. In several cases – and regarding labor policies such as OSH regulations in particular – policies must be implemented at the company level (**Path b**). This is referred to as the meso-level, which lies between the political context and the individual working conditions. For psychosocial work stressors, these are, for example, specifications on how these types of working conditions should be taken into account within the framework of the workplace risk assessment. In Germany, for instance, the Occupational Health and Safety Act was made more concrete in 2013, with the result that the law specifies that psychosocial work stressors must be included in workplace risk assessment. However, there are considerable differences in the implementation of this regulation between countries (Lunau et al. 2017) and between companies within countries (Beck and Lenhardt 2019). There are still many companies, especially smaller ones, that do not implement a psychosocial risk assessment. In addition, there are considerable differences in how companies take



psychosocial work stressors into account in their risk assessment. Some companies fulfill the complete cycle of the risk assessment, from the assessment of the exposure to psychosocial work stressors to the development of appropriate measures for the documentation and evaluation of the results. In other cases, psychosocial work stressors are only marginally taken into account. Also in the area of work-family conflict, the effect of social policy measures such as parental leave entitlement might depend on how accepted these measures are in the companies in which the employees work (Allen et al. 2014).

In addition to having an impact on the distribution of psychosocial work stressors, labor and social policies have been found to affect the association with health outcomes (**Path c**). It has been suggested that the resources provided by the welfare state mitigate the adverse health consequences of psychosocial work stressors (Bambra 2011). For example, in case of strong protective policies (e.g., high levels of unemployment benefits), associations between job insecurity and poor health may be less pronounced, because of the financial security that employees can rely on. In addition, ALMP including training of employees can lead to a better job match (Immervoll and Scarpetta 2012), and it can be assumed that this enables employees to better cope with occupational stress through a better match between occupational requirements and their own skills, thus avoiding a prolonged activation of the stress system. The assumption is therefore that the burden of stress on employees is less pronounced in countries with strong labor and social policy programs than in countries where this is not the case.

To summarize, there are convincing theoretical arguments that macro-level labor and social policies determine the emergence of work stressors at the individual level at least to some extent. The following sections will now provide an overview on how this hypothesis has been empirically tested so far. First, we introduce the empirical design of studies followed by the operationalization of policies. Then, we present recent findings from published studies.

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## Empirical Studies

### Research Designs

Empirical research on the influence of macro-level factors on individual work stressors are dominated by cross-sectional studies with a static view on the association between national policies and experienced psychosocial workloads. Papers in this line of research compare data from different countries to examine whether differences between countries in policy frameworks are related to psychosocial work stressors. For instance, using the fourth wave of the European Social Survey and a sample of 22 countries, it has been shown that in countries which provide substantial unemployment benefits, fear of job loss is less pronounced among workers compared to countries where workers are less protected (Chung and van Oorschot 2011). This approach requires cross-national data measured in a comparable way among all included countries. In this line of research, the most often

analyzed databases are the Survey of Health, Ageing and Retirement in Europe (SHARE), the European Social Survey (ESS), the European Working Conditions Surveys (EWCS), or the International Social Survey Programme (ISSP).

Empirical indicators for labor and social policies are available from international databases such as the OECD or the Eurostat. Due to the hierarchical structure of the data in cross-country studies (individuals nested within countries), analyses are mostly carried out using multilevel regression methods. Using such a method allows us to distinguish between the country (second level) and the individual level (first level). The variations of psychosocial work stressors between the countries can be examined separately from the variations within the countries. It can then be tested whether the indicators measured at the country level (so-called macro-level indicators, e.g., expenditure on ALMP for every country) are associated with individual working conditions and to what extent the included macro-level indicators can explain the differences of psychosocial working conditions between countries.

So far, there are only a limited number of studies with a longitudinal perspective. In a longitudinal perspective, it is possible to link changes in national policies to changes in outcome variables and to establish possible causal directions of the association between policies and individual work stressors. A study by Lubke and Erlinghagen (2014), for instance, has documented that past changes in ALMP are linked to levels of perceived insecurity, and Kohlrausch and Rasner (2014) confirm a longitudinal effect of workplace training on the same work stressor.

Quasi-experimental studies in single countries represent another group of research design. These studies usually analyze the impact of legal interventions and compare changes in experienced workloads among those affected by the intervention to changes in experienced workloads among those being not affected. This research framework has been mostly used in the field of economics and psychology (e.g., Kotsadam and Finseraas 2011; Lovász and Szabó-Morvai 2019).

## **Operationalization of Labor and Social Policies**

Two main approaches are used to operationalize labor and social policies. The first is to create homogeneous groups of countries in a way that they represent comparable regimes. The second approach focuses on country-specific indicators of the single political measures.

The welfare state regime approach established by Esping-Andersen (1990) is the most prominent way to classify groups of countries. Esping-Andersen classified welfare states and their labor and social policy programs mainly on the basis of the two concepts of decommodification and defamiliarization. Decommodification is “the degree to which individuals, or families, can uphold a socially acceptable standard of living independently of market participation” (Esping-Andersen 1990: 37). The degree of decommodification is determined by public transfers such as unemployment benefits or health insurance. Defamiliarization refers to the support that welfare states offer to the citizens to ease the burden of caring responsibilities of families. Examples for this type of welfare state support are public childcare or

parental leave opportunities. Based on these two concepts, the model by Esping-Anderson distinguishes between three welfare regimes: the social democratic, the conservative, and the liberal. The level of state-dependent welfare support in the liberal regime is comparatively low with a low level of decommodification and defamiliarization, which means that individuals are dependent on market forces and that the state does not offer resources in difficult situations (e.g., unemployment or caring of a family member). Examples for this regime type are the United Kingdom or the United States of America.

The conservative regime type is based on Bismarck's social security model. It is characterized by social support benefits based in particular on insurance status. Although social assistance benefits do provide a certain degree of decommodification in this regime type, the status differences are maintained by linking the amount of benefits to previous insurance contributions paid as part of the regular salary. Another feature is the subsidiarity principle, which states that the state only intervenes when welfare benefits of the family are exhausted (Esping-Andersen 1990). Examples of this type of regime are France, Germany, and Switzerland.

Compared to the other regime types, the social democratic regime is defined by a high degree of decommodification. It is characterized by a universalist approach, i.e., access to social support services is not as strongly regulated as in conservative and liberal regimes. The role of the state is at the forefront here, and targeted efforts are being made to redistribute benefits between social groups and to weaken dependence on the family (Esping-Andersen 1990). This is also reflected in offers for reconciling work and family life, which are particularly strongly developed in the social democratic regime (den Dulk et al. 2012). In addition, active labor market policy measures, such as further training courses, are often found in these countries which aim to integrate disadvantaged people into working life. Classical examples are Sweden, Norway, Finland, and Denmark.

Esping-Andersen's theory was extended by several scholars. An essential addition is the extension of the regime classification by further clusters. Ferrera (1996) added the southern type of welfare state, represented by Italy, Greece, Portugal, and Spain. This is also referred to as a rudimentary welfare system, since welfare state services and the level of decommodification are weak. In the southern states, the family plays an important role in the provision of welfare services. In addition to the southern type, the Eastern European states have often been defined as independent welfare states (Bambra and Eikemo 2009). After the decline of the communist regime, there was a shift in these countries towards market-oriented political frameworks more akin to the liberal welfare state regime. Countries of this type include Poland, Hungary, and Slovenia. However, Eastern European countries are very heterogeneous, which has led to the existence of some typologies that divide Eastern European countries into several regimes (Adascalitei 2012).

The welfare typology approach is based on the assumption that certain countries have similar policy ideas and programs. One advantage of this approach is that it attempts to take into account the totality of interrelated policy measures and to order them into distinct regimes (Dahl et al. 2013). However, this approach has also been criticized, since the classification of countries into global welfare regimes does not

allow precise statements to be made about individual and more concrete policies. Therefore research on the effects of the political context on health and health inequalities drew increasingly on country-specific indicators (Bergqvist et al. 2013).

This second approach, based on country-specific indicators, uses distinct elements of national labor and social policies (Dahl et al. 2013). One possibility is to rely on expenditure for labor and social policy purposes. An example of this approach is to measure a country's expenditure on income support for the unemployed. The fact that higher expenditure can also be caused by major social problems has been described as a disadvantage of the expenditure approach (Gilbert 2009). For example, if a country spends relatively high amounts on PLMP, this may be due to a very high unemployment rate and does not necessarily mean that individuals receive high benefits in the event of unemployment. In the meantime, however, approaches have been developed to mitigate at least some of these limitations. One possibility is to include the need for certain benefits in the indicators. If we stick to the example of income support, one possibility would be to use the expenditure on income support in relation to the unemployment rate (Dahl et al. 2013).

Institutional approaches focus on a country's specific political regulation. In contrast to the expenditure approaches, it is not examined how much money is invested in certain areas, but rather the characteristics of welfare state institutions and programs are analyzed. Examples of indicators are the selection criteria that someone must meet in order to receive certain support services (Dahl et al. 2013). Reconciliation policies are usually described by their institutional features, such as characteristics of maternal/parental leave entitlements or childcare eligibility criteria. The length of the paid leave period, compensation levels during the leave periods, and childcare coverage rates are the policy measures most often used (Cukrowska-Torzewska 2017; den Dulk and Peper 2016).

These various approaches, which have been developed and applied in particular in welfare state research, have been applied in recent years in the context of public health research and are now increasingly used in studies on associations between labor/social policies and work stressors (Bergqvist et al. 2013).

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## Empirical Results

Using the previously described designs and operationalizations, an increasing number of empirical studies investigated micro-macro links. The presentation of the results is grouped according to the outcome used, i.e., the type of work stressor investigated. Usually, well-established concepts are used to measure individual work stressors, namely, effort-reward imbalance, job strain, job insecurity, and work-family conflict. According to the effort-reward imbalance model, working conditions are stressful if they are characterized by high efforts and low rewards at the same time. Job strain is the combination of high demands and low control at the workplace, as defined by the demand-control model. Another stressful working condition is job insecurity. It has been shown that it is enough just to worry about losing a job in order to endanger one's health. Another work-related factor with potential impact

on health is work-family conflict. Previous research has widely documented the negative effects of these work stressors on health (Kivimäki et al. 2012; Rugulies et al. 2017; Virtanen et al. 2013).

### **Work Stress Models (Effort-Reward Imbalance, Job Strain)**

Research by Dragano et al. (2011), Lunau et al. (2015), and Wahrendorf and Siegrist (2014) examine the effects of national-level policies on established work stressors, such as job strain or effort-reward imbalance (**Path a**). Some studies analyze work stress outcomes by welfare regimes, while others explore the association of work stressors with specific policy measures. In studies which used cross-country datasets and multilevel analyses, work stress is usually found to be highest in southern and eastern welfare regimes (Dragano et al. 2011; Wahrendorf and Siegrist 2014) and lowest in Nordic countries. Studies by Lunau et al. (2015) and Wahrendorf and Siegrist (2014) also showed that in countries where a higher level of investment is made in ALMP and PLMP, there are lower levels of work stress than in countries where only smaller amounts are invested. The study by Lunau et al. (2015) additionally examined how specific national social and labor policies affect the socially unequal distribution of work stressors. The study showed that in almost all countries, there is a social gradient in the distribution of psychosocial work stressors. Specifically, this means that employees with a low level of education have higher work stressors than people with a high level of education. However, there were substantial differences in the level of inequalities between the countries suggesting that a high level of investment in PLMP and ALMP substantially diminished differences in the prevalence of work stressors between high and low educated workers. This points to the key role that policies may play in supporting disadvantaged social groups and, thus, in reducing social inequality. Some studies, besides analyzing the association of national-level policies and adverse working conditions, also test whether the impact of adverse working conditions on health is more or less pronounced in the presence of specific national policies (**Path c**). For instance, Lunau et al. (2013) showed that the association between psychosocial work stressors such as effort-reward imbalance or low control and depressive symptoms was stronger in countries with lower investment in labor policy measures than in countries where comparatively high investments are made.

### **Job Insecurity**

The perception of job insecurity is known to be a stressor with negative effects on mental and somatic health (Virtanen et al. 2013). Previous cross-sectional research found that employment security is higher in countries with more generous labor and social policies (**Path a**). It has been also documented that unemployment assistance in the form of ALMP/PLMP spending is more beneficial in improving people's job and labor market security perceptions than strict employment regulations (Chung

and van Oorschot 2011; Hipp 2016). According to data from 2008 to 2009, employees in Eastern and Southern countries have the lowest level of job security and people in Nordic countries have the highest (Chung and van Oorschot 2011; Mau et al. 2012).

While some studies use simple one-item measures of perceived job insecurity, others look more closely on subdimensions of the construct like cognitive job security (the perceived probability of job loss), perceived labor market security (the availability of alternative opportunities) or affective job security (not being worried about potential job loss or finding a new job). Hipp (2016) used these three definitions of job security and found that perceived labor market and affective job security are positively associated with ALMP and PLMP expenditures, while ELP had no general significant impact, controlling for GDP level and unemployment rate. The relationship between job security and EPL becomes significant if the proportion of temporary workers is high in a country. One possible explanation is that strict protection against dismissal only helps permanent employees if at the same time a sufficiently large group of employees is provided with a significantly lower level of protection.

Besides institutional factors captured by national social and labor market regulation, macroeconomic conditions have been found to be important determinants of job security perceptions. When comparing the relative importance of general macroeconomic (e.g., GDP, unemployment rate) and institutional (unemployment assistance and employment protection) factors, studies often conclude that economic forces have a more influential role in explaining employment insecurity perceptions (Chung and van Oorschot 2011; van Oorschot and Chung 2015).

However, as noted by Chung and Mau (2014), the finding of the minimal impact of institutions may be explained by the general focus of these studies. Analyzing different segments of the labor market may uncover the effects of such policies more precisely. There is, for example, the evidence that the labor policies are especially helpful for more disadvantaged groups (e.g., lower educated) in the labor market. Along this line Kohlrausch and Rasner (2014) examine the impact of training on job insecurity by educational level. They find that training seems to have a stronger additional value in increasing the feelings of security for the lower educated group, and this group seems to enjoy a more lasting effect of training. This result emphasizes the importance of training and other related measures in enhancing perceived insecurity, especially for the more disadvantaged groups of the labor market.

Most of the published studies on job insecurity use cross-sectional data and analyze between country differences in macro-level factors and individual job security. So far there are only a few papers using longitudinal information to address the relationship between macro-level factors and job security. Lubke and Erlinghagen (2014) introduce a longitudinal dimension into their analysis by using 1-, 3-, 5-, or 10-year changes in the macroeconomic and institutional variables besides including their levels. While the level of ALMP expenditure has not been found to be significant, the 1-year change in ALMP was negatively associated with cognitive job insecurity. In the case of labor market insecurity, results vary by

educational background indicating beneficial impacts of ALMP increases among those who are lower educated. The specifications using GDP and its past changes show that the current level of GDP and past changes in GDP are distinct determinants of job insecurity; however, current level of GDP has a stronger impact.

Some papers also examine the moderating role of labor market policies (**Path c**). For instance, Carr and Chung (2014) found that labor market policies (the generosity of LMPs) attenuated the negative relationship between job insecurity and life satisfaction. However, a newer study by Voßemer et al. (2017) could not confirm these results. In this study the effects of insecure jobs on well-being and health were not attenuated by active and passive labor market policies.

## Work-Family Conflict

Detrimental health impacts of work-family conflict have been widely documented in previous literature (Allen et al. 2000). A growing body of literature is examining how reconciliation policies influence employees' work-family conflict.

Research is diverse both in terms of study design and results. Some papers analyze work-family conflict responses by national social policy context represented by bundles of policies and use countries as proxies for national policies. These studies mostly specify countries or country groups as providing generous or scarce state support. It is usually assumed that more extensive and generous support leads to a lower level of conflict (**Path a**) (Crompton and Lyonette 2006; Gallie and Russell 2009; Strandh and Nordenmark 2006). Results of some studies are in line with this assumption. For instance, Lunau et al. (2014) have shown that the best overall work-life balance is reported by men and women in the Scandinavian welfare regime. Scandinavian countries (Finland, Norway, Denmark, Sweden) have a reputation for providing generous state support to facilitate the balance between employment and private life. Similarly, comparing work-family conflict scores in France, Britain, Portugal, Finland, and Norway, Crompton and Lyonette (2006) found that work-family conflict was lower in Finland and Norway. On the other hand, Gallie and Russell (2009) documented high work-family conflict scores for women in the other two Scandinavian countries, in Denmark and Sweden. While work-family conflict scores among women appear to be not only driven by the generosity of national policies and, thus, differ even between Scandinavian countries, reported scores by men seem to be more in line with the generosity of state support. In the case of women, higher work-family conflict scores are explained by women's longer working hours in Sweden and Denmark (Gallie and Russell 2009; Strandh and Nordenmark 2006). Therefore, one possible explanation for the contradictory findings (of higher work-family scores in some Scandinavian countries) might be the selection of women into more demanding jobs in countries where reconciliation policies make this possible. While such policies improve women's labor market participation, they might be less successful in combining work and family life. On the other hand, women may withdraw from the labor market in countries with insufficient support to combine work and family demands (den Dulk and Peper

2016). Therefore, it is important to view work-family conflict scores not isolated from labor market participation rates.

Besides national policies, a variety of other factors may have a role in shaping work-family outcomes. As pointed out before, working conditions, especially long working hours, have been found to be a key factor (Gallie and Russell 2009; Strandh and Nordenmark 2006). Besides, the gap between gender views and actual gender attitudes might also have an influence. This is the so-called gender-culture hypothesis (den Dulk and Peper 2016; Steiber 2009). For instance, in the case of France, family pressures and the dissatisfaction of French women with the traditional division of household work have been suggested as a possible explanation for high work-family conflict among women (Crompton and Lyonette 2006). A similar explanation has been put forward in the case of Eastern European countries (Hungary and Czech Republic) providing generous parental leave entitlements (Strandh and Nordenmark 2006). In these countries traditional gender views are coupled with traditional division of household work and thus lower work-family conflict scores.

There are only few studies investigating the impact of distinct policy elements. Examples are Stier et al. (2012) and Notten et al. (2017). The common finding of these papers points to the key role of childcare provisions for children up to 3. This was the only policy measure showing significant negative association with work-life conflict scores. Allen et al. (2014) add a meso-level indicator and analyze the relationship between national leave policies including paid sick leave and work-family conflict outcomes (**Path a**) considering family-supporting work environment as a potential mediator (**Path b**). The authors found a significant impact of paid sick leave. In addition, at the meso-level, family-supporting work environments showed a beneficial impact on an individual's work-family conflict perceptions.

A few existing studies examine the impacts of reconciliation policies by specific demographic groups. Work-family conflicts are often assumed to differ by educational or skill level. Individuals with a higher educational background are conventionally assumed to have higher-skilled jobs with more complex tasks and higher levels of responsibility leading to longer and unusual working hours, which are only partly offset by a greater sense of control in these jobs (Gallie and Russell 2009). Besides, there might be differences in household work division, career, and family goals by educational or skill level (Notten et al. 2017). These individual differences make it likely that reconciliation policies will have a differential impact by educational or skill level. Notten et al. (2017) investigating the differential impact of distinct family policies by demographic groups found that the positive impact of childcare provisions for young children in reducing work-family conflict is mostly driven by the lower educated. Higher educated parents were found to benefit less from childcare provision policies.

In sum, previous evidence highlights the important role of extensive childcare facilities for young children as being the key policy measure to decrease work-family conflict (Cukrowska-Torzewska 2017; Notten et al. 2017; Stier et al. 2012). However, perceived work-life conflict outcomes are also shaped by social norms on gender roles and the division of household work (Crompton and Lyonette 2006; Gallie and Russell 2009). Besides, several studies have emphasized the important



role of working conditions, especially long working hours (Crompton and Lyonette 2006; Gallie and Russell 2009). Therefore, when designing national reconciliation policies, alleviating the burdens related to adverse working conditions should receive special attention. Similarly to other outcome measures analyzed in the previous sections (job strain, job security), more disadvantaged groups are likely to benefit more from reconciliation policies in terms of reducing their work-family conflict.

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### Summary: Main Pathways

Even though the research on the influence of political measures on psychosocial working conditions is still rather limited, previous work provides initial insights into this topic. So far, some evidence has been obtained that policy measures have a direct impact on psychosocial working conditions (**Path a**). However, the results to date also indicate that cross-level effects are complex and differ by type of policy. The positive impact of certain policy measures on psychosocial work stressors was particularly evident among socially disadvantaged persons. Therefore, an analysis at the population level may mask associations between policies and work stressors. Analyses by subgroups have a key importance in investigating the impact of national policies.

It also became clear that economic factors, such as GDP, play an important role and should be considered in the analyses. For the domain of work-life balance, the expected results did not always appear so far. While consistent findings exist that policy measures aimed at improving the work-life balance increase the employment opportunities of women (Cukrowska-Torzewska 2017; Lovász and Szabó-Morvai 2019), the respective studies do not always report a better work-life balance for women in these countries.

In addition to these direct effects on working conditions, initial results have shown that certain policy measures also have an influence on the companies (meso-level) and, via this, on the working conditions of the employees (**Path b**). One example is reconciliation policies such as the entitlement to parental leave. Though being entitled, it is possible that employees do not request parental leave due to less family-supportive company atmosphere.

In addition to the above described effects of policy measures on work stressors, initial studies have also provided evidence that national policies can mitigate the adverse health effects of psychosocial work stressors (**Path c**).

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### Outlook/Research Gaps

Although first interesting results on the effects of labor and social policies on psychosocial work stressors are available, there are still important research gaps that should be considered in future studies. Overall, the number of studies is still limited, and several cross-country studies include only a small number of countries.

The latter hampers the generalizability of the findings and may inflate the results of multilevel models which require a larger number of level 2 units (i.e., countries) to calculate unbiased estimators.

A further problem with previous studies is that the temporal perspective has seldom been taken into account; thus questions of causality are difficult to answer. Cross-country cross-sectional analyses have provided initial evidence that certain policy measures are associated with working conditions. However, it is not possible to draw a clear conclusion in the sense that the implementation or increase of policy measures leads to an improvement in working conditions. For this purpose, longitudinal studies which link change at the political and at the individual level are needed. Approaches that combine both the cross-country and temporal dimensions are especially promising as they combine the advantages of the other two types of research (Fairbrother 2014).

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Social Distribution of Occupational Hazards](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work-Life Balance: Definitions, Causes, and Consequences](#)

**Acknowledgment** This project was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) by two grants (grant number 392132829“LU 2211/1-1” and grant number 384210238 “FOR2723” [individual grant number DR 751/1-1]).

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# International Organizations as Drivers of Change in Occupational Health

# 9

Carin Håkansta

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## Abstract

This chapter presents the background, mandate, and reason for existence of international occupational health organizations and the role they play as drivers of change. The main focus is on the International Labour Organization (ILO) and the World Health Organization (WHO) because they are intergovernmental and thus more influential than nongovernmental organizations. International occupational health organizations have played important roles in the struggle for peace and social justice for more than 100 years. Today they face dilemmas and problems, including silo-thinking and insufficient funding, but there are also reasons for optimism, such as growing political recognition of decent work and occupational health. The recent suggestion to make occupational safety and health one of ILO's fundamental principles and rights at work is potentially

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_36](https://doi.org/10.1007/978-3-030-31438-5_36)

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very promising for the future of international occupational health organizations as drivers of change.

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### Keywords

International organizations · Work · Health · Occupational health · Multilateral system · United Nations · ILO · WHO

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## Introduction

Upstream determinants of occupational health are the business of most UN agencies as well as other international and regional organizations. To narrow down the scope, this chapter only discusses organizations with an explicit focus on occupational health. In the multilateral system, the most prominent of those are the International Labour Organization (ILO) and the World Health Organization (WHO). Although other organizations figure in the chapter, focus is mainly on the ILO and the WHO.

The chapter is based on secondary sources complemented by material from the international organizations themselves. Due to the scarcity of solid research on the role of international organizations in the area of occupational health, the chapter rests to a considerable extent on primary sources or secondary literature.

The first two sections of the chapter describe features and history of the main international occupational health organizations. The third and fourth sections present challenges and dilemmas facing the organizations as well as reasons for optimism. The chapter ends with a summary.

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## International Organizations as Drivers of Change

### International Organizations in the Field of Occupational Health

There are two UN agencies with an explicit mandate to work with occupational health: the International Labour Organization (ILO) and the World Health Organization (WHO). In Table 1, the WHO has been categorized as intergovernmental organization, whereas the ILO has been categorized as both intergovernmental and nongovernmental. This is due to the tripartite setup of the ILO (explained below). The International Social Security Association (ISSA) and the International Commission of Occupational Health (ICOH) are nongovernmental.

### The International Labour Organization

The ILO was founded in 1919 and became a specialized agency to the United Nations in 1946. It has a mandate to deal with labor and social policy, and in 2019 it had 187 member states. The ILO has a secretariat in Geneva, Switzerland, the International Labour Office, and field offices in more than 40 countries.

**Table 1** Four key international organizations in the area of occupational health

Name	Founding year	Intergovernmental organisation	Nongovernmental organisation	Members
ICOH	1906			Occupational health professionals, institutes and national associations, health and medical associations
ILO	1919			Governments, employers and workers with equal representation in the Governing Body and the International Labour Conference
ISSA	1927			Social security institutions
WHO	1948			Governments represented in the World Health Assembly

Occupational safety and health is coordinated from the Labour Administration, Labour Inspection and Occupational Safety and Health Branch.

ILO has two features distinguishing it from other UN agencies. First, the “tripartite” structure, which means that it is governed by ILO’s three constituents: governments, employers’, and workers’ organizations. Despite this, the budget system is similar to other UN organizations and fully paid by governments. Policy making takes place during the annual International Labour Conference and the meetings of the governing body. Second, the core activity is standard setting. International labor standards are legal instruments drawn up and adopted by the ILO’s constituents, setting out basic principles and rights at work. They consist of conventions, which are legally binding international treaties, and recommendations, which are non-binding guidelines. Countries that ratify conventions must apply them in national legislation and report on their application at regular intervals. ILO assists member countries in the application of standards and in taking steps toward ratification of conventions. In 2019, there were 189 ILO conventions and 205 ILO recommendations. Tripartite committees regularly issue other codes and guidelines. In addition, a number of declarations have been adopted.

Occupational safety and health experts in the regional offices and at headquarters guide and assist member countries to promote safety and health at the workplace. They help governments respond to consequences of gaps in occupational health protection and establish a preventive culture in labor policy (Sweepston 2018). They also contribute to broader issues affecting health-related human rights, such as violence at work, vulnerable workers, and social insurance (Ibid.). In addition, they take initiatives beyond traditional workplace measures, such as coordinating the latest Globally Harmonized System of Classification and Labeling of Chemicals (Takala, personal communication 2019). Knowledge dissemination is another area of activity, including four consecutive editions of the ILO Encyclopaedia of Occupational Health and Safety and a Masters course in Occupational Health at ILO’s International Training Centre in Turin, Italy, 2016–2017 (Sweepston 2018).



Nearly half of ILO's labor standards deal directly or indirectly with safety and health. Of those, more than 40 conventions and recommendations deal specifically with occupational safety and health (ILO 2019a). The conventions can be classified in four groups (ILO, 2019b, p.16): a. Dealing with fundamental principles and governance of occupational safety and health; b. Encompassing general principles and outcomes (such as those relating to management of occupational safety and health, labour inspection and welfare facilities); c. Related to specific risks (such as ionizing radiation, asbestos and chemicals); d. Related to specific sectors or branches of work activity (such as agriculture, constructing and mining). The conventions dealing with fundamental principles and governance of occupational safety and health are:

- Occupational Safety and Health Convention, 1981, No. 155 (67 ratifications in 2019)
- Occupational Health Services Convention, 1985, No. 161 (33 ratifications in 2019)
- Promotional Framework for Occupational Safety and Health Convention, 2006, No. 187 (46 ratifications in 2019)
- Labour Inspection Convention, 1947, No. 81 (148 ratifications in 2019)

### **The World Health Organization**

The WHO is a specialized agency of the United Nations dealing with international public health. It was established in 1948 and is headquartered in Geneva, Switzerland. Its predecessor, the Health Organization, was (just like the ILO) an agency of the League of Nations. According to the WHO, every person has the right to health, which is defined as a state of complete physical and mental well-being and not only absence of disease and infirmity. The constitution defines the goal of the organization as “the attainment by all people of the highest possible level of health.” WHO decision-making takes place in the annual World Health Assembly.

Within the WHO, occupational health is placed in the public health section. It has merged with environmental issues in the unit Social and Environmental Determinants of Health. According to the director of public health (Neira 2019), the workplace is the setting of “. . .many WHO global health initiatives on environment, and climate change, non-communicable diseases, mental health, tuberculosis, HIV and other communicable diseases.”

Several hundred collaborating centers around the world, including research institutes and universities, assist the WHO in carrying out the organization's programs. Some of those are WHO collaborating centers for occupational health.

### **The International Social Security Association**

The ISSA, founded in 1927, had more than 330 member organizations in 158 countries in 2019. The organization supports its members in social security administrations through guidelines, services, and support, including prevention of occupational injuries and diseases. ISSA's member institutions collaborate with the ILO in organizing the World Congress on Safety and Health at Work every 3 years.

Another initiative is the “Vision Zero campaign” which aims at integrating safety, health, and well-being at all levels of work in an effort to prevent occupational accidents and disease.

### **The International Commission of Occupational Health**

The ICOH was founded in 1906 in Milan, Italy, by Canadian and European occupational health scientists and physicians. It is a professional association of occupational health experts, national safety and health institutes, as well as health and medical associations. The aim of ICOH is to promote worldwide research on occupational diseases and disseminate available knowledge to the scientific community, physicians, practitioners, employers, and workers. For example, many professional bodies use ICOH’s ethical principles and related guidelines. Every 3 years, ICOH holds a large world congress, and at regular intervals, 35 scientific committees in various fields of occupational health research organize smaller conferences and expert meetings. Several ICOH initiatives have been adopted by the Joint ILO/WHO Committee on Occupational Health, such as the elimination of silicosis and of asbestos-related diseases (Takala, personal communication 2019).

### **The Origins: From Social Peace to Decent Work**

Social unrest and concern about workers’ health and safety caused international occupational health organizations to emerge in the early 1900s. This section briefly describes their emergence and evolution. For ease of reference, the section has been divided into three periods of time.

#### **1900 - World War II: – The Beginning of International Occupational Health Organizations**

In the early twentieth century, growing concerns about workers’ health and safety led nations to introduce regulatory control and enforcement. New infrastructure for occupational health emerged, as well as a range of specializations in areas such as regulation, engineering, labor administration, and social insurance. In the sciences, specializations developed in occupational medicine and hygiene.

In 1906, scientists and physicians in Canada and 11 European countries founded the **International Commission on Occupational Health (ICOH)**. The aim of the organization was to promote research on occupational diseases worldwide and disseminate occupational health knowledge to the scientific community, to physicians and practitioners, as well as to employers and workers. A major driver to establish ICOH was the loss of many workers in building the tunnels under the Alps that connect countries south of the Alps with Central Europe. When the ILO was founded, ICOH argued that it should have a strong emphasis on occupational health and safety.

In 1919, the **International Labour Organization (ILO)** was founded as an agency of the League of Nations through the Treaty of Versailles. The constitution

of the ILO says that universal and lasting peace can only be established if it is based upon social justice and that occupational health is an important part of this:

“...conditions of labour exist involving such injustice, hardship and privation to large numbers of people as to produce unrest so great that the peace and harmony of the world are imperilled; and an improvement of those conditions is urgently required: as, for example, by the regulation of the hours of work, including the establishment of a maximum working day and week, the regulation of the labour supply, the prevention of unemployment, the provision of an adequate living wage, *the protection of the worker against sickness, disease and injury arising out of his employment*, the protection of children, young persons and women, provision for old age and injury, protection of the interests of workers when employed in countries other than their own, recognition of the principle of freedom of association, the organisation of vocational and technical education and other measures. . .”(from the preamble of the ILO Constitution, 1919. Italic inserted by author)

At the beginning, the ILO approached occupational health problems as purely technical issues (Swepston 2018), and focus was on standard setting and scientific activities (ILO 2019a). The ILO established international conventions that would stimulate action to reduce occupational health risks neglected in many national legislations (LaDou 2003). When addressing dangerous substances and processes, the ILO disseminated knowledge from more developed to less developed economies, where dangerous materials tend to be used long after they are regulated and forbidden in industrialized countries (Swepston 2018). In the 1930s, the first ILO Encyclopaedia of Occupational Health and Safety was issued.

In 1927 a third international organization emerged: the **International Social Security Association (ISSA)**. The roots of ISSA can be found in mutual insurance as a response to illness, unemployment, disability, and old age among nineteenth-century European industrial workers.

### **Post-World War II 1989: Emerging and Increasingly Influential International Occupational Health Organizations**

Social peace and poverty alleviation were high on the agenda during the reconstruction of war-torn countries after the World War II. In 1944, the ILO members adopted the Declaration of Philadelphia, outlining the key principles for future ILO work. The Declaration stresses the importance of fighting poverty for sustained peace: “...poverty anywhere constitutes a danger to prosperity everywhere; ... the war against want requires to be carried on with unrelenting vigour within each nation, and by continuous and concerted international effort. . .” After the establishment of the **United Nations** in 1945, ILO became a specialized UN agency in 1946.

In 1948, yet another specialized UN agency was formed: the **World Health Organization, WHO**. The constitution of the WHO includes references to occupational health. Priorities during the first years included the control of malaria, tuberculosis, and sexually transmitted infections, as well as improvement of maternal and child health, nutrition, and environmental hygiene.

Occupational health was thus on the agenda of the ILO as well as the WHO. Following a recommendation in the first World Health Assembly, the Joint ILO/

WHO Committee on Occupational Health was set up. In 1950, the first meeting of this committee was organized. In the post-World War period, ILO activities in the field of occupational health were characterized by standard setting and guidance. Due to the overlap between the ILO and the WHO, the ILO abandoned strictly medical aspects, focusing instead on prevention and the combination of safety and health in one program (ILO 2019a).

The post-World War II period was also a time of decolonization. The Declaration of Philadelphia, from 1944, contains two much quoted principles: “labour is not a commodity” and “all human beings, irrespective of race, creed or sex, have the right to pursue both their material well-being and their spiritual development in conditions of freedom and dignity, of economic security and equal opportunity.” There was rapid growth of members in the UN system, and ILO membership grew from the original 45 countries in 1919 to 121 countries in 1971, and by then developed countries had become a minority (ILO 2019b).

In 1969, on its 50th anniversary, the ILO was awarded the Nobel Peace Prize.

Until about 1960, ILO conventions in the field of occupational safety and health were detailed, narrow in scope, and focused on safety and protection. From 1970 they began to focus more on prevention and deal more broadly with health as well as safety. Rather than seeking to adapt the workplace to workers, focus was now on protecting workers from hazards in the workplace (Swepston 2018). Another novelty was that governments and the ILO adopted a “systems approach” to deal with occupational safety and health. This meant that occupational safety and health was no longer seen only as a matter for governments, employers, and trade unions but also as a public health concern. Implied in this thinking was the need to develop a culture of safety and health at work as well as elsewhere. The paradigm shift culminated in the 1980s with the Occupational Safety and Health Convention, 1981 (No. 155), which calls for a dynamic, policy-based approach to occupational safety and health prevention, covering all workplaces and all risks. At the same time, psychological and psychosocial aspects of work gained attention, leading to discussions, research, and policy making related to occupational stress, psychosocial hazards, workload, and work organization (Rantanen 2011).

Another feature of occupational safety and health activities at the ILO were programs to build up capacities and capabilities in developing countries, concentrating on factories inspectorates and the establishment of safety and health institutes (Takala, personal communication 2019).

### **1990s–2019: Struggle for Relevance in a Globalizing World**

The post-Cold War era was characterized by growing hegemony of neoliberal economics and preoccupation with global inequalities. In order to remain influential, international occupational health organizations had to reinvent their role.

In the 1990s, health and working conditions figured in the debates about whether, and if so how, a “social clause” should be included in the international trade system. In 1996, the World Trade Organization was established. To the disappointment of some, the WTO did not get a mandate to negotiate sanction-led enforcement of labor standards. To compensate, the ILO launched two new initiatives: the Decent Work

Agenda and the Declaration on Fundamental Principles and Rights at Work (hereafter the 1998 Declaration). The purpose of both was to renew the organization and respond to the adverse consequences of globalization.

The Decent Work Agenda was launched in 1999 to raise the profile of the ILO, to make Decent Work a strategic international goal, and to promote fair globalization. Decent Work, promoting “opportunities for women and men to obtain decent and productive work, in conditions of freedom, equality, security and human dignity,” became the guiding concept in reinventing the ILO. It was reiterated and expanded upon in the 2008 Declaration on Social Justice for a Fair Globalization and has gained popularity also in other organizations over the years.

The 1998 Declaration introduced a new approach. It selected eight “fundamental conventions” (or “core conventions” or “core labor standards”), together covering the following four principles:

1. Freedom of association and the effective recognition of the right to collective bargaining
2. The elimination of forced or compulsory labor
3. The abolition of child labor
4. The elimination of discrimination in respect of employment and occupation

According to the 1998 Declaration, all member states, regardless if they have ratified the fundamental conventions or not, are obliged to respect, promote, and realize the *four principles*. A consequence of this new focus on principles was a turn of the organization toward “soft law.” Another was that a few selected conventions from then on received more attention than the others did. It has been debated whether this turn of the ILO was beneficial or not, a discussion we will return to later in the chapter.

Parallel to the initiatives to reinvent and promote the ILO, a number of activities were launched to raise awareness about occupational health and place it on the international policy agenda. In 1994, the WHO collaborating centers in occupational health adopted the Declaration on occupational health for all. The purpose was to make health at work a priority issue. In 2003, the ILO adopted a global strategy on occupational safety and health, including a World Day for Safety and Health at Work, the first of which was held on 28 April 2003.

Yet another promotional initiative was the World Congress on Safety and Health at Work, organized by the ILO in collaboration with ISSA every 3 years to raise the visibility of ILO and occupational safety and health. At the 2008 World Congress, the Seoul Declaration was adopted, calling for a preventative safety and health culture. At the 2011 World Congress, the Istanbul Declaration was adopted, calling for a healthy and safe working environment as a fundamental human right as well as a societal responsibility.

Content wise, the ILO has continued with the systems approach of occupational safety and health, resulting in the ILO guidelines on safety and health management systems (ILO-OSH 2001) and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187). Focus in the WHO, according to

the Workers' Health: Global Plan of Action 2008–2017 (WHO, 2007), is interventions and occupational health services for the primary prevention of occupational and work-related diseases and injuries, particularly for workers in the informal sector, agriculture, small enterprises, and migrant workers. There are also efforts to assess the disease burden attributable to occupational risks (WHO 2018a).

In 2019, ILO's Global Commission on the Future of Work suggested a Universal Labour Guarantee, allowing fundamental workers' rights and a set of basic working conditions, including safe and healthy workplaces to all workers (ILO 2019b). This Commission was set up in 2017 to commemorate the 100th anniversary of the ILO. It also suggested that occupational safety and health should be added to the 1998 Declaration as a fundamental principle and right at work. This suggestion was picked up and included in the draft text for an ILO Centenary Declaration, circulated before the 108th session of the International Labour Conference in June 2019 (ILO 2019c, p. 7). The proposal became the most contended and discussed issue during the discussion about the Centenary Declaration (ILO 2019d). The workers' group was in favor; the employers' group was against. Government representatives were divided in the issue, with some being hesitant and others, notably the EU, strongly in favor. In the end a compromise was found in the words "Safe and healthy working conditions are fundamental to decent work" (ILO 2019e). However, the battle to elevate occupational health to a core labor standard seems not yet to have been lost. A resolution adopted at the same time as the Centenary Declaration requests the governing body to: "...consider, as soon as possible, proposals for including safe and health working conditions in the ILO's framework of fundamental principles and rights at work" (ILO 2019f).

## Dilemmas and Challenges

Critics have asked why not more is being done to prevent occupational accidents and diseases considering the substantial economic losses they cause the global economy (Takala et al. 2014, 2017). Others (Lucchini and London 2014; LaDou et al. 2018) question the capacity of the WHO and the ILO to protect workers' health, considering the weak coverage of occupational safety and health legislation in many countries and high number of workers exposed to risks. This section takes a closer look at some of the circumstances that complicate the work of international occupational health organizations.

### The Enforcement of Labor Standards

International law is per definition difficult to enforce and ILO's labor standards are no exception. Countries that do not ratify ILO's conventions are of course not bound by them, and only a fraction of the ILO member states have ratified the core occupational safety and health conventions. Nations that ratify and subsequently do not respect the conventions will only be "named and shamed" in the supervisory system as there is no system for sanctions. Critics suggest that this "lack of teeth" limits the usefulness of

ILO standard setting, whereas its defenders claim that the system works well (Hughes and Haworth 2011; Swepston 2018; Tapiola 2018).

### **Soft Versus Hard Law**

The WHO does not formulate legal instruments, with the exception of the Framework Convention on Tobacco Control. Instead, the WHO promotes ideas through resolutions in the World Health Assembly. ILO's shift in focus from traditional labor standard setting to a more promotional "soft law" approach with the 1998 Declaration set off a debate between those in favor and those against. Hughes and Haworth (2011) discuss this debate and call those in favor of "the ILO school" and those against "the Strategic Misdirection School."

The ILO School defends the turn from hard to soft law, arguing that the ILO needed this renewal and that all hard law has started as aims, claims, and resolutions, including the 1948 Universal Declaration of Human Rights, which is the foundation of all subsequent human rights law (Hughes and Haworth 2011; Tapiola 2018). Philip Alston (2004), one of the critics in the Strategic Misdirection School, argues that ILO's shift to soft law instruments is detrimental because of the vagueness of "core labor standards," both in terms of their connection to all labor standards and to their enforcement. In his opinion, the shift has significantly debilitated the ILO. Lucchini and London (2014) also criticize what they perceive as a shift from accountability to flexibility in the interpretation and application of labor standards, with negative consequences for occupational health, especially in developing countries.

### **Lack of Funding and Attention**

UN agencies are financed from different sources. Regular budget funding consists of membership fees from governments to finance everyday operations. The size of the share of regular budget resources allocated to the area of occupational health is vital for the capacity of the WHO and the ILO to act. Occupational health has been marginalized in the WHO as well as in the ILO in terms of manpower, resources, and attention, making the UN, in the words of LaDou et al. (2018, p. 2), "largely a paper program [which] provides an opportunity for most countries to simply agree to the principles, and to essentially ignore the problem." This severely impedes the development of occupational health at global level (Ibid; Takala 1999).

According to Lucchini and London (2014), one reason for reduced levels of ILO funding allocated to occupational safety and health is the concentration of resources rendered to the fundamental conventions listed in the 1998 Declaration on Fundamental Principles and Rights at Work.

A sign, or perhaps a consequence of reduced attention to the area, is that both the WHO and the ILO have merged their units of occupational health with other units. In the WHO, occupational safety and health is in the public health department, where it has been merged with environmental health. In the ILO, occupational health has been merged with labor administration into the "Labour Administration, Labour Inspection and Occupational Safety and Health Branch."

### **Conflict of Interest**

In addition to the regular budget, UN agencies receive extra-budgetary allocations consisting of voluntary contributions from governments, private foundations, enterprises, and organizations. The share of extra-budgetary funding in the total budget is growing. In the ILO, some 45% of the total resources are extra-budgetary (ILO 2019g), and in the WHO, about 80% of total resources derive from other sources than regular budget (LaDou et al. 2018). One feature of extra-budgetary funding is that it is often ear-marked for a particular question, topic, or region. As a consequence, UN agency activities sometimes differ from the plan of action or strategy. In addition to this dilemma is the risk of conflict of interest, i.e., a situation in which an organization has competing interests or loyalties. There are rules prohibiting conflict of interest, e.g., the tobacco industry funding initiatives related to tobacco control, but it is a difficult area to control. For example, extra-budgetary funding from an enterprise is sometimes channeled through another organization, making it difficult to detect the original source.

### **Organizational “Silos” at the International and National Level**

Silos are the unintentional result of disparate discourses and different mandates. Occupational safety and health intersects with the discourses and mandates in a range of policy areas, leading to problems of silos, i.e., systems, processes, or departments that operate in isolation from others.

At the national level, silos are best known for causing problems of cooperation between various government ministries. In occupational health, this is a recurrent problem as the area tends to lie somewhere between the mandates of the ministries of labor and health. Lack of collaboration between health and labor sectors is, in the words of the WHO chief of Public Health, “a major obstacle for addressing health and safety challenges from a changing world of work” (Neira 2019).

At the international level, occupational health is considered a human right as well as a social and environmental issue (Swepston 2018). The ILO and the WHO both strive for healthy workplaces, but their overarching goals and mandates differ: whereas the WHO formulates its mission in striving for health for all, the ILO aims for decent work for all. Another difference is their expertise. Officials and experts in the WHO tend to have a background in health and medicine. The ILO typically have officials with a background in, e.g., law, economics, engineering, and, exceptionally, health. As a result the two agencies have different approaches, leading to different discourses, e.g., in the case of workplace stress. The ILO describes stress as a psychosocial factor that should be integrated in a systems approach to healthy work environments; the WHO describes stress as an issue of mental health and noncommunicable disease. The differences in approaches and discourses may seem trivial but may complicate inter-agency collaboration.

It is worth noting that there are several UN initiatives in place to make the UN family more coordinated, e.g., the United Nations Economic and Social Council



(ECOSOC), the United Nations Development Programme (UNDP), the Millennium Development Goals (MDGs), and the Sustainable Development Goals (SDGs). In a comment about the SDGs, ILO Director General Ryder recognized the dilemma of silos between organizations: “The most obvious danger is a retreat into institutional silos based on an overly defensive or narrow interpretation of each organization’s mandate” (ILO 2016, p. 16).

There are also silos within the organizations, notably the organizational division in the ILO between occupational safety and health and working conditions. Psycho-social health has been an integral part of occupational health since the 1980s (Rantanen 2011) and is closely related to working conditions. Current changes in working life (ILO 2019b) would make it sensible to pool the resources and expertise in the occupational health branch with those in the “Inclusive labour markets, labour relations and working conditions branch,” where focus is on work organization, nonstandard forms of employment, working time arrangements, and the informal economy. The same divide between occupational health and working conditions is present in the EU between the European Foundation for the Improvement of Living and Working Conditions (Eurofound) and the European Agency for Safety and Health at Work (EU-OSHA). Tradition and legislation are possible explanations. Collective bargaining determines terms and conditions of employment, typically wages and working time. Occupational safety and health is more often regulated by law.

### **The Dilemma of Exclusion**

In an ideal world, all vested interests are included in the decision-making processes of international organizations. In practice, this can be difficult to realize. The WHO does not allow any decision-making power to non-state actors in the World Health Assembly. In the ILO, the participatory process of social dialogue is part of the institutional tripartite setup - also in decision-making. However, although collaborating with civil society organizations, universities, and nongovernmental organizations (ILO 2019a), the ILO does not allow any other actor than its three constituents to vote in the decision-making processes. As a consequence, ILO’s tripartism excludes the interest of many workers and employers (Hagen 2003). First, far from all workers and employers are members of the organizations representing their nation in the ILO. Second, low and sinking rates of union density, e.g., below 10% in France and Turkey (ILO 2017), add to this problem of representation. Third, workers’ and employers’ organizations with a vote in the ILO do not represent self-employed or the most vulnerable workers, e.g., migrants and informal workers. Most workers in the world are active in the informal economy, not the formal economy. According to ILO estimates, two billion workers, or 61% of the global workforce, pursued economic activities in 2016 that were not or insufficiently covered by formal arrangements of law or practice (ILO 2019h). Informality is higher among men (63 percent) than among women (58 percent) and is especially widespread among own-account workers, a.k.a. self-employed (Ibid).

## **International Organizations as Drivers of Change: Reasons for Optimism**

Despite the challenges listed in section three, there are reasons for optimism as occupational health seems to attract increased attention at international level.

### **Increased Pressure for Inclusiveness**

Despite the exclusiveness of tripartism described earlier, calls to include more stakeholders are becoming stronger, e.g., in the Sustainable Development Agenda which talks of “participation of all countries, all stakeholders and all people” (UN 2015 preamble). Since 2008, the ILO has a formal policy to increase collaboration with other non-state actors. However, there is concern among the ILO constituents that their historically privileged position will become marginal or merely formal (ILO 2016, p. 6). According to the ILO Director General: “. . .resistance to any perceived loss of sovereignty might be expected to be strongest at the ILO because, exceptionally, decision-making there is made by employers and workers, as well as by governments” (ILO 2016, p. 17).

Change is nevertheless likely to be slow. Although the Global Commission on the Future of Work refers to all workers including self-employed, those in the informal economy and work in the platform economy, their recommendation is to stick with ILO’s tripartite format rather than “tripartite plus” (ILO 2019b).

### **Stability in Turbulent Times**

International occupational health organizations emerged in periods of social and political unrest. Today, nationalism, intolerance, and populist movements are gaining ground in many countries. International organizations serve as a reminder of why international collaboration is necessary and that stable institutions are needed to cope with an increasingly interdependent world of large-scale migration, climate change, and global trade and investment (UN 2015; ILO 2019b).

The tripartite structure of the ILO, though not without its critics, adds to this stability. The influence and voice of workers and employers balance the power of governments. Furthermore, tripartism leads to a more realistic and effective standard-setting and supervisory progress than is possible in organizations that are purely intergovernmental (Swepston 2018).

### **Collaboration Despite Silos**

Another source of stability is the tradition of collaboration in the field. The Joint ILO/WHO Committee on Occupational Health has existed nearly seven decades and allows representatives from the secretariats as well as members of both UN agencies to meet and discuss priorities and ways to increase collaboration in topics including education, training, scope, and organization of occupational health as well as reporting and establishment of permissible limits (ILO and WHO 2003).

One area of international collaboration is promotional activities to place occupational safety and health higher on the political agenda. As already mentioned, the

ILO launched the World Day for Safety and Health at Work in 2003. Today the WHO and governments alike promote the day. Another example is the World Congress on Safety and Health of Work, a joint effort by ISSA and the ILO.

Another area of collaboration is data and statistics. The WHO and the ILO are developing a joint methodology to allow estimates of the health impacts of occupational risks based on the WHO burden of disease studies and ILO labor statistics. It will be used to monitor progress of SDG 8 and related targets of other SDGs (ILO 2019b; WHO 2019) and will also enable assessments of the impact of precarious employment on quality of life, health, and equity (Benach and Muntaner 2007; Benach et al. 2014).

There are also inter-agency collaborations in specific areas, such as chemical safety. The ILO and the WHO have invited UNEP, UNCTAD, UNITAR, and the World Bank to join the International Programme on Chemical Safety (Takala, personal communication 2019). Health workers is yet another area which received attention in 2014 during the outbreak of Ebola, as more than 100 health workers were infected and some died (Lucchini and London 2014). The WHO, the ILO, and the OECD collaborate in a program focusing on decent working conditions and making jobs more attractive to young people in the health sector (WHO 2018b).

### **Increasing Recognition of Occupational Health**

The suggestion in 2019 to make occupational safety and health a fundamental principle and right at work was not new. The idea had been put forward already at the Copenhagen World Summit for Social Development in 1995, when core labor standards were first discussed. Back then, developing countries rejected the idea of including occupational safety and health, arguing that this could be used against them for protectionist reasons. The suggestion was subsequently reiterated in the 2011 Istanbul Declaration (Tapiola 2018) and by the Global Commission on the Future of Work (ILO 2019b, p. 39). There is also pressure from within the ILO, as its constituents have expressed a wish for more attention to the elimination of problems related to occupational safety and health (ILO 2018, p. 15).

Elevating occupational safety and health to a fundamental principle and right at work may seem of little importance. However, in the light of the attention and resources the ILO has allocated to the 1998 Declaration, there is a fair chance that the area would receive more funds and that more states would ratify the occupational health conventions. The campaigns to promote the 1998 Declaration, combined with monitoring of progress, resulted in a 90% ratification rate of the core conventions (Tapiola 2018).

Recognition of occupational health is also manifest in the 2030 Agenda for Sustainable Development (UN 2015). The ILO (2019a) as well as the WHO (2019) are committed to SDG Target 8.8.: “protect labour rights and promote safe and secure working environments for all workers, including migrant workers, particularly women migrants and those in precarious employment.” It was not always like this. In 1995, the MDGs did not refer to work at all. Only in the 2007 revision of the MDGs, a “decent work target” was added.

Another example of recognition of occupational health was the “High Level Meeting on Non-Communicable Diseases” in the UN General Assembly in 2018, which called for providing healthy and safe working conditions, tobacco-free workplaces, and wellness initiatives and improving health coverage of workers (WHO 2018c).

### **Occupational Health and the Social Dimension of Globalization**

Occupational health is also a recurring theme in the ongoing discussion about a social floor or social pillar to protect those with unacceptable working conditions. In 2019, the Global Commission on the Future of Work suggested a Universal Labour Guarantee to cover all workers regardless of contractual arrangement or employment status and give them fundamental workers’ rights, a living wage, maximum limits on working hours, and protection of safety and health at work (ILO 2019b). The WHO supports the idea, which complements their goal of universal health coverage (Neira 2019). In the European Union, the European Pillar of Social Rights promotes similar ideas.

### **Summing Up**

This chapter has presented the background, mandate, and reason for existence of international occupational health organizations and the role they play as drivers of change. Some of these organizations originated more than a century ago in the struggle for peace and social justice. The International Labour Organization (ILO) and the World Health Organization (WHO) are the two UN agencies with mandate to work in the field of occupational safety and health.

Challenges to international occupational health organizations include low levels of funding and lack of attention to the area. Dilemmas in the legal sphere include enforcement of labor standards and a debate between proponents and opponents of the effects and benefits of “soft law.” Another challenge is the complexity of occupational health, spanning various disciplines and policy areas, as differences in expertise and discourses can lead to misunderstandings and complicate collaboration. Yet another challenge is the tripartite nature of the ILO, as it excludes the representation of many workers and employers.

Positive signs include the role of international organizations as stabilizing forces in times of rapid change and ongoing inter-agency collaboration despite obstacles. Another positive sign is the growth in international recognition of decent work and occupational health since the millennium shift, not least through the UN Sustainable Development Goals. The suggestion to make occupational safety and health one of ILO’s fundamental principles and rights at work is promising for the future of the field at international level.

A recurrent theme in the chapter is the complex nature of occupational health as a policy area, which could explain the lack of research on the effectiveness of occupational health organizations as drivers of change. Such research would be complex and need a truly multidisciplinary effort, yet be of great use to policy makers at national and international level.

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## **Part II**

# **Meso-level Determinants of Occupational Health**



# Social Distribution of Occupational Hazards 10

Diego Montano

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## Abstract

In the present chapter, an overview of the social distribution of major occupational hazards is provided. To this end, the prevalence and/or incidence rates of selected chemical, physical, and organizational hazards across occupational categories are presented. The chapter focuses on chemical substances related to cancer and allergic reactions; physical hazards such as noise, biomechanical forces, and ultraviolet radiation; and organizational hazards related to job demands, decision latitude, working time arrangements, and leadership. In addition, several mediators and moderators of exposure to occupational hazards are discussed which encompass occupational inequalities of hazard control, simultaneous exposure to multiple hazards, and behaviors and attitudes toward safety procedures. The chapter ends with some concluding remarks for future research and practice.

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_1](https://doi.org/10.1007/978-3-030-31438-5_1)

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**Keywords**

Occupational hazards · Health inequalities · Chemical, physical, and psychosocial hazards · Working conditions

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**Introduction**

The social distribution of occupational hazards captures the rate with which health hazards occur within and between occupational categories in the labor force. The likelihood of being exposed to specific health hazards is directly associated with specific occupations and results from a series of complex social processes involving technology, systems of economic production, definition of products and services, and several mediators and moderators of exposure to hazards. The aim of the present chapter is thus to provide a general overview of (i) the occupation-specific prevalence and/or incidence of major groups of occupational hazards (chemical, physical, organizational), (ii) some mediators and moderators of exposure to those hazards, and (iii) emerging occupational hazards.

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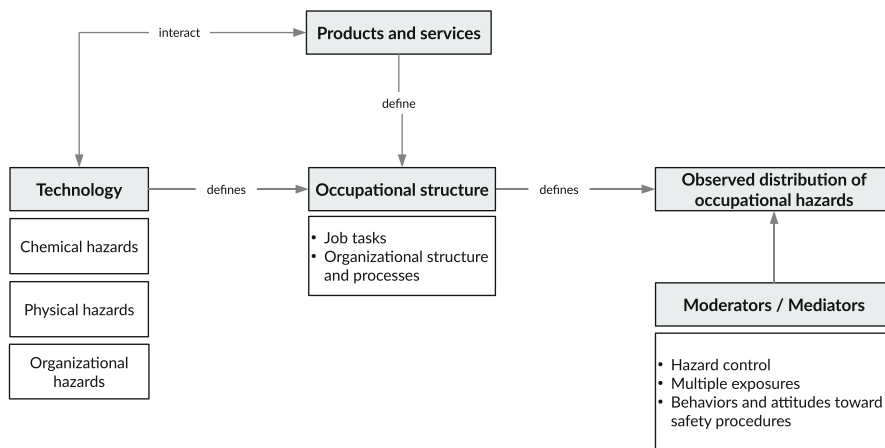
**Socioeconomic Determinants of Occupational Hazard Distribution**

From a historical perspective, the occupational structure of society is not a simple classification of human activities; it is rather the result of economical and political processes determining not only the kind, scope, and intensity of those activities but also the group of individuals carrying them out. Two examples may be illustrative of these processes: the labor allocation system of ancient Rome and the free-market system of the eighteenth century in North America and Europe. In the former case, economic production was performed by free workers, semi-dependent workers, freed workers, soldiers, and slaves in a wide array of occupations including crafts, agriculture, education, and services (Verboven and Laes 2017). However, for the ancient elite writers like Cicero, the social status of most occupations was low, since they implied performing “dirty” job tasks. According to Cicero, for instance, certain occupations (*artes*) such as crafts (*opifices*) and fishery (*piscatores*) were per nature “dirty” (*sordidae*) and, therefore, not appropriate occupations (*liberales*) for the noble and “free” (*liber*) Romans (Cicero 1852, Lib 1, Ch. 42). On the other hand, in the free-market ideology of the eighteenth century, as represented by the writings of Adam Smith, the distribution of occupations in society is due to a natural “propensity to truck, barter, and exchange one thing for another” (Smith 2007, Ch. 2, p. 16), which results in a specialization of human labor, i.e., an occupational structure. In the free-market ideology, “free servants” must pay themselves for the wear and tear of their labor capacity (Smith 2007, Ch. 8, p. 67), according to the “cleanliness or dirtiness, the honorableness or dishonorableness” arising from the nature of the occupation itself (Smith 2007, Ch. 10, p. 83).

Nonetheless, in both instances, the distribution of occupations parallels the hierarchy structure of society, whereby social groups with less power and social status, i.e., free workers, slaves, or “free servants,” perform job tasks which are per se “dirtier” and thus “less honorable.” This reasoning presupposes the belief that the conditions of work cannot be changed and belong to the inherent “dirtiness or cleanliness” of occupations. Thus, it is perhaps only with the advance of public health concerns and the increase of social struggles in the early eighteenth century in Western Europe that the notion of the “natural dirtiness” of occupations began to be challenged at the level of social policy. In this regard, the seminal work of Bernardino Ramazzini on the occupational diseases (*De Morbis Artificum Diatriba*) at the beginning of the eighteenth century represents a first systematic account on the relationship between production processes and disease incidence. Ramazzini’s work focuses not only on the physical and chemical properties of work materials but also on the whole context of production. Ramazzini’s approach is certainly pointing out to occupational hazards, i.e., the sources of potential adverse effects on workers’ health, which, in the context of production and services processes, are amenable to elimination or reduction.

In the period between the late eighteenth and the end of the nineteenth century, the pace of technological and socioeconomic innovations triggered not only unprecedented changes in the working conditions in the larger world economies but also new areas of research on the nature and scale of occupational hazards, especially in Western Europe. With the expansion of the modern state bureaucracy, the creation of health surveillance institutions (e.g., factory inspectorates across Europe), and the collection of statistical data on occupational diseases and accidents, it was possible to estimate, at least to some extent and for the first time in history, the scale of the distribution of occupational hazards in the major industrial sectors and occupational groups by the beginning of the twentieth century in some European and North American industrial centers.

Despite the increased knowledge of the nature and magnitude of work-related hazards, the improvements in the operational safety of industrial machinery, and the implementation and enforcement of worker protection policies (e.g., Health and Safety at Work etc. Act 1974), large inequalities regarding health and occupational hazards persist across occupations (Mackenbach et al. 2003). As discussed in the sections to follow, these inequalities obey to a series of constraints imposed by social, technological, and physical properties of complex work systems. As depicted schematically in Fig. 1, the observed distribution of occupational hazards can be conceptualized as the consequence of the interplay between (i) the technology required to bring about products and services, (ii) the definition of products and services which in turn may bring about technological innovations, (iii) the resulting job tasks and job goals within the boundaries of the organizational structures and processes, (iv) and a set of mediators or moderators reducing or aggravating the magnitude and intensity of occupational exposures. The specific products and services resulting from a certain technology lay the fundamental framework defining specific occupations (work tasks, routines, etc.) and set the overall conditions of work and the magnitude and quality of risks. Technology encompasses not only



**Fig. 1** Major socioeconomic factors determining the observed distribution of occupational hazards. Schematic representation

work devices, substances, and physical properties but also specific production or service processes (e.g., division of labor), managerial approaches, and business models. The set of mediators and moderators can be specific to a certain society, or even involve global conditions, and may be related to key factors such as simultaneous exposure to multiple hazards, different hazard control approaches, or more complex social-psychological and organizational phenomena concerning safety behaviors and attitudes.

In order to provide an overview of the vast literature on occupational hazards, the present chapter will focus on the distribution of selected occupational hazards which either have serious health adverse effects, such as cancers, allergies, respiratory symptoms, musculoskeletal disorders, or mental health symptoms, or account for a relatively large proportion of exposures. In the present chapter, the occupational structure will be often described by the International Standard Classification of Occupations (ISCO) 2008, which operationalizes an occupation as an aggregation of jobs with highly similar main tasks and duties. By considering the skill levels and skill specialization of occupations, the highest level of aggregation results in ten occupational categories. A more detailed description of the occupations subsumed in these general categories is provided in Table 1 as a reference for the subsequent sections.

## Technology, Products, and Services

### Chemical Hazards

Hazards resulting from the use of chemical compounds in work processes are extremely large. By May 2019, the total number of hazardous substances registered under the European REACH legislation (Registration, Evaluation, Authorization

**Table 1** ISCO 2008 major and sub-major occupational groups (ILO 2012)

ISCO	Major group	Subgroups
1	Managers	Chief executives, senior officials and legislators, administrative and commercial managers, production and specialized services managers, hospitality, retail, and other services managers
2	Professionals	Science and engineering professionals, health professionals, teaching professionals, business and administration professionals, information and communications technology professionals, legal, social, and cultural professionals
3	Technicians and associate professionals	Science and engineering associate professionals; health associate professionals; business and administration associate professionals; legal, social, cultural, and related associate professionals; information and communications technicians
4	Clerical support workers	General and keyboard clerks customer services clerks, numerical and material recording clerks, other clerical support workers
5	Service and sales workers	Personal service workers, sales workers, personal care workers, protective services workers
6	Skilled agricultural, forestry, and fishery workers	Market-oriented skilled agricultural workers; market-oriented skilled forestry, fishing, and hunting workers; subsistence farmers, fishers, hunters, and gatherers
7	Craft and related trades workers	Building and related trades workers, excluding electricians, metal, machinery, and related trades workers, handicraft and printing workers, electrical and electronic trades workers, food processing, wood working, garment, and other craft and related trades workers
8	Plant and machine operators and assemblers	Stationary plant and machine operators, assemblers, drivers, and mobile plant operators
9	Elementary occupations	Cleaners and helpers; agricultural, forestry, and fishery laborers; laborers in mining, construction, manufacturing, and transport; food preparation assistants; street and related sales and service workers; refuse workers; and other elementary workers
0	Armed forces occupations	Commissioned armed forces officers, noncommissioned armed forces officers, armed forces occupations, other ranks

and Restriction of Chemicals) comprises about 22,000 different substances (from more than 140,000 in the market according to the Classification and Labelling Inventory), from which around 7,300 have widespread use by professional workers (European Chemicals Agency 2019). Even though regulations such as the European REACH (EC 1907/2006) or the American Toxic Substances Control Act in the United States aim to improve the protection of human health, the number of substances and their widespread use in particular occupations and economic sectors account for persistent inequalities of hazard exposure around the globe. Since a full assessment of all potential health adverse effects of each chemical compound is not

feasible, occupational physicians and researchers concentrate on about 1,400 chemical substances associated with particularly severe health outcomes such as cancer (carcinogenic substances), sensitization of airways or the skin (sensitizers), systemic intoxication, pregnancy toxicity, and cell germ mutagenicity (reprotoxic and mutagenic substances) (Deutsche Forschungsgemeinschaft (DFG) 2018). For this kind of chemical substances, however, a scientifically based estimate of the maximum workplace concentration values, i.e., concentration with “no observed adverse effect level” NOAEL, has been determined for only about 209 substances by the German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (Deutsche Forschungsgemeinschaft (DFG) 2018). Under the REACH legislation, manufacturers, importers, and downstream users of chemical compounds are required to provide estimates of the so-called derived no-effect level (DNEL), i.e., the level of exposure above which human populations (e.g., workers, consumers) should not be exposed. In spite of the limited knowledge on toxicity, maximum concentration values, and potential exposure scenarios of each chemical compound, several epidemiological studies have estimated the degree of exposure inequality across occupations for some substances or compound groups (for a review see Montano 2014a).

In the 2010 SUMER study in France (Havet et al. 2017b), a random sample of occupational physicians was asked to perform an assessment of employees’ exposure during 1 week to 28 carcinogenic, mutagenic, and reprotoxic (CMR) agents. Assessment of exposure was performed for substances which are known or presumed to have CMR effects on workers’ health according to the International Agency for Research on Cancer (IARC) and the Council Directive 67/548/ECC. A total of 47,983 randomly selected employees consented to participate in the study. In a series of logistic regression analysis, Havet et al. (2017b) investigated the prevalence of exposure to at least one CMR agent, the exposure duration, and exposure intensity (i.e., whether short-term exposure limits were exceeded or not). The most common exposures comprised diesel engine exhaust, mineral oil, wood dust, crystalline silica, and formaldehyde. The results indicated large exposure differences across ISCO occupational categories. In comparison to managers and professionals (ISCO 1 and ISCO 2), the odds ratio (OR) for each exposure indicator (i.e., prevalence, duration, and intensity) is higher for workers in the other ISCO categories, in particular among technicians (ISCO 3), services workers (ISCO 5), and skilled and unskilled blue-collar workers (roughly ISCO 7, 8, and 9) (Havet et al. 2017b). Moreover, trend analyses performed with data from two waves of the SUMER study (2003 and 2010) indicated that these exposure inequalities persist in spite of the overall decline of exposure rates across occupations during that period in France (Havet et al. 2017a).

Similar results were obtained from data of the Italian Information System on Occupational Exposure to Carcinogens (SIREP), a database of measurements of exposure to airborne carcinogens. The most common carcinogenic agents such as hardwood dust, benzene, polycyclic aromatic hydrocarbons (PAH), 1,3-butadiene, and acrylonitrile are usually concentrated among carpenters, chemical processing plant operators, and asphalt workers (Scarselli et al. 2007). Further analyses of the

SIREP database confirmed an elevated odds ratio of being highly exposed to carcinogenic agents among clerical and craft workers (ISCO 4 and 7), machine operators (ISCO 8), and the elementary occupations (ISCO 9) (Scarselli et al. 2018). The increased likelihood of exposure among these occupational groups may partially explain the increased risks at specific cancer sites reported in epidemiological studies. In a large population-based case-control study in Italy, for example, adjusted odds ratios of lung cancer were higher among mostly male workers in the ceramic and refractory brick sector and the occupations within the nonferrous basic industry (Consonni et al. 2010).

The inequality of exposures across occupations reflects to a large extent the type of products, services, and technologies used in the economic activities. Analyses based on the European and Canadian Information System on Carcinogen Exposure (CAREX and CAREX Canada) have revealed that about 32 million workers in the 15 countries of the European Union and 16 million in Canada, respectively, may be exposed to carcinogens, especially to solar radiation, crystalline silica, diesel exhaust, radon, wood dust, lead and inorganic lead compounds, benzene, asbestos, and formaldehyde (Kauppinen et al. 2000; Peters et al. 2015). However, single and multiple exposures pertain primarily workers in construction, manufacturing, transportation and warehousing, retail trade, and agriculture. In a large cross-sectional survey of 27,157 adults in the United States, prevalence rates of dermal exposure to chemicals and frequent exposure to vapors, gas, dust, or fumes at work were most common in the mining industry, construction, manufacturing, agriculture, waste management, accommodation, and food services (Calvert et al. 2012).

Similarly, exposure to sensitizing substances, i.e., substances which can cause allergies mostly of the skin and the respiratory airways (Deutsche Forschungsgemeinschaft (DFG) 2018), is highly concentrated on certain occupational titles and industrial sectors. In Germany, the majority of confirmed cases of occupational obstructive airways disease due to sensitizers in 2003 were found among bakers, hairdressers, wholesalers, retailers, purchasers, and chemical workers (Latza and Baur 2005). Results from a systematic review on occupational exposure to vapors, gas, dust, and fumes and chronic obstructive pulmonary disease confirmed not only increased risks of disease for exposed workers but also dose-response relationships for workers involved in cotton textile, jute processing, farming, grain and animal feed, wood processing, welding, foundry work, coal mining, and non-mining industrial dust (Omland et al. 2014). For hand eczema, a relatively common disease in the population (approx. 9.7% prevalence) associated with burning, stinging, and stinging of the skin (Diepgen et al. 2009), occupational exposures have been estimated at 51% of cases in a multicenter study with 319 patients (Diepgen et al. 2009). Moreover, a more detailed analysis with a sample of 1466 chronic hand eczema patients in Switzerland and Germany indicated large associations between hand eczema and several exposures including wetness, detergents, disinfectants, wearing gloves, solvents, industrial oils, and lubricants (Cazzaniga et al. 2017). These associations were frequently observed in the healthcare sector, hairdressing, cleaning, food processing, and catering, among female workers, and in the construction and metal and chemical sector among male workers (Cazzaniga et al. 2017). The

occupational distribution of exposure to sensitizers leading to hand eczema is also confirmed in patch testing studies (i.e., clinical diagnostic studies) showing larger risks among hairdressers, beauticians, bricklayers, stonemasons, nurses, precision workers in metal and related materials, and health professionals (e.g., Pesonen et al. 2015). Even though job tasks are the major conditions of exposure to allergens leading to contact dermatitis, there are several product- or service-related factors which account for the actual level of exposure. For example, exposure to allergenic rubber chemicals (e.g., thiurams) or biocides and preservatives (e.g., methylisothiazolinone) is not directly related to specific job tasks such as cleaning or laundry work, or painting and varnishing, but to the usage of rubber gloves as protective devices in wet work or paints containing allergenic preservatives, respectively (Pesonen et al. 2015).

## Physical Hazards

Occupational physical hazards can be classified according to the nature of exposure in (1) noise; (2) biomechanical forces, e.g., carrying or moving heavy loads, tiring or painful positions, sitting, and traumas; (3) ionizing radiation, e.g., X-ray and particle radiation; (4) electromagnetic radiation (not ionizing), e.g., lasers, ultraviolet, or infrared radiation; (5) temperature (including high or low temperatures of solids and liquids); and (6) electricity. In occupational settings, noise, biomechanical forces leading to injuries, musculoskeletal disorders or neurological symptoms, and electromagnetic radiation such as solar radiation are the most common exposures (EU-OSHA 2009, 2010). In the United States, prevalence estimates based on self-reported data of hazardous workplace noise exposure (measured as “speaking in a raised voice”) resulted in high rates among vehicle and mobile equipment mechanics, construction and mining workers, transportation and material moving, warehousing, and utilities (e.g., Tak et al. 2009). In another study from Norway investigating the associations of occupation and disabling hearing loss of more than 35 dB hearing threshold elevation, the age-adjusted prevalence ratios of hearing loss for men were largest among wood workers, miners, linemen, construction workers, and workshop mechanics (Engdahl and Tambs 2009). For women, high prevalence rates were observed among bakers, nursing care workers, engineers, and technicians. Moreover, the positive associations between occupation, noise exposure, and hearing loss have been also observed in prospective studies. With data from a sample of construction workers in the United States in a 10-year follow-up period, it was found that the hearing threshold levels increased by approximately 2.5–3 dB for an additional 10 dB noise exposure (Seixas et al. 2012). Similar results were obtained with a large sample of construction workers in Denmark in which not only the overall hearing threshold levels increased but also were more pronounced at higher frequencies from 0.19 dB to 0.99 dB per year at 2 kHz and 8 kHz, respectively, in a 4-year follow-up period (Leensen and Dreschler 2014).

Trend analysis of data from the European Working Conditions Survey (EWCS) between 1995 and 2010 reveals that the inequalities of exposure to physical risk

factors remain consistent and highly concentrated in specific occupational groups. Workers in the EWCS reporting being exposed “all the time” and “almost all the time” to either low or high temperatures, working in tiring or painful positions, carrying or moving heavy loads, repetitive hand or arm movements, and vibrations from hand tools and machinery are usually agricultural workers (ISCO 6), craft workers (ISCO 7), plan and machine operators (ISCO 8), and elementary occupations (ISCO 9) (Montano 2014b). A comparable pattern of exposure to biomechanical hazards such as carrying heavy loads, repetitive work, painful or tiring postures, and uniform arm or hand movements was observed in Switzerland where the prevalence exposure rates among the lowest social class (i.e., occupations in production and low education) in comparison to the highest social class (i.e., supervisors and managers with high education) were approximately fivefold (Hämmig and Bauer 2013). Additional analyses of the EWCS data on the prevalence ratios of back pain and neck/upper limb pain indicate higher risks among mobile plant operators; market-oriented skilled agricultural and fishery workers; extraction and building trade workers; precision, handicraft, printing, and related trade workers; and drivers (Farioli et al. 2014). Similarly, a large population-based Norwegian study revealed higher cross-sectional prevalence ratios of low-back pain, neck-shoulder pain, and arm pain among routine manual workers, skilled and unskilled workers, and workers usually performing heavy physical job tasks (Mehlum et al. 2008).

Even though the results obtained from studies based on self-reported musculoskeletal symptoms may under- or overestimate the level of exposure, they agree to some extent with studies based on physician diagnoses. For example, in a physician-based study in the United Kingdom, diagnoses of musculoskeletal diseases reported by occupational physicians and rheumatologists were analyzed by occupation, anatomical region, and job task (Chen et al. 2006). For upper limb diseases, higher rates were observed among clerical, craft-related (e.g., builders, decorators, fitters, welders, and textile machinists), and machine work. For neck and back disorders, craft-related and machine workers had higher prevalence rates, together with professional workers, especially nurses. Tasks associated with upper limb disorders were fine hand work (e.g., keyboard work) and forceful grip (e.g., guiding/holding building tools), neck/back with heavy lifting, and lower limb disorders with standing and walking and heavy lifting. From these results it can be seen that the incidence of musculoskeletal diseases is higher for job tasks which characterize the major occupational groups with higher exposure rates to biomechanical forces.

Furthermore, excessive exposure to ultraviolet radiation (UVR), i.e., electromagnetic radiation of wavelength 100–400 nm, is considered by the IARC to cause different types of skin cancer. Common sources of UVR are solar radiation and some technologies used in dye and paint-drying techniques, microbial inactivation in the food industry, in welding processes (e.g., arc welding and gas welding), and tanning devices (EU-OSHA 2009). In a meta-analysis of cohort and case-control studies investigating the relationship between occupational UVR exposure and cutaneous squamous cell carcinoma, it was found that workers exposed to UVR have increased cancer risk in comparison with nonexposed workers (Schmitt et al. 2011). For the labor force in the EU-15 countries, the exposure estimates of the CAREX database to



solar radiation in the period 1990–1993 amount to approximately 8.9 million exposures, with workers employed in agriculture and hunting, construction, public administration and defense, and land transport accounting for about 5.7 million exposures (Kauppinen et al. 1998). In more detailed analysis of occupational UVR exposure, large differences across occupational groups have been identified (for a review see Modenese et al. 2018). In a population-based study in France, UVR exposure assessed by satellite data and self-reported information on time, duration, and place of outdoor work for 889 individuals resulted in larger URV doses among gardeners and landscapers, construction workers, agricultural workers, culture and social workers, and industrial workers (Boniol et al. 2015). On the contrary, lowest UV exposure levels were estimated for managers (ISCO 1), professionals (ISCO 2), and clerical and support workers (ISCO 4) (Boniol et al. 2015).

Concerning occupational injuries, reported estimates from North America and Europe indicate an overall decline of injury incidence rates. In the United States, the incident rates of injury and illnesses show a steady decline from about 80 in 1992 to about 55 injuries in 2002 per 1000 full-time workers (Subramanian et al. 2006). In France and Germany, the long-term trends of incidence of occupational accidents per 1000 workers decreased from 118 in the year 1955 to 38 in 2008 (Serres 2010) and from 110 in the year 1960 to about 23 in 2016 (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2017), respectively. Global estimates for the years 1998, 2001, and 2003 suggest that the incidence rates of fatal and nonfatal occupational accidents have been decreasing in regions such as Western and Eastern Europe, and the Eastern Mediterranean, but less so in Southeast Asia and Africa (Hämäläinen et al. 2009). Nevertheless, detailed analyses on the distribution of injuries indicate large differences of the incidence rates across occupations. In the European Union, for instance, the number of workers reporting one or more accidental injuries at work in the years 1997 and 2007 is higher among the skilled and low-skilled manual workers (about 5.5%) than among the highly skilled nonmanual workers (1.8%) (European Commission 2010). Moreover, accidents are most frequently reported in agriculture, hunting and forestry, mining and quarrying, manufacturing, construction, transport, and health and social work. Most occupational accidents in the European Union involving more than 3 days of absence correspond to wounds and superficial injuries; dislocations, sprains, and strains; and concussion and internal injuries, especially in the upper and lower extremities, the back, and head (European Commission 2010). Comparable findings were obtained in the United States where the number of nonfatal occupational injuries of the upper extremities and the back in the years 2000–2002 is usually observed among operators, fabricators, laborers, workers in precision production, craft and repair workers, and services (Subramanian et al. 2006).

## Organizational Hazards

Organizational technology can be understood in very general terms as the set of norms and procedures by means of which collective labor is coordinated in production processes toward the creation of products or services in socio-technical systems

(Child 2015). The concept “technology” implies here that the structure of organizations as such may be regarded as an instrument for the attainment of organizational goals and, therefore, be modified to improve the efficacy and efficiency of collective labor. In the context of occupational health, the hazardousness of specific organizational technologies is commonly assessed by the subjective perception of workers on important aspects of the work environment and processes such as decision latitude, control of work tasks, role and task conflict, working time arrangements, job tasks, promotion opportunities, and labor contract conditions. Thus, organizational hazards can be identified with those characteristics of the organizational structure and processes which can have potential adverse effects on the physical and/or mental health of workers. Previous research has identified several organizational characteristics resulting in health adverse outcomes such as (i) the combination of high job demands and low decision latitude (i.e., job strain), (ii) the combination of high efforts and low rewards, (iii) long working hours and night work, (iv) inadequate leadership styles, and (v) unstable employment conditions.

Due to the fact that organizational hazards may be found in every occupational category, since they are related to general principles of labor allocation and coordination, structural characteristics of the organization and labor contract conditions have a pivotal role in the distribution of these kinds of hazards. In a large case-control study with register data in Denmark, the distribution of work strain, i.e., high job demands and low decision latitude, reveals larger prevalence rates among construction and craft workers, health workers, machine and plant operators, and cleaners than among managers, professionals, and teachers (Wieclaw et al. 2008). These findings reflect the top-down line of command in most organizations, whereby the extent of individual decision latitude decreases from the managerial and administrative levels to the shop-floor levels of the organization. A similar observation has been made for workers in France and Germany. In the SUMER French study of 2003, managers and professional workers report more frequently being exposed to external demands requiring immediate action (65,6%) than unskilled workers (26%); in contrast, unskilled workers have lower control over their work pace than managers (38.3% vs. 11.7%, respectively) (Arnaudo et al. 2004). Moreover, in the year 2010, a gradient of job strain was observed among French workers: Professionals and managers had the lowest prevalence rates, while service and blue-collar workers the highest (13.6%, 24.8%, 22%, respectively) (Niedhammer et al. 2018). In the German Socio-Economic Panel, a gradient of decreasing job efforts and, at the same time, decreasing job rewards was observed, with workers in the higher service class reporting more efforts, but also more rewards, in comparison to skilled and unskilled manual workers who report less efforts but also less rewards (Götz et al. 2018).

From the perspective of larger occupational categories and single dimensions of job demands such as pace of work (intensity), long working hours or days (extensivity), handling emotionally disturbing situations (emotional hazards), and harassment and discrimination (social hazards), a distribution pattern of hazards can also be identified. For workers in the European Union in 2015 (Eurofound 2019), for instance, a higher prevalence of extensive work was observed among the elementary occupations (ISCO 9), whereas craft workers (ISCO 7) and plant and machine

operators (ISCO 8) reported more frequently intensive and extensive work. In contrast, professionals (ISCO 2), technicians (ISCO 3), and service and sales workers (ISCO 5) reported higher levels of emotional demands and social hazards, while managers (ISCO 1) were exposed to higher levels of extensive work. On the other hand, the interaction of job autonomy (i.e., whether workers can change the order of tasks, methods of work, or work pace) and work intensity (i.e., whether work involves working at high speed and tight deadlines) reveals also a clear pattern of hazard distribution across occupations. With data from EWCS 2010, it has been shown that managers experience more often a higher work intensity and, at the same time, higher job autonomy, followed by professionals and technicians. On the contrary, craft workers, workers in elementary occupations, and especially plant and machine operators report lower job autonomy and, at the same time, a higher work intensity (Eurofound 2012).

Concerning working time arrangements, available prevalence estimates indicate that the distribution of hazards such as long working hours and night work usually depends on the constraints of manufacturing systems (e.g., continuous mass production), the sector and business model (e.g., utilities, health, or security services), or specific job commitments (e.g., accountability or failure risks). Data from the SUMER French study in the year 2010 revealed higher prevalence rates of frequent night work (i.e., > 45 days per year) for technicians and machine operators (31% for skilled workers and 17.5% for unskilled), security personnel (29.7%), sailors and fishers (27.4%), and police workers and firefighters (20%) (Vinck 2014). The largest numbers of exposed workers were found in the transportation and warehousing sector, healthcare, the food sector, and the hospitality and restaurant industry (Vinck 2014). A similar distribution has also been reported in Germany for the year 2012: Shift work is more frequently experienced in occupations in the manufacture sector (23%), transport and warehousing (20%), the hospitality and restaurant industry (20%), and the health sector (21%) (Lohmann-Haislah 2012).

Even though leader behavior has been identified as an important predictor of several indicators of subordinates' mental health such as stress, burnout, affective symptoms, and general health complaints (Montano et al. 2017), evidence on the prevalence rates of single leadership behaviors is limited. In particular, the so-called destructive leadership, i.e., harmful behavior against the organization or subordinates, is a genuine organizational hazard which is seldom collected in large surveys. Some estimates with a Norwegian sample of employees ( $n = 2,539$ ) resulted in 8.8% of employees exposed to the so-called derailed leadership (i.e., anti-organizational and anti-subordinate leadership) and 3.4% to tyrannical leadership (i.e., humiliating, belittling, or manipulative leadership behavior) (Aasland et al. 2010). In a sample of 2,829 workers in the United States, the prevalence of aggression at work originating from the supervisor or boss resulted in higher rates among construction, extraction, farming, and fishing workers (16.5%); installation, maintenance, and production workers (16.1%); and managers (15.5%) (Schat et al. 2006). At least for workers in the European Union, there is some evidence from the EWCS 2010 suggesting a gradient of higher to lower leadership quality along the ISCO occupational categories. By considering whether the supervisor gives feedback on work, shows

respectful behavior, has a good ability to solve conflicts and plan work activities, and encourages employees to participate in decisions, it was found that managers and professionals (ISCO 1 and 2) report higher levels of leadership quality than operators and workers in elementary occupations (ISCO 8 and 9) (Montano 2016). An occupational gradient of exposure to bullying in the last 6 months from supervisors or co-workers has also been observed in a German sample ( $n = 4,143$ ). Unskilled workers reported more frequently having being bullied by supervisors or colleagues (19.1% and 10.2%, respectively) than academics and managers (9.4% and 5.3%, respectively) (Lange et al. 2018). Moreover, in the same sample, severe bullying by one's supervisor, i.e., exposure to bullying once a week for at least 6 months, was more frequently reported by unskilled workers (8.1%) than academics and managers (3.1%). In general, for the year 2001 in Germany, the number of mobbing cases were larger among clerks, service, and sales workers (17.5% of mobbing cases) and skilled healthcare and social workers (6.9% of mobbing cases) (Meschkutat et al. 2002).

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## Mediators and Moderators

The actual level of exposure to occupational hazards in specific work environments depends on diverse context factors such as the hazard control procedures in organizations, the extent of simultaneous exposure to multiple hazards, and the attitudes and behaviors of workers and employers toward occupational health and safety issues (Hale and Borys 2013). Thus, in real work situations, the health outcomes resulting from exposure to particular occupational hazards can be attenuated or aggravated given the level of certain mediators or moderators of exposure. A salient research finding in this context is related to occupational-specific differences in the level of hazard protection. In France, for instance, the probability of obtaining engineering control measures such as ventilation systems to reduce the exposure to carcinogenic, mutagenic, or reprotoxic agents (see section “[Chemical Hazards](#)”) is substantially lower among clerical workers (ISCO 4), service and sales workers (ISCO 5), machine operators, agricultural, and workers in elementary occupations (ISCO 6, 8, and 9) than among managers and professionals (ISCO 1 and 2) (Havet et al. 2018). Since engineering controls are much more effective in reducing exposure than personal protective equipment, the magnitude and frequency of occupation-specific hazards may be increased. Moreover, studies investigating how organizations manage occupational safety and health (OSH) risks have pointed that the awareness of risks does not imply action to reduce them (EU-OSHA 2017). This may depend, for instance, on the belief that certain risks are intrinsically associated with the profession, e.g., working under pressure or dealing with angry or aggressive clients and customers. Hence, it is unlikely that organizations take action to reduce the level of exposures which are deemed “unavoidable” per se. Moreover, by considering the intensity of exposure to occupational risks (here psychosocial risks) and the extent of risk management, as reported by enterprises in the European Survey of Enterprises on New and Emerging Risks (ESENER), it could be observed

that the risk awareness and risk management differ across economic sectors: from low levels of both risk awareness and management observed in the agriculture, construction, and wholesale and retail trade sectors to high levels in the health sector (EU-OSHA 2017).

Furthermore, the prevalence and health effects of exposure to multiple hazards of the same or different type (e.g., chemical and organizational hazards) have received less attention in occupational health research, even though they should be a rather common phenomenon in real work environments. Nonetheless, some studies have investigated how different types of hazards may interact to increase the likelihood of adverse health effects in employed populations. In a large Danish register-based study with a cohort of hospital and administrative workers ( $n = 69,200$ ), the probability of injury was higher for workers in the evening and night work shifts than for workers in the day shift (Nielsen et al. 2018). These results and similar studies (Uehli et al. 2014) provide support for the association linking shift work with sleep disorders (Boivin and Boudreau 2014), which in turn lead to a higher probability of work injuries (Uehli et al. 2014). Another example of multiple exposures and increasing likelihood of health adverse outcomes is related to multiple exposures to carcinogens. In spite of the difficulties and limitations associated with the assessment of actual concentrations of carcinogens in the work environment, the estimation of the effects of multiple exposures to carcinogens on health has been attempted in a lung cancer case-control study in Central and Eastern Europe and the United Kingdom (t Mannelte et al. 2011). In that study, the working lifetime exposure to dust and fumes/mist of chromium, nickel, cadmium, and arsenic was assessed on the basis of expert cut points for cases and controls. Whereas exposure to at least one metal was associated with an odds ratio of 1.28 (95% CI 1.07–1.86), simultaneous exposure to all four metals yielded an odds ratio of 3.38 (95% CI 1.25–9.12). Moreover, the distribution of exposures was mainly concentrated in the sectors of construction and metal manufacturing industries, agriculture, and specific occupations such as blacksmiths, toolmakers, painters, plumbers, welders, and sheet metal workers.

A very important moderator of actual exposure which has received less attention in the occupational health literature so far is the degree to which safety rules and procedures interact with the distribution of hazards across occupations (see Hale and Borys 2013 for an extensive review on safety rules). Commonly, two approaches to safety management are discussed: (1) a behavioral approach based on the identification of critical behaviors and their modification by means of feedback conditioning and (2) a cultural approach based on organizational and social-psychological models of norms, values, beliefs, and behaviors related to safety in organizations (DeJoy 2005). However, in both approaches it is assumed that the actual exposure to hazards is to some extent the consequence of failures at single hazard control levels (e.g., ignoring warning and usage rules of chemical substances) or at the level of the organizational culture (e.g., ignoring safety rules is usual practice in the organization) (DeJoy 2005). From a more general perspective, occupational risks and safety issues at the workplace are embedded in complex social-psychological decision processes occurring within organizations.

Previous investigations focusing on the causes, motives, or mental models involved in the violation of safety rules suggest a wide array of factors responsible for this type of norm violation. This can be briefly illustrated by considering the results from a focus group study with employees at a large steel manufacturing company in Sweden which gives some insight into the social-psychological processes involved in occupational risk exposure (Nordlf et al. 2015). From the perspective of the interviewed workers, employees (1) held the belief that risks associated with their work were unavoidable (fatalism); (2) were convinced that the individual worker has the largest responsibility for safety, and not the company; (3) had little trust in the company's commitment to safety; (4) experienced that communication and collaboration with colleagues were very important for safety; and (5) believed that some degree of nonchalance toward risks was prevalent due to effort reduction and getting used to a risky environment. In a literature review of similar studies conducted in the health, aviation, mining, rail transport, and construction sectors, Alper and Karsh concluded that violation to safety procedures involves several factors: characteristics of the individual workers (e.g., experience, age, gender), the work system (e.g., task demands, complexity, time demands, department goals), organizational factors (e.g., policies, rules, goals), and the external environment (e.g., standards, legislation) (Alper and Karsh 2009). In the context of the distribution of occupational hazards, these findings suggest that the observed magnitude and frequency of actual exposure are in some instances rather a consequence of the interaction between the different components of the whole work environment and not just the nature of specific job tasks. Hence, by the same token, in spite of the presence of unavoidable risks given by the nature of the production and service processes themselves, it seems that exposure reduction or elimination should still be attainable in working environments.

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## Conclusions and Future Directions

The findings briefly discussed in the preceding sections indicate that occupational hazards are substantially higher among service and sales workers (ISCO 5), skilled agricultural and fishery workers (ISCO 6), craft and related trades workers (ISCO 7), plant and machine operators (ISCO 8), and workers in elementary occupations (ISCO 9). Despite the fact that it is very difficult to accurately estimate the contribution of these hazards to the total incidence of disease in the population, the higher prevalence of chemical, physical, and organizational hazards for workers in these occupational categories is to some extent reflected in the distribution of recognized occupational diseases. Available results for the European Union in 2001 reveal that the incidence per 100,000 workers of overall occupational diseases by occupation is highest among craft and related trades workers (106.3), plant and machine operators (90), elementary occupations (74.3), skilled agricultural and fishery workers (35.2), and service and sales workers (13) (Karjalainen and Niederlaender 2004). In contrast, the incidence rates among managers, professionals, technicians, and clerks are less than 6 per 100,000 workers, i.e., approximately 17 times lower than for craft and

related trades workers (Karjalainen and Niederlaender 2004). The most frequent occupational diseases follow the pattern of exposure to biomechanical (hand or wrist tenosynovitis, epicondylitis of the elbow, Raynaud's syndrome or vibration white finger, carpal tunnel syndrome), physical (noise-induced hearing loss), and chemical hazards (mesothelioma, asthma, asbestosis, and coal worker's pneumoconiosis). Nonetheless, these estimates largely underestimate the true burden of occupational hazards on workers' health, since they correspond to "recognized" occupational diseases, i.e., a selected group of diseases whose clinical features are aligned with the health effects following exposure to a single, specific agent (European Commission 2009), and fulfill the evidential criteria required by the insurance policies in the different jurisdictions of the European Union. As an illustration, from the 80,163 reported cases for social insurance compensation in Germany in the year 2016, only 22,320 were "recognized" as an occupational disease, i.e., an overall recognition rate of approximately 27% (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2017). In countries where reporting of cases is not mandatory, the underestimation of occupational disease incidence should be even larger.

As discussed in section "[Socioeconomic Determinants of Occupational Hazard Distribution](#)," there is no natural "dirtiness or cleanliness" of occupations; instead, the deliberate development and use of products, services, and production technologies set the general conditions on the type, magnitude, and frequency of occupational exposure to hazards. As new technologies at the production and organizational level develop and the magnitude of globalization of production and consumption patterns increases, it is to be expected that the type and distribution of hazards across occupations will accordingly change. Some global and regional trends can already be observed. The spreading of digital and automation technologies, for instance, increases the scale of production and the labor market in the manufacturing of electronic devices, electronic waste, and related industries and, thus, the number of workers exposed to substances such as organic solvents, cadmium, mercury, or nickel, especially in Eastern Asia (e.g., Friesen et al. 2014). Similarly, the intensification of global trade, market liberalization, and the consolidation of regional production clusters in sectors such as textiles and clothing may potentially increase the rates of exposure to carcinogenic, mutagenic, or reprotoxic agents, especially in Southern and Southeast Asia (e.g., Khan et al. 2015). On the other hand, in North America and Europe, the occupational structure has shifted from manufacturing to the services sector, and, accordingly, the type and distribution of hazards in several occupations are more related to organizational characteristics associated with factors including sitting and standing, irregular work, long working hours, working under pressure, tight deadlines, high-speed work, and low job control (e.g., Doubleday et al. 2019; Eurofound 2019). Even though it can also be expected that current management approaches such as lean and agile management will continue expanding, the consequences of these approaches on workers' health have not been assessed in occupational health research. To some extent, this knowledge gap is due to the traditional focus of occupational health research on individuals and not on individuals *within organizations*. Nonetheless, some basic principles of work organization in the lean and agile management approaches seem to indicate an

increase in the exposure to organizational hazards. Work organization principles such as just-in-time production, strict cost-saving work procedures, reduction of operating and personnel costs, increased work specialization and standardization, and tighter deadlines, among others, suggest an increase of the exposure to psychosocial hazards associated with lower job control and autonomy, increased work intensity, longer working hours, and increased job demands (Koukoulaki 2014).

Finally, in a series of expert reports commissioned by the European Agency for Safety and Health at Work (EU-OSHA), several chemical, biological, psychosocial, and physical hazards have been identified for future research and occupational safety and health measures. Among the new chemical hazards, it is estimated that nanoparticles, diesel exhausts, man-made mineral fibers, epoxy resins, isocyanates, and crystalline silica-based products may pose unknown or increasing health risks for European workers. Regarding biological risks, the most important emerging occupational hazards identified by the experts concern global epidemics, zoonoses, drug-resistant organisms, and endotoxins. Concerning psychosocial hazards, it is expected that job insecurity, aging of the workforce, work intensification, high emotional demands at work, and poor work-life balance will account for increasing levels of exposure. Among the most important emerging physical hazards, the experts identified lack of physical activity, combined exposure to musculoskeletal hazards and psychosocial factors, poor design interfaces, thermal discomfort, ultraviolet radiation, and vibrations. Future research is needed to assess the impact of these emergent hazards both on the distribution of occupational hazards and the occupation-specific mortality and morbidity rates.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Impact of the Digitization in the Industry Sector on Work, Employment, and Health](#)
- ▶ [Job Intensity](#)
- ▶ [Occupational Noise: A Determinant of Social Inequalities in Health](#)
- ▶ [Shift Work and Occupational Hazards](#)
- ▶ [The Demand Control Support Work Stress Model](#)

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# Occupational Noise: A Determinant of Social Inequalities in Health

# 11

Ingrid Sivesind Mehlum and Lisa Aarhus

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_2](https://doi.org/10.1007/978-3-030-31438-5_2)

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## Abstract

Occupational noise exposure is common in many workplaces and a well-known cause of noise-induced hearing loss and related to tinnitus and hyperacusis (hypersensitivity to sound), as well as other health outcomes, such as distress, hypertension, and occupational injuries.

Hearing loss and many health conditions are more frequent in lower socio-economic groups. Loud occupational noise is generally also more common among blue-collar workers, while white-collar workers are virtually unexposed. Therefore, occupational noise exposure would seem like a plausible cause of socioeconomic inequalities in hearing and other health outcomes; in other words, occupational noise could be a mediator (intermediate variable) between socioeconomic position and health.

However, hardly any studies have investigated the impact of occupational noise exposure on social inequalities in hearing, and none seems to have studied its impact on other health outcomes. One study found that the association between socioeconomic position and hearing loss was reduced after controlling for occupational noise exposure, suggesting that occupational noise to a considerable extent could explain the association between occupation and hearing loss.

There is a lack of studies addressing the impact of occupational noise exposure on social inequalities in health; thus, more studies specifically designed to investigate this topic are needed.

## Keywords

Hearing loss · Hearing preservation · Mechanism · Mediator · Noise exposure · Occupation · Socioeconomic indicator · Socioeconomic position

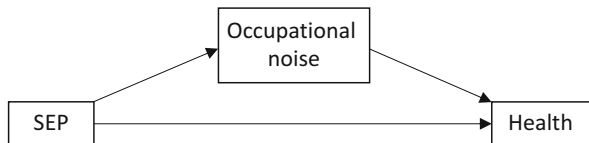
## Introduction

Is occupational noise exposure a cause of socioeconomic inequalities in health? This chapter will focus on what is currently known about this topic.

Occupational noise exposure is common in many workplaces and a well-known cause of noise-induced hearing loss. There is also evidence that occupational noise increases the risk for other health-related outcomes, such as distress, hypertension, and occupational injuries.

A causal relationship between occupational noise and social inequalities in health requires that there are causal relations between socioeconomic position (SEP) and

**Fig. 1** Causal model showing relationships between socioeconomic position (SEP), occupational noise exposure, and health



occupational noise exposure and between SEP and the health outcomes in question. A plausible model showing these relationships is shown in Fig. 1, where occupational noise is a mediator, i.e., an intermediate variable on the causal pathway between SEP and health.

This chapter will address these relationships. Section “Occupational Noise Exposure and Health” will cover the relationship between occupational noise exposure and health, while the relationship between SEP and occupational noise is covered in section “Socioeconomic Position and Occupational Noise Exposure.” In section “Socioeconomic Position and Hearing Loss,” SEP and hearing loss will be focused, and in section “The Impact of Occupational Noise on Social Inequalities in Hearing Loss,” the impact of occupational noise on socioeconomic inequalities in hearing loss. The impact of occupational noise on social inequalities in non-auditory health effects is the topic of section “The Impact of Occupational Noise on Social Inequalities in Non-auditory Health Effects.” Finally, implications of socioeconomic inequalities in occupational noise and related health outcomes are covered in section “Conclusion.”

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## Occupational Noise Exposure and Health

### Occupational Noise Exposure

Occupational noise exposure is still a widespread problem. Summary statistics on occupational noise exposure are not available for most industrializing and non-industrialized countries; however, about 22 million US workers are exposed to hazardous noise levels at work (NIOSH 2018), and in Germany, the corresponding number is four to five million people (12–15% of the workforce) (WHO 2004).

### Hearing Loss

Occupational noise exposure has been associated with several adverse health effects, such as hearing loss, tinnitus, hypertension, and accidents. The best documented health effect is hearing loss. Hearing loss is a major source of disability in adults and is associated with serious psychosocial problems and substantial healthcare costs (Cunningham and Tucci 2017). It has been estimated that over 5% of the world’s population, or 466 million people, have *disabling hearing loss* (pure-tone average of 0.5–4 kHz > 40 dB hearing threshold level in the better hearing ear) (WHO 2019).

The most important cause of hearing loss is aging, leading to age-related hearing loss (presbycusis). Whereas the prevalence of *hearing loss* (pure-tone average of 0.5–4 kHz > 25 dB hearing threshold level in the better hearing ear) among males between 20 and 24 years of age is only 1%; the corresponding prevalence among males in the age group 75–79 years is 77% (Borchgrevink et al. 2005). Moreover, men are more likely to experience hearing loss than women (Borchgrevink et al. 2005), and genetic factors play a large role (Kvestad et al. 2012). Exposure to noise, chemicals (e.g., organic solvents, lead), prior ear infections (Aarhus et al. 2015a), and certain medications and diseases are also well-known risk factors. Smoking, diabetes, and cardiovascular disease have been associated with hearing loss, as well, but the clinical relevance is doubtful (Engdahl et al. 2015).

### Noise-Induced Hearing Loss

Noise-induced hearing loss (NIHL), which is mostly caused by damage to the hair cells of the inner ear, is characterized by increased hearing thresholds for frequencies between 3 and 6 kHz. NIHL is one of the most recorded occupational diseases in Europe and globally and accounts for about 10% of the burden of adult hearing loss (Dobie 2008). The majority of NIHL occurs during the first 10–15 years of noise exposure, after which continued exposure has a diminished detrimental effect (ISO 1990). On a group level, people who are exposed to a noise level of 85 dB over a 15-year period have an estimated mean hearing loss of 5 dB in the frequency range most sensitive to noise (3–6 kHz), compared to non-exposed people (ISO 1990). At noise exposure levels closer to 100 dB, the mean hearing loss in the same frequency range is estimated at 30–40 dB. There is a large individual variability in susceptibility to NIHL, but strong evidence is lacking about susceptibility factors. Thus, recommendations about specific limit values of susceptibility factors to protect susceptible groups are not yet possible to give. However, several studies show a synergistic effect between occupational noise exposure and organic solvents (Hormozi et al. 2017). As to pre-existing hearing loss, a study showed that the association between occupational noise exposure and hearing loss was similar in adults with and without childhood sensorineural hearing loss (a simple additive effect) (Aarhus et al. 2015b).

Improved regulation and more use of better protective equipment have probably resulted in less occupational NIHL today, as compared to some decades ago. As of today, exposed groups include, among others, the armed forces, the offshore sector, sheet-metal workers, workshop mechanics, workers in building and construction, and workers in agricultural settings (Engdahl and Tambs 2010).

### Tinnitus and Hyperacusis

Tinnitus affects about 10% of the adult population (Bhatt et al. 2016) and may be significantly disabling. The main risk factor is hearing loss, including NIHL; other



risk factors include various mental and somatic health problems and aging (Baguley et al. 2013). Hyperacusis (hypersensitivity to sound) often occurs together with tinnitus and may also be caused by noise exposure (Chen et al. 2013). Complex mechanisms in the central nervous system and the inner ear are probably involved in the development of tinnitus and hyperacusis.

## **Stress and Distress**

Occupational noise exposure has also been related to distress and stress reactions. For example, studies of workers in open-plan offices have shown a link between occupational noise exposure and reduced job satisfaction (Lee et al. 2016); stress, fatigue, and impaired task performance (Jahncke and Halin 2012); and increased risk of sickness absence (Clausen et al. 2013).

## **Hypertension**

Some studies indicate that occupational noise exposure is associated with an increased risk of hypertension, while a possible association between occupational noise exposure and coronary heart disease is less certain (Skogstad et al. 2016).

## **Occupational Injuries**

Noise in the workplace increases the risk of accidents (Picard et al. 2008), possibly because noise exposure may lead to distraction or warning signals not being properly heard. It has been estimated that more than one in ten work accidents can be attributed to noise exposure at levels greater than 90 dB and NIHL (Picard et al. 2008). A case-control study in a Brazilian city found that as much as 63% of the work accidents that took place were statistically associated with occupational noise exposure (Dias and Cordeiro 2008).

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## **Socioeconomic Position and Occupational Noise Exposure**

### **Relationship Between SEP and Occupational Noise Exposure**

If occupational noise is to be a cause of socioeconomic inequalities in health, there must be a causal relationship between socioeconomic position (SEP) and occupational noise exposure, as mentioned in the introduction and shown in Fig. 1. In other words, there needs to be social differences in the exposure. It might seem self-evident that blue-collar workers are more exposed to occupational noise than white-collar workers and that there would be an abundance of studies showing this, but that does not seem to be the case.

## Studies Including SEP and Occupational Noise Exposure

Although many studies have included both SEP and occupational noise exposure in their analyses, they rarely show the distribution of occupational noise according to SEP. Many studies have examined the relationship between occupational noise exposure and different health outcomes, as mentioned in section “[Occupational Noise Exposure and Health](#),” but they usually treat SEP as a confounder that is adjusted for, without showing the distribution of, noise exposure according to SEP. Other studies have examined hearing loss or other noise-relevant health outcomes in relation to SEP (covered in the next sections of this chapter) but hardly ever show the separate role of occupational noise exposure or its distribution according to SEP.

## Social Differences in Occupational Noise Exposure

Some studies have briefly mentioned the social distribution of occupational noise exposure, although this was not the main focus of the study. A Swedish study (Hasson et al. 2010) found a small correlation ( $r = -0.17$ ) between subjective SES, assessed by means of a self-rating instrument, and noise exposure, indicating a higher noise exposure in lower SES groups. Suadicani et al. (2012) found that noise-exposed men more frequently belonged to low social classes in the Copenhagen Male Study. Among men who were noise-exposed for more than 5 years, 59.5% were blue-collar workers, while the corresponding proportion among men who were non-exposed was 45.2% (statistically significant difference). Virkkunen et al. (2005) similarly found that no white-collar workers in their study of Finnish, middle-aged, industrially employed men were exposed to loud noise (defined as continuous noise  $>80$  dB or impulse noise).

## Occupational Noise Gradients May Vary

However, not all studies have found a consistent social gradient in occupational noise exposure. Clougherty et al. (2010) found that higher-grade skilled tradesman experienced higher noise exposures, on average, than those in lower-status jobs within the hourly (blue-collar) workforce at a large US aluminum smelting facility, contrary to other exposures in the same facility. In a cross-sectional study among workers from 14 unionized worksites, Quinn et al. (2007) found that, between hourly wage categories, those with higher wages were more likely to report noise exposure, as opposed to most other occupational exposures. There was little variation in the exposure reporting across the three educational categories, ranging from 26% among workers with more than high school to 32% among workers with less than high school. However, the study may not have been able to show large exposure contrasts due to the selection of the study participants.

**Table 1** Self-reported occupational noise exposure among employed Norwegian men, according to socioeconomic position (SEP), based on occupational class and education level. (Data source: Statistics Norway’s “Survey of Living Conditions on Work Environment” 2009. (Excerpt of a table presented in Mehlum 2013, in Norwegian))

SEP	Occupational class		Education level	
	N	Noise exposed (%)	N	Noise exposed (%)
1 (high)	1629	3,8	571	1,2
2	746	4,8	1130	3,0
3	619	7,1	1758	16,1
4	279	16,1	440	16,6
5 (low)	1480	23,6	844	15,5
All men	4753	11,2	4743	11,1

## The Role of Different Socioeconomic Indicators

Studies based on different socioeconomic indicators may not give the same results. A Norwegian report (Mehlum 2013) showed, among employed men, a strong, stepwise social gradient for self-reported occupational noise exposure, according to occupational social class (five categories), as defined by Erikson-Goldthorpe-Portocarrero (EGP) (Erikson et al. 2010), based on data from a representative population sample of Statistics Norway’s “Survey of Living Conditions on Work Environment” in 2009 (Statistics Norway 2009) (Table 1).

While only 3.8% among higher- and lower-grade professionals (EGP occupational classes I–II) reported noise exposure, the proportion was 23.6% among skilled and non-skilled workers (EGP occupational classes VI–VII). The corresponding relationship between education level (five categories) and self-reported noise exposure was more dichotomous. Among subjects without higher education (the three lowest education levels), approximately 16% reported noise exposure, compared to 1–3% among subjects with university or college education (Table 1).

Socioeconomic indicators may differ in their ability to discriminate exposures and diseases, and an occupation-based classification system for SEP may better capture specific job-related factors than other socioeconomic indicators, such as education or income level (Galobardes et al. 2007).

## Socioeconomic Position and Hearing Loss

Several studies have shown a relationship between SEP and hearing loss. Mostly, SEP has been measured as education level, occupational class, or income level, whereas hearing has been measured by self-report or by pure-tone audiometry. In the following section, some studies that provide objectively measured hearing threshold level according to SEP indicators will be presented.

## Social Inequalities in Hearing Loss

A large Norwegian population study showed that SEP, as measured by education level and occupational class, was associated with high-frequency hearing loss among men aged 41–65 years (Helvik et al. 2009). On the other hand, the study showed no association between SEP and hearing loss among women. Another large Norwegian study showed marked effects of occupation on hearing loss, with the most elevated hearing thresholds in men among wood workers, miners, linemen and cable jointers, construction carpenters and workers, seamen, and workshop mechanics (Engdahl and Tambs 2010). A Chinese study also showed that measures of occupation and education were associated with hearing loss in the working-age population (He et al. 2018). The US National Health and Nutrition Examination Survey (NHANES) 1999 to 2004 waves showed that lower education and lower income were associated with hearing loss (Cheng et al. 2009), as was also reported in a study of the Hispanic/Latino population (Cruickshanks et al. 2015), in a Korean population (Lee et al. 2015) and in an English population (Scholes et al. 2018). Similarly, a Canadian study showed that persons with low household income and/or educational attainment were more likely to have hearing loss than those in higher income/education households (Feder et al. 2015). Moreover, a WHO report describes that the incidence of hearing loss is higher in low-income countries (WHO 2012).

### Is There a Causal Relationship Between SEP and Hearing Loss?

The relationship between SEP and hearing loss could reflect *reverse causality*, namely, that hearing loss leads to lower SEP. For example, prospective cohort studies have shown an association between hearing loss and educational attainment (Idstad and Engdahl 2019; Järvelin et al. 1997). In order to assess the direction of the association between SEP and hearing loss and the underlying mechanisms, a large well-designed longitudinal study is needed.

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## The Impact of Occupational Noise on Social Inequalities in Hearing Loss

### Possible Mechanisms for Social Inequalities in Hearing Loss

Although the association between SEP and hearing loss is well established, the underlying mechanism is not well clarified. The effect of low SEP on hearing loss may be mediated by multiple factors, such as higher noise exposure (occupational noise, environmental noise, leisure noise), higher prevalence of smoking, cardiovascular disease or diabetes, poorer hearing status at birth, or poorer access to healthcare for ear- and hearing-related conditions.

## Evaluation of Potential Mediators of the Association Between SEP and Hearing Loss

Some studies have evaluated the impact of potential mediators. For example, a study of hearing loss among US adults showed that less educated participants had increased risk of high-frequency hearing loss, even after adjustment for age, sex, race, smoking, noise exposure (both occupational noise and leisure noise), diabetes, and hypertension (Agrawal et al. 2008). Another study showed that after adjustment for covariates, which were grouped into demographic characteristics, occupational noise exposure and risk factors for cardiovascular disease, hearing loss still showed a strong socioeconomic gradient (Scholes et al. 2018). Finally, a study that adjusted for diabetes, hypertension, body mass index, smoking, and noise exposure from occupational and non-occupational sources described that none of the factors showed statistically significant mediation (Emmett and Francis 2015).

## Evaluation of Occupational Noise Exposure as a Potential Mediator

As already mentioned, the relationship between occupational noise exposure and hearing loss has been well documented (section “Occupational Noise Exposure and Health”). In addition, there is higher occupational noise exposure in lower SEP groups (section “Socioeconomic Position and Occupational Noise Exposure”). Together, this would indicate that occupational noise exposure could be an important predictor of socioeconomic inequalities in hearing loss. The specific impact of occupational noise exposure on social inequalities in hearing can be tested by assessing the effect of SEP on hearing loss with and without adjustment for occupational noise exposure. This will give an estimate of how much of the association between SEP and hearing loss that is mediated by occupational noise exposure. If the association is reduced after adjustment, this indicates that occupational noise exposure is on the causal pathway between low SEP and hearing loss (see Fig. 1, Introduction).

However, in studies of the association between SEP and hearing loss, occupational noise exposure was only adjusted for, together with other covariates of, the association (Agrawal et al. 2008; Scholes et al. 2018; Emmett and Francis 2015). In other words, the specific mediation effect of occupational noise exposure was not evaluated. To the best of our knowledge, no study has been specifically designed to investigate the impact of occupational noise exposure on social inequalities in hearing. However, one study has reported results on the specific mediation effect of occupational noise exposure on occupational differences in hearing.

Engdahl and Tambs 2010, who estimated the effect of occupation on hearing threshold level in a large Norwegian population study, described that controlling for self-reported occupational noise exposure reduced the effect of occupation by 20–40% in men  $\geq 45$  years. On the other hand, controlling for leisure-time noise did not change the effect of occupation. Moreover, the effect of occupation was only slightly reduced after controlling for education and income. These results may indicate that occupational noise exposure is an important mediator of the relationship between occupation and hearing loss.

Unpublished analyses from the same author (Engdahl, personal communication), using the same data material (the HUNT study) showed that the effect of education on hearing was significantly mediated by occupational noise among men (25%) and among women (12%). On the other hand, the effect of income on hearing was not significantly mediated by occupational noise exposure (4% and 1% among men and women, respectively).

## Potential Effect Modification

Another potential mechanism of the relationship between SEP, occupational noise exposure, and hearing loss is effect modification or interaction. In other words, the impact of occupational noise exposure on hearing loss could be greater for workers in lower-status jobs than for those in higher-status jobs. As previously described, studies show a synergistic effect between solvents and occupational noise exposure on hearing loss (Hormozi et al. 2017). Exposure to solvents is usually more common in lower-status jobs; therefore, the impact of noise exposure on hearing loss might possibly be greater for workers with low SEP. There is also some evidence that other occupational exposures might also modify the effect of noise exposure on hearing, e.g., hand-arm vibration (Pettersson et al. 2012), which is also more common in lower SEP workers.

## Social Inequalities in Environmental Noise Exposure

A recent systematic review evaluated social inequalities in environmental noise exposure in the WHO European Region, taking different sociodemographic and socioeconomic dimensions into account, as well as subjective and objective measures of environmental noise exposure (Dreger et al. 2019). The eight included studies and their methods were very heterogenic, and different SEP indicators were used. The authors concluded that general indices of deprivation and social indicators at the individual level representing material aspects tended to be associated with higher environmental noise exposure. However, multiple noise exposures at different places (e.g., at home, at work, during leisure-time activities) were not assessed in any of the included studies. This fact could be of particular importance when looking at social inequalities in noise exposure, as socially deprived people may not only live in noisier areas but also work in jobs with elevated noise exposure. Moreover, the number of included studies per social indicator was too low to draw general conclusions for individual SEP indicators.

## Does Occupational Noise Lead to Social Inequalities in Hearing Loss?

To sum up, there is little evidence of the impact of occupational noise exposure on social inequalities in hearing. To our knowledge, only one study has investigated the extent to which the association between SEP and hearing loss is reduced after controlling for occupational noise exposure (Engdahl and Tambs 2010). The study

suggests that occupational noise exposure to a considerable extent explains the association between occupation and hearing loss. In order to better address the impact of occupational noise exposure on social inequalities in hearing, more studies specifically designed to investigate this topic are needed.

## **Potential Consequences of Occupational Hearing Loss**

Hearing loss has been found to affect participation in working life. Several studies describe associations between hearing loss and unemployment (Stam et al. 2013; Hogan et al. 2009), early retirement (Helvik et al. 2013), sickness absence, and disability pension (Friberg et al. 2012). Thus, the social patterning of occupational noise exposure and hearing loss may also contribute to socioeconomic inequalities in work participation and social life.

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## **The Impact of Occupational Noise on Social Inequalities in Non-auditory Health Effects**

### **Possible Mechanisms for Social Inequalities in Non-auditory Health Effects**

As mentioned in section “[Occupational Noise Exposure and Health](#),” some health outcomes, in addition to NIHL and other hearing-related outcomes, have been linked with occupational noise exposure, such as distress and stress reactions, hypertension, and occupational injuries. Although these outcomes may also be associated with social position, potential mechanisms may be even less clear than for hearing-related outcomes, for example, for hypertension. SEP, noise exposure and hypertension are all associated; however, the effect of low SEP on hypertension may be mediated by several factors, not only noise exposure but also smoking and other lifestyle factors (Virkkunen et al. 2005). To further complicate the picture, it has been suggested that, in an attempt to cope with the annoyance caused by noise, a person may smoke more or adopt worse eating habits (Virkkunen et al. 2005). It has also been found that both noise exposure levels and noise annoyance have effects on serum lipid levels, independent of each other (Melamed et al. 1999), and that exposure to occupational noise has a greater negative impact on changes in blood pressure and job satisfaction over time among those performing complex jobs (Melamed et al. 2001), in other words, that occupational noise interacts with the complexity of the job in having an effect on the blood pressure.

### **Evaluation of Potential Mediators of the Association Between SEP and Non-auditory Health Effects**

Although some health outcomes have been found to be associated with both SEP and occupational noise exposure, very few, if any, studies have investigated the extent to

which the associations between occupational noise and these health outcomes are mediated or “explained” by occupational noise exposure. Thus, the situation is no better than for occupational noise exposure and social inequalities in hearing.

The fact that white-collar workers hardly are exposed to loud noise also complicates the analyses. Therefore, blue-collar workers are analyzed separately in some studies (Virkkunen et al. 2005; Suadicani et al. 2012). Suadicani et al. (2012) found that the overall risk of ischemic heart disease mortality was higher among the lower social classes in all noise exposure groups, but the risk associated with noise exposure was not significant for either the high or low social classes. This is in line with other studies not finding an association between occupational noise exposure and coronary heart disease (Skogstad et al. 2016).

Lack of studies addressing the impact of occupational noise exposure on social inequalities in non-auditory health outcomes indicates that studies are needed to investigate the impact on social inequalities in non-auditory health outcomes, as well as hearing.

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## Conclusion

Occupational noise exposure is common in many workplaces, particularly among blue-collar workers, and a well-known cause of noise-induced hearing loss and related to tinnitus and hyperacusis (hypersensitivity to sound), as well as other health outcomes, such as distress, hypertension, and occupational injuries.

Hearing loss and many health conditions are generally more frequent in lower socioeconomic groups. Loud occupational noise is generally also more common among blue-collar workers, while white-collar workers are virtually unexposed. Therefore, occupational noise exposure would seem like a plausible cause of socioeconomic inequalities in hearing and other health outcomes; in other words, occupational noise could be a mediator (intermediate variable) between SEP and health.

Hardly any studies have investigated the impact of occupational noise exposure on social inequalities in hearing, and none seems to have studied its impact on other health outcomes. One study found that the association between SEP and hearing loss was reduced after controlling for occupational noise exposure, suggesting that occupational noise to a considerable extent could explain the association between occupation and hearing loss.

The social patterning of occupational noise exposure and hearing loss clearly has public health implications and contribute to social health inequalities. Hearing loss also affects work participation, measured as unemployment, early retirement, sickness absence, or disability pension.

Socioeconomic position and occupational noise exposure should be taken into consideration when hearing preservation programs are developed. The burden of hearing loss and hearing aid use are generally highest in the lowest socioeconomic groups; thus, initiatives to detect hearing loss earlier and increase the uptake and use of hearing aids may provide substantial public health benefits and reduce socioeconomic inequalities in health and participation in social life.



There is a lack of studies addressing the impact of occupational noise exposure on social inequalities in health; thus, more studies specifically designed to investigate this topic are needed.

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## Cross-References

- ▶ [Financial Gains, Possibilities, and Limitations of Improving Occupational Health at the Company Level](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [Precarious Employment Conditions, Exploitation, and Health in Two Global Regions: Latin America and the Caribbean and East Asia](#)
- ▶ [Social Distribution of Occupational Hazards](#)

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## Abstract

Working time is a key issue in work organization, linking human capacities with production means in a world where increasing economic competition, globalization of labor market, new technologies, and operational strategies require continuous human assistance throughout the 24 h. Shift work enables round-the-clock activities, due not only to rigid technological constraints and provision of basic social services but also to support commercial choices and a wider use of leisure time. Shift work, in particular that including night work, is a significant risk factor as it perturbs the circadian rhythms of psychophysiological functions; reduces performance efficiency with consequent errors, accidents, and injuries; worsens health (mood, sleep and eating troubles, chronic psychosomatic disorders); and

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_3](https://doi.org/10.1007/978-3-030-31438-5_3)

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hinders human relations with negative consequences on family and social life. Tolerance to shift and night work shows a high inter-individual variability connected to personal, family, working, and socioeconomic conditions. Shift schedules based on ergonomic criteria, flexible working times, higher work autonomy, social support and counselling, suitable medical surveillance, and more balanced integration among work, environment, and society are the main tools able to support a right evolution of *homo sapiens* in the 24/7 society.

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**Keywords**

Working hours · Shift work · Night work · Sleepiness · Human error · Accident risk · Health disorders · Temporal flexibility · Preventive actions · 24/7 Society

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**Introduction**

Working time arrangement has become a key issue in work organization and a basic condition linking human capacities with production means. It is connected to increasing economic competition among companies and countries, due to globalization of labor markets, development of new technologies and productive strategies, as well as extension of social services to the general population, requiring continuous human assistance and control throughout the 24 h.

Now, thanks to new technologies, not only the link between workplace and working time has been broken (e.g., telework, smart working, gig economy), but also the value of working time changes according to the different economic, social, and health implications it may have at different hours or stages of worker's life. Moreover, the more the modern economy transfers its interest from tangible to intangible goods, the more time becomes the main criterion of evaluation and profit ("time is money").

Thus, the boundaries between working and social time are no longer fixed and rigidly determined by the normal daytime workday: not only are waking hours extended to evening and night hours, but working hours have become increasingly variable.

Shift work includes any arrangement of working hours differing from standard daytime work, aimed at extending the operating time of companies up to 24 h a day by succession of different work teams.

Shift and night work enable round-the-clock activities not only in connection with rigid technological constraints (e.g., chemical and steel industry, power plants) and provision of essential social services (e.g., hospitals, transports, electricity, telecommunications) but also to support productive and commercial choices (e.g., manufacturing, banking), as well as a wider use of leisure time (e.g., tourism, entertainments).

Recent European statistics show that the majority of working population is engaged in irregular or "non-standard" working hours, including shift and night work, weekend work, split shifts, on-call work, compressed week, telework, part-

time work, on-demand work, and extended duty periods. The standard working week, from 7–8 am to 5–6 pm, Monday to Friday, is nowadays a condition for a minority of workers: one in four of employed and one in ten of self-employed people. In general, about 20% of the working population worldwide is involved in shift work including night work (Costa et al. 2004; Messenger 2018).

Hence, shift and night work are the cornerstone of this “temporal flexibility,” which characterizes current trends in diversification of work organization, together with “numerical flexibility” (i.e., various forms of work contracts, temporary, on-demand and on-call work), “productive/geographic flexibility” (i.e., outsourcing, subcontracting), and “functional flexibility” (i.e., job rotation, job enrichment, teamwork, multitasking, on project) (Goudswaard and De Nanteuil 2000).

There are different uses of flexible working hours among countries and companies according to different cultural and socioeconomic factors, as well as work sectors and industrial relations, as there are advantages and disadvantages for individuals, enterprises, and whole society (Table 1).

In general, employers are keener to view them in terms of prompt adaptation of production systems to market demands and technological and organizational innovations, while employees consider them an important tool to improve health and social life by decreasing work constraints and gaining more job control and time sovereignty on work-life balance. A more individual-oriented flexibility of working hours (e.g., part-time work, bank of hours) meets also the changing needs of employees in different stages of life (e.g., education, family, aging) (Costa et al. 2004).

The problem is how to reach the best possible compromise by increasing the advantages and limiting as much as possible the drawbacks for everybody, aimed at improving human life (more goods, higher salaries, mores services, more leisure) in the “24/7 Society” (24 h per day, 7 days per week), that never stops and requires continuous adjustments to its evolution and organization.

Thus, shift workers are at the same time builders and victims of the 24/7 society, as the interaction between employment status and worktime patterns may have a

**Table 1** Possible advantages and disadvantages of flexible working times

	Advantages	Disadvantages
<b>Worker</b>	<ul style="list-style-type: none"> <li>&gt;Possibility to meet personal needs and preferences</li> <li>&gt;Job opportunities</li> <li>&gt;Salary</li> </ul>	<ul style="list-style-type: none"> <li>&lt;Working conditions</li> <li>&gt;Precarious jobs</li> <li>&lt;Career opportunities</li> <li>&gt;Atypical working hours</li> <li>&lt;Time “sovereignty”</li> </ul>
<b>Enterprise</b>	<ul style="list-style-type: none"> <li>&gt;Coping with fluctuations of work demands</li> <li>&gt;Productivity (just-in-time, etc.)</li> <li>&gt;Exploitation of installations</li> <li>&lt;Costs (electricity, machines obsolescence)</li> </ul>	<ul style="list-style-type: none"> <li>&gt;Complexity of work organization</li> <li>&gt;Difficulty in management</li> <li>&gt;Difficult industrial relations</li> </ul>
<b>Society</b>	<ul style="list-style-type: none"> <li>&gt;Goods available</li> <li>&gt;Social services</li> <li>&lt;Unemployment</li> <li>&gt;Consumer’s convenience</li> <li>&gt;Living conditions</li> </ul>	<ul style="list-style-type: none"> <li>&gt;Vulnerable work force</li> <li>&gt;Distorted competition</li> <li>&gt;Environmental and social problems</li> <li>&gt;Social disparities</li> </ul>

different impact on worker's health and well-being, depending on different combinations of job insecurity, work intensity, time pressure, and low worktime control, existing in permanent and temporary workers, as well as in self-employed and employed workers.

Medical and social interest to this problem started last century and increased over the latest decades, although Bernardino Ramazzini (1633–1714), the “father” of Occupational Health, in his book *De Morbis Artificum Diatriba* (Diseases of Workers), had already pointed out the harmfulness of shift work, in particular night work concerning bakers, who “work at night, so when the others sleep they stay awake, while trying to sleep during the day like animals who escape the light: hence, in the same town, there are men living an antithetic life in comparison with the others.”

With reference to the World Health Organization's definition of “health” as “a state of complete physical, emotional, and social well-being, not merely the absence of disease or infirmity,” shift work fits well with it as it interferes with all those dimensions, in particular:

- (a) It perturbs biological homeostasis, due to disruption of circadian rhythms of psychophysiological functions, starting from sleep/wake cycle.
- (b) It reduces performance efficiency due to fluctuations over the 24-h span, with consequent higher risk of errors, accidents, and injuries.
- (c) It worsens health both in the short term, through disturbances of mood, sleep and eating habits, and in the long run through chronic neuropsychological, digestive, metabolic, cardiovascular and reproductive disorders, and probably cancer.
- (d) It hinders human relations with consequent negative influences on family and social life.

Studies and research carried out in last decades concerning the relationships among working hours, health, and well-being show the negative consequences deriving from uncontrolled globalization, inaccurate implementation of new technologies, and not human-centered working time organization, with consequent high economic and social costs for individual, enterprise, and whole society (Birth 2007; Costa 2001).

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## **Interference on Biological Homeostasis**

Staying awake at night and trying to sleep during the day are not a physiological condition for diurnal creatures like humans, who have connected wakefulness and activity with daylight, and rest and sleep with night. This social behavior is supported by the rhythmic fluctuation of body functions (neuropsychological, metabolic, digestive, cardiovascular, etc.) throughout the 24 h (“circadian rhythms” from Latin “circa diem”), with higher levels during the day and lower during the night.

The perturbation of sleep/wake cycle is a significant stress for the endogenous regulation of biological circadian rhythms, which is driven by the biological master clock, located in the suprachiasmatic nuclei (SCN) in the hypothalamus, and synchronized to the 24-h cycle by environmental cues, namely, the light/dark cycle, through non-vision-related photic stimuli from retinal ganglion cells with high sensitivity to light (particularly in the blue visible range). The SCN, via the superior cervical ganglion, regulates melatonin secretion by the pineal gland, which is inhibited by light exposure, while it increases during the dark period (with peak between 2 am and 5 am), indicating the “biological night” (Roenneberg et al. 2007).

Shift work, in particular that including night work, obliges workers to modify their normal sleep/wake cycle and related circadian settings according to changing periods of activity. Such “adjustment” entails a progressive phase shift of body functions, which increases with the number of successive night shifts but seldom or never reaches the complete inversion, particularly in case of more common rotating (weekly or faster) shift schedules, being invariably frustrated by the constant changeovers. On the other hand, in case of permanent night work, the adjustment may be almost complete only if the inverted sleep/wake cycle is maintained even on rest days.

The misalignment or disruption of circadian rhythms (period, phase, amplitude, mean level) of body functions is responsible for the so-called “jet lag” syndrome, being similar to that occurring after transmeridian flights, characterized by feelings of fatigue, sleepiness, insomnia, digestive troubles, irritability, poorer mental agility, and performance efficiency. It takes few days to recover, depending on direction (clockwise or counterclockwise), extent and duration of phase shift imposed, as well as on personal characteristics and coping strategies.

Sleep suffers both in quantity and quality according to timing of duty and rest periods, environmental conditions, and worker’s characteristics, habits, and behaviors (e.g., age, gender, chronotype, commuting times, family, and social commitments). After the night shift, the worker has to sleep during the normal rising phase of circadian rhythms (cortisol *in primis*) which sustains wakefulness. This makes it difficult to fall asleep, and sleep is shortened by 1–4 h and less restorative, being more fragmented, with reduction of stage 2 and rapid eye movement sleep, and perturbed in its normal sequence of stages. This is also due to unfavorable environmental and housing conditions, in particular as concerns disturbing noises and lighting. Even in early morning shifts, sleep can be greatly reduced (mainly the REM phase), due to the truncation of its last part, usually not compensated by a corresponding advance of bedtime the previous night, due to family ties and social habits (Akerstedt 2003; Sallinen and Kecklund 2010; Boivin and Boudreau 2014).

Therefore, severity of sleep deterioration may vary according to timing and sequence of shifts, position and duration of intervals, and rest periods, which can become very critical in case of “quick return,” that is, a too fast counterclockwise rotating shift schedule, having morning shift immediately after afternoon shift, and followed by night shift in the same day.

As a matter of fact, sleep disturbances are complained by the majority of shift workers. According to Akerstedt (2003), three out of four people who work at night



complain about sleep disorders that can be defined as insomnia according to Swedish standard criteria.

The diagnosis of “shift-work sleep disorder” (SWSD) has been defined by the International Classification of Sleep Disorders as “a primary symptom of either insomnia or excessive sleepiness that is temporally associated with a work period that occurs during the habitual sleep phase, and not attributable to other sleep disorders or medical conditions.” It has shown a differential prevalence of 14.1% and 8.1% for night and rotating shift workers, respectively, as compared to day workers, in a US community survey of more than 2500 workers, aged between 18 and 65. Moreover, shift workers with SWSD show higher absenteeism and miss significantly more family or social activities in comparison to day workers with insomnia or excessive sleepiness (Drake et al. 2004).

According to more recent epidemiological studies on different work sectors, workers screened positive for excessive wake time sleepiness and insomnia related to shift work ranged from 32.1% to 53.9% as compared to 10–15% of day workers (Wickwire et al. 2017). It has been also reported that highly sleep reactive individuals to stress show a five times greater risk of developing SWSD after transitioning to rotating shifts (Kalmbach et al. 2015).

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## **Impaired Performance Efficiency, Errors, and Accidents**

Both homeostatic (time elapsed since waking) and circadian (sleep/wake cycle) processes interact in determining the fluctuation of vigilance and performance efficiency over the waking day, and even more so at night. During a normal day after a night sleep, alertness is high in the morning and early afternoon and progressively decreases during late afternoon and night hours, while conversely sleepiness increases, due to the circadian drop of most psychophysical functions and the extension of time awake.

Many studies on sleep deprivation have documented that having less than 5 h sleep in the preceding 24 h, as well as less than 12 h in the preceding 48 h, increases the risk of a significant performance impairment. The decrement of cognitive psychomotor performance after 17 h of sustained wakefulness is comparable to that observed at a blood alcohol concentration of 0.05%, which is the legal limit for driving in most countries (Dawson and Reid 1997).

Therefore, the association of circadian disruption and sleep deprivation is responsible for high levels of sleepiness and fatigue during shift work, in particular at night, which further increases in case of cumulative sleep deprivation due to more consecutive night shifts. This results in greater propensity to errors, incidents, and injuries, by interacting with organizational factors, such as environmental conditions (dim light, less hectic), workload (time on task, work pacing, monotony), and time pressure (Jehan et al. 2017).

In industry, in 3×8-h shift systems with comparable working conditions, the relative risk of accidents has been estimated to increase of 18% in afternoon shift and 30% in night shift, as compared to morning shift. Moreover, the risk increases over

consecutive night shifts, being about 6% higher in the second, 17% higher in the third, and 36% higher in the fourth night (Folkard and Tucker 2003). Shift length is also a relevant factor for fatigue-related accidents. According to several studies reporting an almost exponential increase of accidents after the 8th hour of work, it is possible to estimate a 13% and 27% increased risk associated to 10-h and 12-h shifts, respectively (Knauth 2007, Lombardi et al. 2010).

In the transport sector, fatigue and lapses of attention due to sleep deprivation are key risk factors in road and railway accidents involving professional drivers. It has been evidenced that drowsy drivers often are not aware of their risky conditions and not able to take the appropriate actions to avoid an accident, as they frequently drive with closed eyes for few seconds (microsleep episodes). Thus, “single vehicle” accidents on roads have the greatest probability of occurring at night or in the early morning, even when traffic density has been controlled (Philip and Åkerstedt 2006; Smolensky et al. 2011). Also in train drivers and railway traffic controllers, severe sleepiness has been recorded in 50% of night shifts and 15–20% of morning shifts, and the risk of severe sleepiness is 6–14 times higher in night shift and about twice as high in morning shift as compared with day shift (Härmä et al. 2002).

Regarding hospital health care, both physicians and nurses, engaged in shift and night work and for prolonged duty periods, show significant negative effects on cognitive, behavioral, and psychomotor performance with increased risk of clinical errors such as to hinder patients’ safety and health. Among physicians, several studies reported significantly higher injury rates from biological accidents in night shifts, doubled rate of motor vehicle crashes while driving home after night and extended work shifts, and wrong drug administration and errors in clinical evaluation of critically ill patients, due to fatigue and drowsiness. Even nurses working rotating schedules have been recorded to be nearly twice as likely to report committing a medication error and falling asleep at least once during their work shift. A significant association was also found among errors in drug administration, shift work, and age, as well as among incorrect operation of medical equipment, excessive daytime sleepiness, and age. Several studies also showed an association among nurses’ staffing levels, prolonged or irregular working hours, and patient mortality or adverse outcomes (Costa 2014).

It is worth mentioning that the “human error” connected to shift scheduling and fatigue due to sustained operation have been cited as important contributory factor in many overnight flight, ship, industrial, and environmental disasters occurred in latest decades: e.g., Three Mile Island (1979) and Chernobyl (1986) nuclear power plants radiation release, leakage of toxic chemicals in Bhopal area (1984) and in Rhine waters (1986), explosion of Challenger space-shuttle (1986), Exxon Valdez tanker shipwreck with oil spill (1989), sinking of Estonia ferry (1994), and petroleum freight train derailment in Quebec (2013) (Reinberg et al. 2015).

In the USA, in the year 1988, it has been estimated that 52% of work accidents were potentially related to sleepiness, with associated 5565 fatalities and 945,000 disabling injuries, creating a cost of \$24.7 billion. The accidents occurred during the hours of maximum sleepiness (i.e., between 2:00 to 7:00 am and 2:00 to 5:00 pm, i.e., 33% of the 24-h day), accounted for 36.1% of fatal accidents and 41.6% of total

accidents. A significant contribution was certainly given by shift and night work considering that about 25% of working Americans were engaged in shift work and 6% in night shift work (Léger 1994). The same happens for the increasing prevalence and costs, direct and indirect, of insomnia worldwide, including comorbidities, injuries, lost productivity, and absenteeism: regarding the latter, insomnia was recorded as the most predictable factor for absenteeism at work among 36 variables taken into consideration (Léger and Bayon 2010).

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## Health Disorders

An increasing amount of epidemiological studies show that shift and night work may cause severe long-term effects on health, with consequent high economic and social costs for both workers and society.

Shift workers frequently complain of irritable, nervous, anxious, or depressed mood in relation to more stressful working conditions and greater difficulties in family and social life. In the long run, this may cause persistent sleep disorders, chronic fatigue, anxiety, and depression, requiring the administration of psychotropic drugs (Bara and Arber 2009).

Shift workers show a higher prevalence (20–75% vs. 10–25% of day workers) of digestive troubles (dyspepsia, gastric pyrosis, constipation, or diarrhea) and have on average a 2 to 5 times higher prevalence of gastrointestinal disorders, namely, gastroduodenitis, peptic ulcer, and irritable bowel syndrome. This is a consequence of the mismatch between mealtimes and circadian digestive functions with related hormonal secretion (e.g., ghrelin, leptin, insulin), as well as to changes in food quality (often prepackaged food) and increased assumption of stimulating drinks, which interact in perturbing the complex hierarchical organization between central biological clock and peripheral clocks in the liver, adipose, and muscle tissues (Knutsson and Boggild 2010).

Consequently, a higher prevalence of metabolic disturbances, such as dyslipidemias, overweight, metabolic syndrome, and type 2 diabetes, which are risk factors for cardiovascular diseases, has also been reported (Gronfier et al. 2016). A 20 to 40% increased risk of coronary heart diseases has been recorded by several studies in shift workers as compared to day workers (Torquati et al. 2018). On the basis of prevalence of shift workers in adult working population in Canada, an attributable risk for shift work of 7.0% for infarction and 7.3% for coronary events in the entire population was also estimated (Vyas et al. 2012).

Several pathways, including direct and indirect physiopathological mechanisms, are involved in the causal association between night shift work and cardiovascular diseases (in particular hypertension and ischemic heart disease) and are related to:

- (a) Physiological stress, connected to elevated indices of inflammation and coagulation (homocysteine, fibrinogen), changes in autonomic cardiac control (increased heart rate variability), and hormonal responses (HPA axis)

- (b) Psychological stress, due to more stressful working conditions, work-life conflicts, and poor recovery from work
- (c) Behavioral stress, related to sleep deprivation and unhealthy lifestyles (smoking, unbalanced nutrition, poor physical activity) (Puttonen et al. 2010)

“Shift work that involves circadian disruption” has been classified as “probably carcinogenic to humans (Group 2A)” by the International Agency for Research on Cancer (Straif et al. 2007), on the basis of “limited evidence in humans for the carcinogenicity of shift-work that involves night work” and “sufficient evidence in experimental animals for the carcinogenicity of light during the daily dark period (biological night).” The suggested mechanisms, by which circadian disruption may damage the cell cycle regulation and favor induction and/or promotion of malignant tumors, concern multilevel endocrine changes connected with suppression of melatonin secretion by exposure to light at night, epigenetic changes of clock genes that regulate the timing of biological functions, and deficiency of immune surveillance also related to chronic sleep deprivation. This assessment was essentially related to breast cancer in women with long experience of shift and night work (>20 years), while conflicting results have been reported for other organs (prostate, ovary, lung, pancreas, colon, bladder, skin, lymphopoietic). In recent years an increasing number of studies and meta-analyses have been published which, despite some limitations in assessing exposure and controlling confounding factors, tend to confirm the concern about breast cancer, while they are still limited and inconclusive for other organs or systems (Gronfier et al. 2016). In the second evaluation carried out in June 2019, IARC Working Group concluded “there was limited evidence that night shift work causes breast, prostate, and colorectal cancer» and confirmed its classification as “probably carcinogenic to humans (Group 2A)” (Ward et al., 2019).

For women shift workers, many studies have reported a higher prevalence of disorders of menstrual cycle, premenstrual syndrome and menstrual pains, miscarriage rates, and impaired fetal development, including preterm birth and low birth weight (Nurminen 1998).

Shift work may also increase the toxicological risk in relation to the circadian fluctuation of metabolic processes of detoxification and elimination of chemical substances, to which shift workers may be exposed at different times of day and night (Smolensky et al. 2019). On the other hand, it may also hinder the efficacy of medicaments which require a precise timing of administration and a stable life regimen for the control of some chronic health disorders quite frequent in the general population (i.e., diabetes, hypertension, endocrine dysfunctions).

Economic costs of shift work-related health disorders are certainly relevant, taking into account the combined effects of lost productivity, disability, and existential damage, but difficult to quantify. In the USA, the extra cost due to irregular work hours has been estimated in about \$4 billion per year for coronary heart diseases and \$2 billion more per year for gastrointestinal and psychoneurotic disorders and the management of other chronic illnesses (Moore-Ede 1993).

## Family and Social Life

Shift and night workers are frequently out of phase with the society, as most family and social activities are planned according to day-oriented rhythms of general population. Work, leisure, and sleep times usually assume different values according to social timetables: late afternoon and evening hours, as well as weekends, are the most desirable for social contacts and leisure activities.

Shift workers find it more difficult to combine their times as “producers” and “consumers,” particularly when their leisure activities involve the integration of many people into organized groups (e.g., sport teams, civic groups, political, and cultural organizations) and require regular contacts. Thus, shift work may lead to some degree of social isolation or marginalization.

Moreover, shift workers experience the conflicts between their time budgets and the complex coordination of individual times of family members, as family life can vary greatly according to different phases of family cycle (e.g., marital status, number and age of children, elderly cohabiting relatives), distribution of duties among members (official job, housework, moonlighting), and timetables of community services (i.e., schools, transports, shops, etc.) (Loudoun and Bohle 1997; Grzywacz 2016).

These problems are further complicated when both partners are shift workers and can have negative effects on parent’s roles and relationships, as well as children’s education. Time pressure is a constant condition for those who have high family burdens or complementary duties. It must also be considered that reduced fertility and higher abortion rates may be a consequence of personal choices of women forced to choose between motherhood and employment, due to difficulties in managing irregular living patterns. It is obviously impossible to quantify the costs of losing a child or forced resignation from maternity considering their existential significance not only for women but also for society and mankind in general.

Such social problems are often more felt than the biological ones and may be the main cause of maladaptation to shift work, playing an important role on development of psychosomatic disorders.

On the other hand, shift workers are obliged to learn how to use daytime periods more positively. Shift work gives more flexibility to those who enjoy solitary activities (e.g., hobbies) or in the case of women who prioritize family and domestic duties over personal leisure time.

Shift work may be better tolerated by workers who are able to find more opportunities for private needs or simply to enjoy longer intervals of free time between shift cycles (e.g., the youngsters). For these reasons some more stressful shift systems in terms of biological effect, that is, those based on counterclockwise fast rotation with quick changeovers or on 12-h shifts are often preferred for their long off-duty periods (Pisarski et al. 2008).

Thus, the well-known trade union slogan “Eight hours’ labour, Eight hours’ recreation, Eight hours’ rest,” coined at the beginning of the nineteenth century in order to avoid long and demanding working hours and to achieve a fair balance in human activities, is now undergoing a profound reflection, not only with regard to

quantitative relationships in terms of position, duration, and sequence but also for qualitative aspects and mutual interference between work and social life.

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## **Factors Affecting (Mal)adaptation and (In)tolerance to Shift Work**

There is a high inter-individual variability in tolerance to shift work, as the process of (mal)adaptation or (in)tolerance may have different speed and intensity among the persons, according to different personal characteristics, as well as to working and social conditions they deal with and may change along the working life. Consequently, health troubles and disorders can manifest in different life periods, with different degrees of severity and duration, and sometimes in an alternating way.

### **Personal Characteristics**

Aging people can face increasing difficulties in coping with irregular work and living patterns due to several factors related to (a) weakening of the circadian system, resulting from molecular and functional changes in the central biological clock, that makes the organism more prone to internal desynchronization; (b) progressive tendency to a phase advance of circadian rhythms; (c) slower circadian adjustment over successive night shifts; and (d) reduction of sleep duration and quality, resulting in less recovery and greater sleepiness during waking hours. Alertness and performance efficiency of elder workers suffers more from homeostatic than circadian process; moreover, health deterioration with increasing age may be more pronounced in shift workers due to chronic fatigue and sleep deprivation. This can favor age discrimination or unequal treatment at workplace of elder workers and increased social problems in a progressively aging society. On the other hand, we have also to consider that aging shift workers may develop better coping strategies, mainly in terms of work commitment, more regular life regimen, more satisfactory job positions, better housing conditions, and fewer domestic constraints (Costa and Di Milia 2008).

Subjects having the characteristics of “morningness,” that is, most awake and functional in early morning hours due to their advanced phase position of circadian rhythms, face more difficulties in short-term adjustment to night work compared to “evening” types, more awake and functional during the late afternoon or evening hours for their delayed circadian phase position, which partially compensate the through of biological functions at night. Conversely, “morning” types cope better than “evening” types with early morning shifts (Folkard and Hunt 2000).

Also individuals with a less stable circadian structure, and more susceptible to internal desynchronization, show a poor tolerance, characterized by persistent fatigue, sleep and mood disturbances, and regular use of sleeping pills (Reinberg and Ashkenazi 2008).

Moreover, people with high levels of neuroticism, or with rigid sleeping habits and lower ability to overcome drowsiness, may have more difficulties in their

adaptation to irregular work schedules (Saksvik-Lehouillier et al. 2012). On the other hand, good physical fitness and a strong commitment to shift work may favor a better tolerance (Härmä 1996).

## Family and Living Conditions

Difficulties in family and social life are often perceived by shift workers as more important than those linked to the biological sphere, and frequently they are the main cause of intolerance, since in turn they can act as additional risk factors for psychosomatic disorders.

Marital status and happiness, number and age of children, cohabitation with old and/or sick people, housing location, and comfort (e.g., rooms protected from disturbing noises) have been shown to concur significantly in acceptance and tolerance to shift work. Support from family and friends at home, as well as from co-workers and supervisors at work, has been proved to mitigate negative effects and to enhance adaptability and tolerance (Kogi 2001). The partner's job (above all if a shift worker too) and the organization of social services (in particular school timetables, shop hours, public transport) are factors able to change dramatically their tolerance. It has been noted that family's attitude toward the shift worker can act either positively, by activating a process of slight "self-adjustment" to the shift worker's timetables (mainly in case of women), or negatively by isolating the shift worker (mainly in case of men) periodically from family context. Even tradition of shift work within a community can significantly promote tolerance, as the social organization is more closely linked to working hours (Loudoun and Bohle 1997; Pisarski et al. 2008).

## Working Conditions

Shift and night work may be variously associated with different types of employment and work sectors. Workload and content may notably differ between shift and day workers even within the same job, particularly with regard to job demand, control and autonomy, and work-life conflicts.

All that has a significant impact on job satisfaction, psychological well-being, and family-work balance.

It has been evidenced that a more individually oriented flexibility of working hours is associated with higher levels of health, work satisfaction, and family life, whereas a more company-oriented flexibility may have more negative effects. However, the result of their interaction may depend and largely differ for personal manifestations and time of occurrence in the worker's life (Costa et al. 2006; Janssen and Nachreiner 2004).

Regarding shift systems in particular, there are thousands of different shift schedules which may have a quite different impact on worker's health, safety, and social life, according to (i) presence and amount of night work; (ii) duration of shifts

(mostly 8 h but may range from 4 to 12 or more hours); (iii) if they are fixed or rotating, regularly or irregularly; (iv) number of workers/crews who alternate during the working day (e.g.,  $2 \times 8$  h,  $3 \times 8$  h,  $4 \times 6$  h or  $2 \times 12$  h rotas); (v) speed (“fast,” i.e., up to three shifts in a row, or “slow,” i.e., four or more shifts in a row) and direction (clockwise or counterclockwise) of shift rotation; and (vi) start and end time of duty periods (i.e., start between 4 and 8 am for morning shift, and between 6 and 12 pm for night shift). These aspects will be re-examined in section “[Preventive and Compensative Measures](#).”

## Socioeconomic Conditions

The organization of working hours may be similar in developing, industrialized, and post-industrialized countries, but their historical, cultural, and socioeconomic background makes the impact on health, safety, and well-being quite different.

In many developing countries, the effects of night work on health and safety are aggravated by unfavorable social conditions, such as low education, low economic level, malnutrition, poor housing, scarce social and health services, lack of social and labor protection, labor market restrictions, and discrimination. Moreover, shift work is often associated with long working hours and poor working conditions, such as environmental pollution, heavy workload, low qualification, and inadequate transportation facilities (Ong and Kogi 1990; Fischer 2001).

In the industrialized countries with high immigration levels, minority ethnic groups are often engaged in jobs with low pay and worse working conditions, including more shift and night work, with consequent negative impact also on leisure activities and social integration.

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## Preventive and Compensative Measures

Particular attention must be paid to the organization of shift schedules taking into account not only economic reasons but giving priority to workers’ conditions, in particular with regard to human physiology, psychological and social problems, and possible negative effects on health and well-being, as stated by international institutions (i.e., International Labour Organization Convention no. 171/1990 and Recommendation no.178/1990, European Parliament Directive 2003/88/EC).

The main guidelines for designing shift systems according to ergonomic criteria (Knauth and Hornberger 2003) are:

- (a) Quickly rotating shift systems are better than slowly rotating systems, since they interfere less with circadian rhythms and limit cumulative sleep deficits.
- (b) Clockwise rotation (morning/afternoon/night) is preferable to counterclockwise (afternoon/morning/night), since it follows the endogenous circadian periodism (which is slightly longer than 24 h in conditions without external environmental



- cues), avoids quick changeovers, and allows longer rest periods for immediate recovery.
- (c) Too early start of morning shift should be avoided in order to reduce the truncation of sleep and consequent sleepiness and fatigue.
  - (d) Prolonged work shifts (9–12 h) should only be contemplated when workload is suitable, i.e., with adequate pauses and timing to minimize fatigue accumulation and exposure to toxic substances.
  - (e) Shift systems should be regular and ensure as many free weekends as possible, to allow people to plan and enjoy their social and leisure time more conveniently.
  - (f) Permanent night work can be acceptable only for exceptional work situations, which require a complete adaptation to night work to ensure maximum safety levels.
  - (g) Flexible working hours should be promoted in order to meet workers' needs and preferences.

However, it is worth emphasizing that there is no “best” shift system to recommend in general, but each shift schedule should be tailored according to the different job activities and demands, as well as to the characteristics, social habits, and cultural background of workers involved. This implies a careful strategy for planning shift rotas, which requires workers' participation in their analysis, design, implementation, and assessment. This is of paramount importance, not just to get directions from those who have direct experience of the problem but also to promote the right motivation for accepting the changes and, consequently, improving their psychophysical tolerance.

Furthermore, many interventions can be implemented to counteract the drawbacks. However, but it must be considered that the “counterweights” are only aimed at compensating for the disadvantages (i.e., monetary compensation, improved general working conditions), whereas the “counter-values” are correctly aimed at risk containment, through reduction of working hours and/or night work, more rest days or extra time off, additional breaks for meals and naps, sleeping and canteen facilities, social support (e.g., day nursery, transports, extended school and shop hours, better housing), health surveillance, physical and psychological training, transfer to day work after a certain number of years, and early retirement.

Proper education and counseling are key issues in this regard. Managers in charge of working time organization must understand which may be the negative consequences on worker's health and performance, hence also on absenteeism, productivity, and company costs, in order to plan the best working time agreement and workers' management. Workers need to understand which problems and disorders are related to shift and night work and which are the best coping strategies to prevent or limit them, in particular with reference to sleep hygiene, diet, physical fitness, stress management, (ab)use of medicaments, light exposure, and off-job activities (Kogi 2001; Pallesen et al. 2010).

Regarding health surveillance, it must be taken into account that there are many pathological conditions, either directly associated with shift and night work, as abovementioned, or independent of them, which can be a potential contraindication

for shift and/or night work. This is the case, in particular, of persistent sleep disorders, severe gastrointestinal and cardiovascular diseases, neuropsychic syndromes, metabolic and hormonal dysfunctions, chronic renal impairment, and cancer. They must be carefully evaluated during the process of assessing fitness for work in terms of severity and possibility of appropriate therapy, with any limitations and/or prescriptions on a temporary or permanent basis (Costa 1998).

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## Conclusions

The aforementioned testifies to the severity of this risk factor on human health and well-being both from the psychophysical and social point of view, starting from disruption of biological circadian rhythms and sleep/wake cycle, passing through impaired performance efficiency and family and social life, and ending in several psychosomatic disorders.

Both professional and nonprofessional stressors, as well as cognitive and behavioral coping efforts and strategies, interact to determine the complexity of the problem and the difficulty in managing factors belonging to work, personal, and social dimensions.

These interferences are complex and multifaceted in their origins and temporal manifestations; hence, the more holistic the approach is, the greater the possibilities to better understand the problem and, consequently, to adopt the right preventive and corrective strategies at the best “cost/effectiveness” ratio for both workers and communities. This requires the integrated involvement of several domains that describe human life, such as physiology, psychology, sociology, ergonomics, economics, politics, and ethics.

Arrangement of shift schedules according to ergonomic criteria, adoption of more flexible working times, greater autonomy and control of work organization and conditions, more compensations in terms of social services, job, and career opportunities, suitable counselling and training, appropriate medical surveillance, as well as a more balanced integration among work, environment, and society, are the main tools capable of supporting a right evolution of *homo sapiens* in the 24/7 society.

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## Cross-References

- ▶ [Work–Life Balance: Definitions, Causes, and Consequences](#)
- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Financial Gains, Possibilities, and Limitations of Improving Occupational Health at the Company Level](#)
- ▶ [Interactions of Work and Health: An Economic Perspective](#)
- ▶ [Job Intensity](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [Social Distribution of Occupational Hazards](#)
- ▶ [The Associationalist Demand–Control \(ADC\) Theory](#)

- ▶ The Demand Control Support Work Stress Model
- ▶ Work and Health
- ▶ Work Stress and Adverse Health Behaviors
- ▶ Work Stress and Autonomic Nervous System Activity
- ▶ Work Stress, Immune, and Inflammatory Markers

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# Underemployment, Overemployment, and Mental Health

# 13

Deborah De Moortel

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## Abstract

This chapter focuses on the difficulty locating work that is consistent with one's needs, abilities, values, and interests and its consequence for workers' mental health. More specifically, the concept of "volition" is entered in research on mental health consequences of working hours. Volition, in this context, means the degree to which workers are able to work their preferred number of working hours. To describe work hours that are not in line with one's preferences, the concepts of under- and overemployment are used. Firstly, a short literature review

Deborah De Moortel is a FWO [PEGASUS]<sup>2</sup> Marie Skłodowska-Curie Fellow. Her research has received funding from the FWO and European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665501

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_5](https://doi.org/10.1007/978-3-030-31438-5_5)

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on under- and overemployment conceptualizations and measures is given. Afterwards, three relevant empirical questions are answered: (1) whether the length of the working hours is a determinant for mental health or whether the involuntary nature of working hours is harmful to mental health; (2) whether family- and work-related resources are important for the health impact of under- and overemployment; and (3) whether a narrower interpretation of “volition,” comparing solely the discrepancy between actual and preferred working hours, is a determinant of health. In this chapter, it becomes clear that the conceptualization and measurements of under- and overemployment are extremely heterogeneous. Moreover, it is hours mismatch rather than the actual number of hours that is detrimental for health.

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**Keywords**

Health · Well-being · Working hours · Mismatch

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**Introduction**

Time is a resource for good health (Strazdins et al. 2016). People need time to exercise, to eat healthy food, to build strong and supportive relationships, to earn an income, to visit a doctor, etc. (Strazdins et al. 2016). A lack of time results from competing demands. For workers, the most obvious competing demands are those between paid and unpaid work. Individuals need both work and leisure time. Work time offers health-promoting resources, including an income, occupational status, social networks, and benefits (Kleiner et al. 2015). Work provides individuals with structure in their daily lives, social contacts, a sense of collective purpose, status, and activity (Jahoda 1981). In contrast, leisure time offers opportunities for recovery, socializing with family, etc. Unsurprisingly, paid work needs to be “balanced” with other parts of life for an individual to gain a good health.

Research on the intersection of work and private life is faced with changes in the experience of time, both at work and at leisure activities. Many scholars have observed changes in individual values and norms related to work and leisure time (Cogin 2012; O’Carroll 2014). These tendencies are partly driven by demographic changes, namely, the rise in dual-earner couples and single parent households (Greenhaus and Powell 2006). The preference for achieving better trade-offs between time and money is rising (Cogin 2012). Among generation Y, leisure is becoming the most valued use of time (Cogin 2012). A blurring of traditional gender roles is also noticed, with men wanting to be a more involved father, husband/partner, and son (Aumann et al. 2011).

Yet, not only individuals’ values and norms are changing; the organization of work time is also altering. “Standard” working hours (i.e., working from 9 to 5) are under pressure. Due to, among others, the rise in the service economy, many jobs require more diversified and flexible working-time arrangements. Unpaid overtime and boundaryless work are on the rise (O’Carroll 2014). Change in the length of

work hours is used as a flexibility strategy by employers (Anderson and Winefield 2011). Although the majority of contemporary paid jobs are still full-time (Eurofound 2016), part-time employment is frequently used as a flexibility strategy by employers to change labor supply with customer demand (Anderson and Winefield 2011). As a consequence, scholars raise concerns about whether people are adopting part-time jobs because they have no choice (Anderson and Winefield 2011). Overtime and long hours might also be done unwillingly. Within high-skilled professional jobs, the sensation of “constant availability” and the blurring of the boundary between paid work and personal life are becoming the norm (Eurofound and ILO 2017; O’Carroll 2014).

Because of these tendencies, a growing group of scholars argue that the concept of “volition” needs to be entered in research on health consequences of working hours (Başlevent and Kirmanoğlu 2013; Maynard and Feldman 2011; Reynolds 2003). These authors focus on the difficulty locating work that is consistent with one’s needs, abilities, values, and interests (Allan et al. 2016). To describe work hours that are not in line with one’s preferences, the concepts of under- and overemployment are used. Although there are divergent definitions, generally under- and overemployment refer to having work hours that are less and more than one’s preferences, respectively. Under- and overemployment have been recognized as a problem faced by increasing numbers of individuals in high-income countries around the world (Hiemer and Andresen 2019; McKee-Ryan and Harvey 2011).

The first section of this chapter gives a short literature review on under- and overemployment conceptualizations and measures. Thereby, it becomes clear that the conceptualization and measurements of under- and overemployment are extremely heterogeneous. Secondly, we discuss the underlying mechanisms explaining the link of under- and overemployment with mental health. Low schedule control, defined as the inability to realize one’s preferences, is discussed as the main stressor linking under- and overemployment to poor mental health and well-being. Afterwards, we discuss some studies on under- and overemployment and mental health in more depth. Three relevant empirical questions are answered: (1) whether the length of the working hours is a determinant for mental health or whether the involuntary nature of working hours is harmful to mental health; (2) whether family- and work-related resources are important for the mental health impact of under- and overemployment; and (3) whether a narrower interpretation of “volition,” comparing solely the discrepancy between actual and preferred working hours, is a determinant of mental health. We end this chapter with a conclusion and some ideas for future research.

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## Defining Underemployment and Overemployment

Overemployment is generally conceptualized as a preference for less work hours (Golden and Gebreselassie 2007). In contrast, underemployment is actually a broad and multidimensional term (Feldman 1996). The concept of underemployment has been introduced around the 1950s by economists as a reaction to the sole focus, in



labor market research, on unemployment and employment. At that time, the term was mostly used to describe employment situations where the employed population is not fully utilized, i.e., part-time employment (Berdecia and Jaffe 1955). With the growing interest of behavioral scientist, “underemployment” evolved into a broader term and from a unidimensional to a multidimensional term (Feldman 1996). Nowadays the term describes a whole range of different labor market situations, ranging from inadequate employment relative to some societal standard (e.g., part-time versus full-time work or temporary versus permanent work) to inadequate employment relative to individuals’ preferences or needs (e.g., working less hours than preferred or overeducation). Maynard and Feldman (2011) describe underemployment along three dimensions: (a) time-related underemployment (e.g., involuntary part-time work and involuntary temporary work), (b) skill-related underemployment (i.e., overeducation, overqualification, and involuntary employment outside of educational credentials); and (c) income-related underemployment (i.e., underpayment).

Yet, studies using the concept of “volition” when examining working hours (e.g., comparing workers actual and preferred work hours) are a strand of research on its own and can be found using the following overarching terms: “work hour constraints” (Bell et al. 2011), “work hour congruence” (Lee et al. 2015), “work hour deviations” (Başlevent and Kirmanoğlu 2013), “work hour mismatch” (Pagan 2017; Reynolds 2003), and more recently “employment discrepancy” (Allan et al. 2016). These studies have in common that they investigate whether workers prefer to work less (i.e., overemployment) or more (i.e., underemployment) than their actual working hours. Each of the abovementioned terms have in common that they refer to the perceived employment situation: whether employees’ individual perception of work hours is matched, under- or overemployed (Hiemer and Andresen 2019). When using the terms under- and overemployment in this chapter, this general definition is referred to.

To date a bulk of research on under- and overemployment has been published (Başlevent and Kirmanoğlu 2013; De Moortel et al. 2017; Reynolds 2003). Although, in general, the terms refer to working less or more than preferred, there are almost as many operational definitions as there are researchers studying it (Friedland and Price 2003). There are divergent wording and formats of the questions used to measure under- and overemployment (Hiemer and Andresen 2019; Maynard and Feldman 2011). To illustrate, under- and overemployment are either operationalized (1) as a state in which employees work longer than preferred or wish to increase their working hours, (2) as a state in which an employee wants to work more or less with reference to the dimension of increased or reduced earnings, or (3) as the impossibility of working more or less (Hiemer and Andresen 2019). Thus, estimations of how many people are under- and overemployed vary widely (Hiemer and Andresen 2019).

Studies also differ with respect to their measurement scales (i.e., categorical or continuous) (Hiemer and Andresen 2019). In a large portion of studies, a continuous measure is used to quantify the extent of under- and overemployment (Allan et al. 2016; Reynolds and Johnson 2012). Individuals are asked for the number of actual and preferred work hours, and the difference is calculated, or they are directly asked by how many hours they would like to reduce or increase their current work time (Hiemer and Andresen 2019). Categorical measures of under- and overemployment

are also commonly used. Different types of categories are operationalized. Authors frequently use the three-category variable: (1) “matched,” desired = actual hours; (2) “underemployed,” desired > actual hours; and (3) “overemployed,” desired < actual hours (De Moortel et al. 2018; Pagan 2017). Data from the 6th wave of the European Working Conditions Survey show that, according to this definition, 14% of all workers in Europe are underemployed and 30% overemployed (Eurofound 2016). Other studies make a cross-classification between the above-described categories under- and overemployed and correctly matched workers on the one hand and working hours categories (i.e., <35 h, 35–40 h, 41–49 h, >49 h) on the other hand (Angrave and Charlwood 2015; Constant and Otterbach 2011).

Table 1 summarizes all the different ways under-, over-, and matched employment can be operationalized. The table is subdivided in three large parts: over-,

**Table 1** Different types of operationalization of under-, over-, and matched employment

Terms	Measurement scales	Cutoff points	
		Number of actual hours per week	Number of preferred hours per week
<b>Overemployment</b>			
Involuntary long hours	Categorical	>40 h or more	≤40 h or more
Involuntary full-time	Categorical	>34 h	<35 h
Involuntary working hours categories	Categorical	1–20 h 20–34 h 35–40 h 41–49 h 50 h or more	<1–20 h <20–34 h <35–40 h <41–49 h ≤50 h or more
Wanting less hours	Categorical or continuous	Number of actual hours per week > number of preferred hours per week	
<b>Underemployment</b>			
Involuntary part-time or short hours	Categorical	<35 h	>34 h
Involuntary working hours categories	Categorical	1–20 h 20–34 h 35–40 h 41–49 h 50 h or more	≥20 h >20–34 h >35–40 h >41–49 h >50 h or more
Wanting more hours	Categorical or continuous	Number of actual hours per week < number of preferred hours per week	
<b>Matched employment</b>			
Voluntary long hours	Categorical	>40 h or more	>40 h or more
Voluntary full-time	Categorical	>34h	>34 h
Voluntary part-time	Categorical	<35 h	<35 h
Involuntary working hours categories	Categorical	1–20 h 20–34 h 35–40 h 41–49 h 50 h or more	1–20 h 20–34 h 35–40 h 41–49 h 50 h or more
Matched employment	Categorical or continuous	Number of actual hours per week = number of preferred hours per week	

under-, and matched employment. For every type of employment, the different terms, measurement scales, and cutoff points used by researchers are listed. Within the table, the first column lists the terms, the second column lists the measurement scale(s), and the last columns list the cutoff points. As a side note, besides all the distinctions described in the table, studies can differ in another aspect: some studies introduce a minimum gap in the work hour range – a minimum discrepancy of 4 or 10 h between desired and actual hours, for instance – to define workers as under- or overemployed (Hiemer and Andresen 2019).

One of the most commonly used conceptualizations of underemployment is involuntary part-time employment (Allan et al. 2017). Involuntary part-time employment is defined as working less than 35 h per week but wanting more. In the EU there are 10 million people who are working part-time but who want to work full-time (Eurofound 2018). This is around 20% of the workforce with an involuntary part-time job (De Moortel et al. 2017). Moreover, involuntary part-time employment is on the increase in European labor markets (Eurofound 2017). The increasingly segmented nature of European labor markets, the jeopardizing of the quality of jobs, and the intensification of competition as a result of the recession are put forward as reasons for the growing presence of involuntary part-time employment (Lallement 2011).

Because of the divergent operationalization of under- and overemployment, integrating existing research results is challenging (Hiemer and Andresen 2019). When describing numbers and percentages, special attention needs to be paid to the conceptualization of under- and overemployment.

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## **An Important Mental Health Determinant**

Regardless of the definition or specification used, “under- and overemployment can be considered psychosocial work stressors” (De Moortel et al. 2018). A worker confronted with a potentially “stressful” work characteristic (such as under- or overemployment) will experience actual stress if the worker has no available resource to cope with it. This work characteristic is called a psychosocial work stressor because the experienced stress is chronic or repeated (Mc Ewen 1998). According to De Moortel et al. (2018), “under- and overemployment might hinder a sense of control over the number of hours worked.” Low schedule control, defined as the inability to realize one’s preferences, is recognized as the main stressor linking under- and overemployment to poor health and well-being (Lyness et al. 2012). Why workers want more hours or less hours may differ, for example, because of a low income or high family responsibilities. Yet, a low income or high family responsibilities can also be present without the workers reporting a preference for more or less working hours. Under- and overemployed workers are distinguishable from matched workers through their shared sense of a lack of control over their working hours, which when perceived as unable to deal with might cause chronic or repeated stress (Mc Ewen 1998).

The importance of “low schedule control” for workers’ mental health is well illustrated by examining how “healthy” it is to involuntarily work hours that are different from the standard working week (working 35–40 h per week; Dixon et al. 2014). In Europe, there is a tendency of abandonment of the “standard working week” (De Moortel et al. 2017). Firstly, flexibility is increasingly achieved by reducing the length of the work week. This is the deregulation of employment protections concerning the temporal organization of work (Dixon et al. 2014). As a consequence, working fewer hours per week than is preferred is becoming more prevalent (Stier and Lewin-Epstein 2003). Secondly, to an increasing extent, jobs are defined by “rich” work tasks, a high level of autonomy, and the disappearance of fixed hours and locations (Van Echtelt et al. 2006). This has been found to increase time spent working, sometimes more than preferred (Van Echtelt et al. 2006), especially within high-skilled professional jobs (Van Echtelt et al. 2006).

Working less than the standard work week (from here on: short working hours) is a potential health hazard because of an enhanced negative work home spillover, namely, workers needs and desires are deprived. Drawing on the resource approach, which highlights the health-promoting resources tied to employment, working short hours might among others result in lower income and fewer social contacts at work (Kleiner et al. 2015). Working more than the standard work week (from here on: long working hours) is also a potential health hazard because of an enhanced negative work home spillover, namely, workers are time deprived. Nevertheless, it is expected that especially when the short or long working hours do not match with preferences, an adverse relation with mental well-being outcomes can be expected, because of the experienced “low schedule control” (Dixon et al. 2014). To explore which mechanism (“enhanced negative work home spillover” or “low schedule control”) is at play for workers employed with involuntary short or long working hours (also a specific definition of under- and overemployment), the question needs to be answered whether the length of the working hours is a determinant for mental health or whether the involuntary nature of working hours is harmful to mental health. Because few evidence exists, in the following part, we illustrate this question with own findings.

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## Empirical Evidence

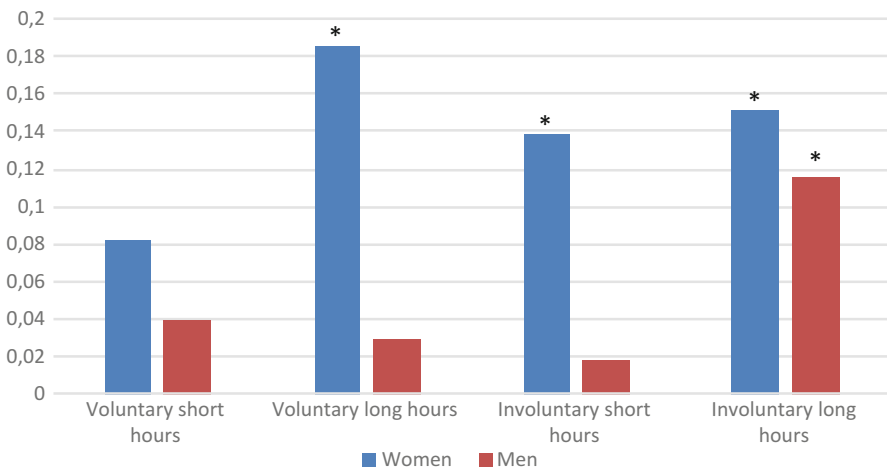
Using the questionnaire from the European Social Survey (ESS) Rounds 2 (2004–2005) and 5 (2010), a study was conducted on wage earners younger than 66 years old (De Moortel et al. 2017). In the ESS, employees were asked how many hours they normally work in a week (overtime included) and how many hours they would choose to work in a week, bearing in mind that earnings would go up or down according to the number of working hours chosen. So, a reference to the dimension of increased or reduced earnings is made. A cross-classification is made between volition (yes/no) and three types of working hours (short hours, standard hours, long hours) resulting in five categories:

1. Standard hours (working and preferring 35–40 h per week)
2. Voluntary short hours (working and preferring <35 h per week)
3. Voluntary long hours (working and preferring  $\geq 41$  h per week)
4. Involuntary short hours (working <35 h per week but preferring more hours)
5. Involuntary long hours (working  $\geq 41$  h per week but preferring less)

Mental well-being was measured by three of the five items from the World Health Organization Well-being Index (WHO-5), reflecting positive affect (Bech et al. 2003). The item scores were summed and normalized to a range from 0 to 10, with 10 indicating the worst mental well-being.

De Moortel et al. (2017) found that not per se short working hours are a health hazard but involuntary working these hours (see Fig. 1). Yet, this was only found for women. For women working involuntary short hours, low schedule control, rather than the deprivation of needs and desires, might be the main mechanism causing poor mental well-being. Social norms dictate women to take up family and housework responsibilities, rather than men. These social norms, among others, may push these women into undesirable working hour situations. According to De Moortel et al. (2017): “[. . .] behaviour that originates from norm compliance might not correspond with one’s own preferences and needs. When norm compliance is felt as undesirable, it may result in a sense of low schedule control and poor mental well-being.”

Figure 1 also shows that working more than the standard working hours is always bad for women’s mental well-being, while for men only involuntary long working hours are related to poor mental well-being. For women, working (in)voluntary long hours probably means being time deprived is detrimental for their mental health.



**Fig. 1** Poor mental well-being (higher values mean worse mental well-being) by working hours category (coefficient estimates) (ref. = standard hours) (\* significant  $p \leq 0.05$ ). European Social Survey 2004 & 2010. Data derived from De Moortel et al. (2017)

Long working hours in the labor market mean a double shift at home for many women, and then it is no wonder that long hours in employment make them dissatisfied (Schröder 2018). For men working involuntary long hours, low schedule control (due to social norms that push these men into undesirable working hours situation) – rather than being time deprived – might be the main mechanism causing poor mental well-being. For men, it is socially expected to be the breadwinner.

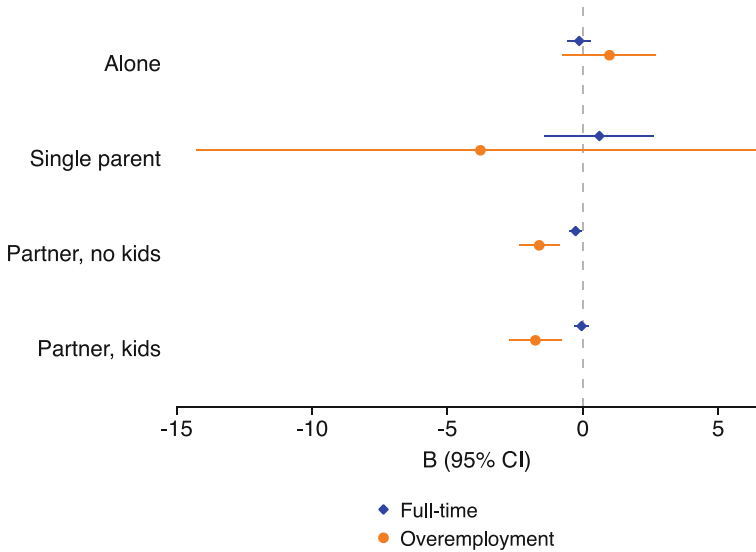
However, these results are from a cross-sectional study, while evidence whether involuntary short or long working hours lead to a decrease of mental health can only be derived from longitudinal studies. Little previous longitudinal research has taken volition into account when examining the relation between mental health and working hours. For notable exceptions see Angrave and Charlwood (2015) and Otterbach et al. (2016). These studies determine within working hours categories (i.e., <35 h, 35–40 h, 41–49 h, >49 h) whether the worker prefers these hours or not. Using UK data, Angrave and Charlwood (2015) found that long working hours are not associated with lower levels of well-being. They found that well-being only falls if there is a mismatch between actual and preferred hours. Otterbach et al. (2016) also concluded that it is mismatch rather than the number of hours worked each week that is critical, which is in line with the results of men from the cross-sectional study described above. Angrave and Charlwood (2015) also found evidence that underemployment tends to be associated with lower well-being for women working short hours, but not for men, which is also in line with the above-described study. Otterbach et al. (2016) found no strong evidence that underemployment exhibited an association with mental health. Bearing in mind that comparing studies is difficult because of different definitions of under- and overemployment, the few previous longitudinal studies come to more or less the same conclusions as the study described above.

---

## The Importance of Enhancing the Work-Life Balance

By now, it must be clear that social norms surrounding family and work life play a significant role in the experience of schedule control and thus under- and overemployment. Therefore, family- and work-related resources, that enhance a good work-life balance, may be important when experiencing low schedule control. In the next paragraphs, the importance of family- and work-related resources is investigated for the health of full-time workers, taking into account whether they work these hours voluntarily. It is hypothesized that family- and work-related resources that enhance a good work-life balance might reduce the negative mental health effects of involuntary full-time work (another specific definition of overemployment). Because involuntary working full-time may be difficult to reconcile with other life domains, resources that enhance a good work-life balance might buffer its negative consequences.

Using the German Socio-Economic Panel (GSOEP), a dummy variable was created: (1) full-time hours (working and preferring >34 hours per week) and (2) overemployment (working >34 hours per week but preferring less). This variable

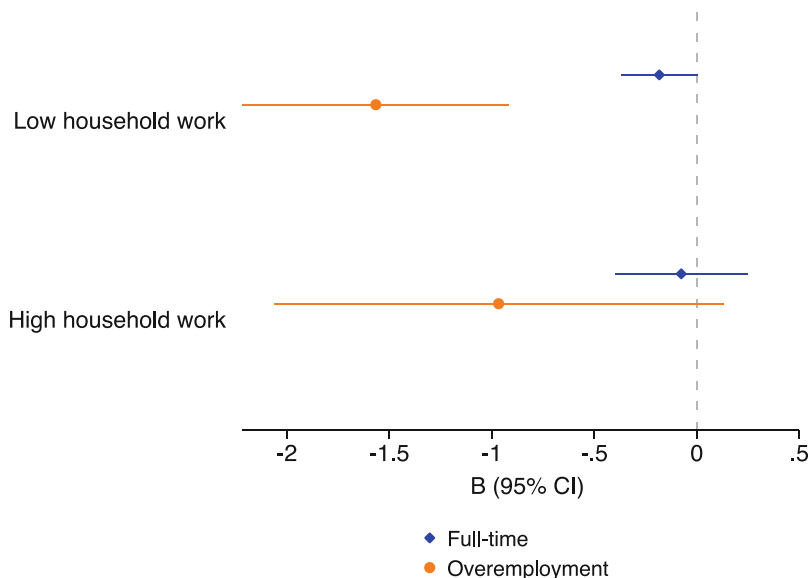


**Fig. 2** Change in mental health for men, by family role, Germany, German Socio-Economic Panel 2004–2010

was based on the number of working hours per week (overtime included) and the number of preferred hours per week, bearing in mind that earnings would go up or down according to the number of working hours chosen. For the analyses, we used data from waves 21 (2004), 23 (2006), 25 (2008), and 27 (2010) to create baseline observations for the measurement of involuntary full-time work, family-related resources, and mental health. We restricted the samples to individuals in full-time paid work, aged 20–60 years. The outcome measure was based on information on mental health assessed 2 years later. The analyses were done for men and women separately.

As regards the results for having multiple roles, overemployed men who have a partner (with or without children) experience a deterioration of mental health after 2 years (see Fig. 2). For these men, the additional social role(s) as a partner (and father) might actually result in more stress. Involvement as a father and husband/partner is increasingly important to men (Aumann et al. 2011). Yet, men still feel pressured to be the main provider and rather increase their hours (and incomes) when having a family (Reynolds and Johnson 2012). For men having multiple roles and wanting less hours than full-time hours, the expectations of high engagement at work and in the family put them at risk for role conflict (Aumann et al. 2011).

As regards the results that consider the household workload, overemployed men who have a low or average household workload (i.e., those who spend 2 or less hours a day on household work tasks) experience a deterioration of mental health after 2 years (see Fig. 3). There is no difference in mental health for full-time or overemployed men, when they spend more than average time on household work



**Fig. 3** Change in mental health for men, by working household workload, Germany, German Socio-Economic Panel, 2004–2010

tasks. This might indicate that overemployed men want to spend more time with family, and being unable to spend more time might exaggerate the stress associated with overemployment.

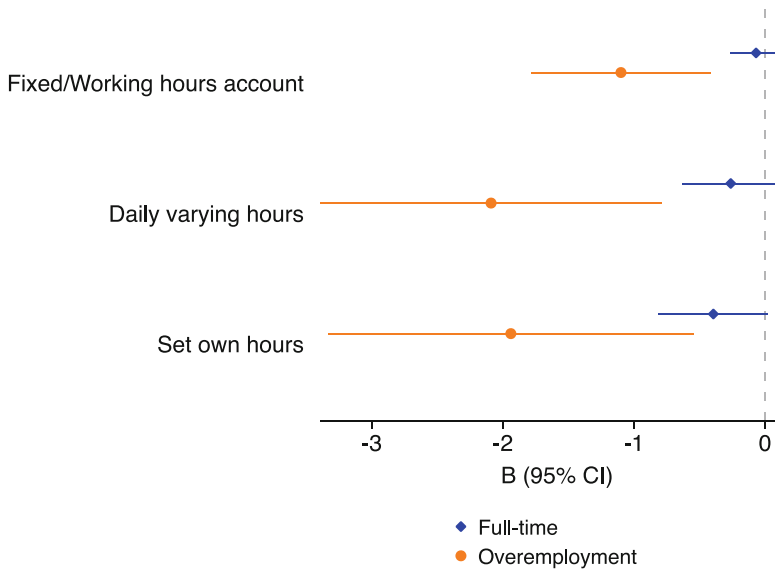
As regards the results that consider the working hours arrangements, overemployed men who are able to set their own hours have no significantly worse change in mental health, compared to full-time workers (see Fig. 4). In contrast, overemployed men with fixed hours, a working hours account, or daily varying hours have significant change in mental health while those with full-time hours do not. This indicates that overemployed men need freedom to choose when to spend time with their families or on social activities. Not having this freedom might exaggerate the stress associated with overemployment.

No significant results were found for women. The time delay might be too long since women might more quickly resolve a working hours mismatch. Expectation of “male breadwinner” role might result in role stress for overemployed men, while women probably are freer to change their work situation to meet family care needs.

## A Narrower Look on Volition

The above-described studies focus on the effects of weekly hours that deviate from the industrial norm (35–40 h per week) and its consequences for the mental health of workers. Studies investigate (involuntary) either part-time employment or (involuntary) long (or full-time) working hours and their links to different health outcomes





**Fig. 4** Change in mental health for men, by working hours arrangements, Germany, German Socio-Economic Panel, 2004–2010

(De Moortel et al. 2018). A narrower interpretation of “volition” can also be used. This approach compares the discrepancy between actual and preferred working hours, irrespective of the number of working hours. Drawing on this approach, a worker can be underemployed (working less than preferred), overemployed (working more than preferred), or correctly matched.

Using the German Socio-Economic Panel, the change in mental health was assessed during a 2-year follow-up period. De Moortel et al. (2018) found that overemployment (i.e., wanting less hours) is related to a reduction in mental health after 2 years, while underemployment (i.e., wanting more hours) is not (after adjusting for different family and job characteristics) (De Moortel et al. 2018). However, when fitting the models without all confounders, there was a significant negative relation between underemployment and change in mental health. Using stepwise inclusion of the control variables showed that when controlling the model for household income, the effect of underemployment disappears. This is in line with previous research indicating that underemployed workers are overexposed to a lack of (financial) stability and low-skilled routine jobs (Stier and Lewin-Epstein 2003).

## Conclusion

This chapter has shown that under- and overemployment are social determinants of mental health. Working hours, that are in line with your preferences, can be thought of as a resource that people need for good health. The relationship of under- and

overemployment with different health outcomes has been the subject of a considerable body of literature (e.g., see Başlevent and Kirmanoğlu 2013; De Moortel et al. 2017; Reynolds 2003). Yet, because of the divergent ways of defining and operationalizing under- and overemployment, it is fairly impossible to make a summary of previous findings.

Three research questions were discussed in more depth: (1) whether the length of the working hours is a determinant for mental health or whether the involuntary nature of working hours is harmful to mental health, (2) whether family- and work-related resources are important for the mental health impact of under- and overemployment, and (3) whether a narrower interpretation of “volition,” comparing the discrepancy between actual and preferred working hours, is a mental health determinant. Bearing in mind that every study uses different surveys and questions to operationalize under- and overemployment, I summarized some studies with similar wording. They concluded that it is hours mismatch rather than the actual number of hours that is detrimental for health. It was also found that family- and work-related resources buffer the stress of being overemployed for men, but not for women.

Throughout this chapter, it became clear that one of the most important dividing lines for working hours is gender. Due to the gendered norm of family devotion, bringing work hours in balance with family continues to be viewed as a “women’s issue” (Wheatley 2017). This, among others, is the reason why men and women have distinctly different working hours. Women, who’s working hours largely depend on how well they combine employment with family responsibilities, are found in part-time positions (Artazcoz et al. 2014). This is among others because one of the most common working time arrangements to enhance work-life balance is the adjustment in the length of the work day (e.g., working part-time) (Wheatley 2017). Women are wanting more hours. Thus, more women than men work involuntary part-time hours (Puig-Barrachina et al. 2014).

However, male’s employment is not free from gendered norms either. For men, the ideal worker norm dictates that career trajectories are characterized by commitment, unbroken trajectories, availability, and visibility (Wheatley 2017). For them, full-time working hours are the standard type of employment. Men use part-time work with a greater degree of choice, for instance, while studying or as part-time retirement (Wheatley 2017). Yet, recent research indicates blurring gender norms, with men wanting a more engaged role in the family. However, according to Wheatley, the notion of flexibility is in conflict with the ideal worker norm. As a result, a lot of male workers work more hours than they prefer (Golden and Gebreselassie 2007). The expectation of the “male breadwinner” role might result in role stress for men, while women probably are freer to change their work situation to meet family care needs (De Moortel et al. 2019).

Future research should pay more attention to social inequalities in under- and overemployment. Under- and overemployment vary according to demographic and socioeconomic characteristics. Young workers are more likely to be involuntary part-time employed (Maynard and Feldman 2011). Older workers may also face underemployment, as these relatively long-tenured employees face increased layoffs and age discrimination upon reemployment (McKee-Ryan and Harvey 2011). Future

research needs to investigate the potentially U-shaped pattern of underemployment, whereby recent entrants into the labor market and older workers are most likely to experience underemployment (McKee-Ryan and Harvey 2011). It is furthermore unclear whether the health effect of under- and overemployment diverse according to age.

Researchers have yet to examine the differential health effects of under- and overemployment across occupational groups. Involuntary part-time employment is mostly found in the lower-paid, lower-skilled end of economic activity (Eurofound 2018). Over half of involuntary part-timers work in lower service occupations, such as sales and service work. This is alarming since this occupational group accounts for around one-quarter of total employment (Eurofound 2018). Domestic employment, working for householders, is the sector where workers are most likely to be involuntarily part-time employed (Eurofound 2018). Managers, on the other hand, are much less likely to be working part-time, but if they are, it is less likely to be involuntarily (Eurofound 2018). Managers are more likely to be working more than preferred (overemployment).

Besides demographic features, intrinsic job characteristics (such as the level of skill discretion or decision autonomy required and possibilities for personal growth) might also determine how the under- and overemployed individuals experience their jobs (Karasek and Theorell 1990). The specific content of a job might act as a buffering or reinforcing factor influencing the mental well-being effects of under- and overemployment.

Moreover, a large amount of cross-sectional studies exist (De Moortel et al. 2017; Friedland and Price 2003), but longitudinal evidence is scarce. Furthermore, to date, empirical accounts of under- and overemployment have also remained fairly atheoretical (McKee-Ryan and Harvey 2011). Useful theories have been the job-person fit theory, relative deprivation theory, or the discrepancy theory. Yet, most of these theories have been used to describe underemployment and not overemployment.

Few studies investigate the role of macro-indicators for the experience of under- and overemployment. For a notable exception, see De Moortel et al. (2017). They found that involuntary part-time appears to be linked to poor labor market performance. Involuntary part-time grew most in countries where unemployment increased most since 2008 – Cyprus, Greece, and Spain (Eurofound 2018). Feldman (1996) hypothesized that underemployment would increase in a recession and when there were concerns with governmental regulation of labor costs. Feldman (1996) also predicted increased underemployment among those who are influenced by industry- and firm-specific economic factors that result in declining industries, firms, or units.

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## Cross-References

- ▶ [Work and Health](#)
- ▶ [Work–Life Balance: Definitions, Causes, and Consequences](#)

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# The Paradoxical Health Effects of Occupational Versus Leisure-Time Physical Activity

# 14

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## Abstract

Generally, physical activity (PA) is conceived as among the best investments for a long healthy life and is therefore widely encouraged for the general population.

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© Springer Nature Switzerland AG 2020

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_6](https://doi.org/10.1007/978-3-030-31438-5_6)

For example, recent PA guidelines for adults recommend at least 150 min a week of moderate-intensity PA or at least 75 min a week of vigorous-intensity PA, without specifying the domain of PA. However, the epidemiological evidence for beneficial health effects and lower mortality associated with higher levels of PA is mostly limited to PA occurring during leisure time (LTPA). In contrast, emerging evidence has shown that high levels of occupational PA (OPA) increase the risk for adverse health outcomes and mortality from cardiovascular diseases and all causes. The observation of differential health effects of OPA and LTPA is referred to as the “PA health paradox.” Up to now, all PA public health guidelines have ignored this paradox, not distinguishing OPA and LTPA. This is unfortunate as OPA of various types and intensities is a fundamental requirement for working people. Most adults spend more than half of their time awake at work, and lower socioeconomic groups are predominantly physically active as part of their work. In-depth knowledge of the PA paradox is therefore fundamental for understanding the physical determinants of the socioeconomic health inequalities in working populations. In this chapter, we give an introduction and historical perspective to the PA health paradox, provide an overview of the current epidemiological evidence for the PA paradox, and reflect on the implications of the PA health paradox for future research, health promotion, and disease prevention.

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**Keywords**

Physical activity at work · Physical work demands · Ergonomics · Physical workload · Sedentary work · Cardiovascular disease · Mortality

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## Introduction to the PA Health Paradox

Physical activity (PA) comprises a wide variety of movements, postures, and activities. In the PA continuum, PA can range from activities requiring small amounts of energy expenditure and effort, such as sitting, to strenuous activities increasing the energy expenditure many times beyond resting levels – such as stair climbing, running, or lifting of heavy objects.

PA is known to improve health and prevent noncommunicable diseases, such as hypertension, obesity, diabetes, cancer, cardiovascular disease, and mortality (U.S. Department of Health and Human Services 2018). More recently, also documentation for the beneficial effects of PA on mental health and well-being has emerged (White et al. 2017). The strongest evidence is for the beneficial health effect of moderate-to-vigorous intensity PA (e.g., activities like brisk walking, running, team sports, and cycling), but more recent studies have also shown positive health effects of PA of light intensity like slow walking (Ekelund et al. 2019). In other words, physical inactivity can inflict harmful effects on several noncommunicable diseases (U.S. Department of Health and Human Services 2018), while even small increments in daily PA can have beneficial health effects.

The most recent US PA guideline for adults recommends at least 150 min a week of moderate-intensity PA or at least 75 min a week of vigorous-intensity PA (U.S. Department of Health and Human Services 2018). Moreover, the WHO recently announced a global action plan for promoting PA, “More active people for a healthier world,” with the main message of a need for promoting any kind of PA to people worldwide, with a systemic approach including stakeholders, city planners, policy makers, and others (World Health Organization 2018). In a recent publication in *Lancet Global Health*, initiated by the WHO (Guthold et al. 2018), the proportion not fulfilling the PA guideline (based on total PA at work, home, transport, and leisure time) is twice as high in high-income countries as in low-income countries. Thus, by not differentiating between OPA and LTPA, low-income countries are found to have the highest proportion fulfilling the PA guidelines (Guthold et al. 2018), while failure to meet the PA guidelines appears to be predominantly a problem for high-income countries. Considering the evident contrast in health and life expectancy of high-income and low-income countries, there seems to be a flawed logic that low-income countries should have the least problems with fulfilling the supposedly health-promoting PA guidelines.

This flaw in logic can be explained by the basic common assumption across current PA guidelines and action plans that “the more PA, the better,” no matter the domain, environment, or context in which the PA occurs. Despite the fact that empirical evidence for beneficial effects of PA is mostly restricted to LTPA (U.S. Department of Health and Human Services 2018), this common assumption dominates. For the majority of people, however, the most prevalent domain of PA is OPA (Lear et al. 2017). This is particularly the case for lower socioeconomic groups and in low-income countries, where hardly any PA is recreational (Lear et al. 2017).

Does it matter if the PA occurs during working hours or leisure time? In contrast to the established benefits of LTPA, recent reviews suggest that OPA may actually be detrimental for health and longevity (Coenen et al. 2018a; Li et al. 2013). These differential health effects can be explained by the type, duration, intensity, and activity-rest patterns of PA that differ characteristically during work and leisure (Holtermann et al. 2017).

LTPA is characterized by dynamic movements at conditioning intensity levels mostly performed voluntarily over short time periods with enough recovery time afterward (Holtermann et al. 2017). In contrast, OPA often involves static work and is typically of much longer duration, and its purpose, design, and social context differ from LTPA (Holtermann et al. 2017). At work, demands of being productive dominate, and the environment and social organization of work are designed to maximize efficiency or profit, often with disregard for workers' health. Consequently, OPA may be rather constrained to either predominantly sitting for an office worker, standing still for a manufacturing worker in a production line, walking for a cleaner, or heavy lifting and manual handling for a construction worker. These activities often require maintenance of awkward and static postures and monotonous and repetitive movements and, in general, constitute nonconditioning activities that are performed over long periods of time, often exceeding standard 8 h per day, 5 days per week, and may include overtime and weekend work or even exposure to multiple



jobs frequently held by workers of low socioeconomic position. Such work schedules typically do not provide sufficient recovery time.

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## Historical Perspective of the PA Health Paradox

While beneficial cardiovascular health effects of LTPA are well established, the literature about the respective effects of OPA remains inconsistent. Research in the 1950s and 1960s, comparing PA and health of different occupational groups, identified sedentary work as a potential cardiovascular risk factor (Morris et al. 1966). This research has been the starting point of a large amount of epidemiological research on the health effects of PA. Surprisingly, however, while these first studies were based on OPA, much of that later work focused on LTPA.

These classic studies were vulnerable to alternative explanations because of selection bias (the health status influences which job and level of OPA the person chooses or is capable to remain employed in) and socioeconomic confounding (because of the relatively high correlation between socioeconomic status and OPA, it is difficult to differentiate OPA from health behaviors, access to healthcare, and other psychosocial factors which may impact the health outcomes). In their pioneering work, Morris and colleagues were probably one of the firsts being able to control for socioeconomic position. They attributed the lower risk of coronary heart disease among London bus conductors to their relatively high level of movement at work compared to the more sedentary work of their colleagues, the bus drivers (Morris et al. 1966). However, since then, research has shown that the excess risk of cardiovascular disease among urban bus drivers is not experienced by rural bus drivers, and, for urban bus drivers, it has shown to be independent of both LTPA and OPA (Rosengren et al. 1991; Gustavsson et al. 1996). Instead, the excess risk among urban bus drivers is now thought to be attributable to the high levels of job stress experienced by those drivers (Belkic et al. 1994), a psychosocial job factor that may have confounded the reported association with sedentary work. It is also questionable if driving a more than 7-ton heavy bus loaded with people on two decks and without power steering or power braking at the time of Morris' study should be considered sedentary work.

Another influential study of San Francisco Longshore men published in 1975 by Paffenbarger and colleagues used a more accurate three-level OPA measure that was based on energy expenditure estimates derived from earlier ergonomic studies among Los Angeles dockworkers (Paffenbarger and Hale 1975). While Paffenbarger found no substantial differences between light and moderate levels of OPA, those performing high OPA with repeated bursts of high-level energy expenditure had a reduced risk of dying from coronary heart disease. It should be noted that at that time, the union contracts regulated recovery time by limiting each work hour to 55% PA and 45% rest for the workers with high OPA. Also, after a minimum of 5 years (average 13 years), these workers moved from jobs with high OPA to jobs with lower OPA, which may very well explain the lower risks in the high OPA subgroup of workers.

The simultaneous assessment of OPA, LTPA, and application of modern multivariate analyses controlling for potential confounders began with the seminal prospective Western Collaborative Group Study of 3525 men employed in 10 Californian companies (Rosenman et al. 1975). The study found that high levels of LTPA had a protective effect on coronary heart disease (Rosenman et al. 1975). However, in contrast to earlier studies, this study did not find any protective effect for high levels of OPA regarding coronary heart disease. In fact, it is the first prospective cohort study adjusting for potential confounding factors that documented differential effects for OPA and LTPA on risk for cardiovascular disease. Several population-based prospective Scandinavian studies published since the 1980s observed similar patterns, starting with the Oslo Men's study, in which the authors for the first time explicitly called attention to this pattern as a "paradoxical" finding (Holme et al. 1981).

The literature on OPA and cardiovascular health has remained inconsistent for more than three decades. In 2010, an editorial calling on researchers to disentangle the effects of OPA and LTPA summarized the accumulated evidence as follows: "with regard to PA and cardiovascular disease (CVD), the epidemiological literature is actually more inconsistent than is often recognized. Most epidemiological studies to date either failed to differentiate between LTPA and OPA, or excluded OPA from their analyses altogether. While the beneficial effects of LTPA on the circulatory system appear well established (U.S. Department of Health and Human Services 2018), the health effects of OPA have remained inconsistent (Kristal-Boneh and Silber 1998). In high quality prospective population-based observational studies, higher levels of OPA were associated with a reduced risk of CVD in some studies (Salonen et al. 1982; Hu et al. 2007), showed no association in others (Kannel et al. 1986; Haapanen et al. 1996), or were associated with an increased CVD risk (Eaton et al. 1995; Krause et al. 2015; Krause et al. 2000). A few studies showed differential effects, with LTPA being protective and OPA having no effect (Haapanen et al. 1996), LTPA having no effect and OPA constituting a CVD risk (Krause et al. 2015), LTPA having a protective effect only among persons with low levels of OPA (Hu et al. 2007) or LTPA constituting a CVD risk (Eaton et al. 1995). One case-control study reported an inverse relationship of LTPA with acute myocardial infarction, but a u-shaped association with OPA" (Krause 2010).

In 2010, Holtermann and colleagues referred for the first time to the PA health paradox in the title of a paper that reported on the differential health effects of OPA and LTPA in a prospective study of Danish workers (Holtermann et al. 2012). Following this paper, there has been an increasing number of publications on the PA health paradox. Reviews of prospective studies that simultaneously analyzed both LTPA and OPA in multivariate models, adjusting for key potential confounders, report about 25% increased cardiovascular and all-cause mortality risks for high OPA compared to low OPA (often defined as having a predominantly sedentary job) (Coenen et al. 2018a; Li et al. 2013). It is the newer studies with better exposure assessments of OPA that tend to confirm the PA health paradox (Coenen et al. 2018a). There is less evidence for women and for stroke, potentially because women engage to a lesser extent in high-intensity OPA and because stroke incidence

is a relatively rare disease requiring large study samples. A recent 2019 US cohort study of over 30,000 working women addressed both evidence gaps and showed that higher intensity levels of OPA increased the risk for stroke and transient ischemic attack, while LTPA decreased these risks (Hall et al. 2019). These latest findings corroborate the PA health paradox for women and cerebrovascular disease.

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## Empirical Evidence for the PA Health Paradox

During the last decade, epidemiological evidence indicating a PA health paradox has been rapidly accumulating, with studies showing differential health effects of OPA and LTPA on disease and mortality outcomes.

Regarding the effect of OPA on *all-cause mortality*, evidence from 17 prospective cohort studies published before 2017 are summarized in a systematic review with meta-analysis of data from 193,696 participants (Coenen et al. 2018a). Men with high levels of OPA had an 18% increased risk of all-cause mortality compared to men engaging in low levels of OPA (hazard ratio (HR) 1.18, 95% CI 1.05–1.34). The same effect was not seen among women (hazard ratio 0.90, 95% CI 0.80–1.01). This gender difference may be due to the fact that most physically demanding jobs are being performed by male blue-collar workers, and when women and men share the same job, the heaviest work tasks may more often be performed by the male co-workers. Apart from gender differences, the adverse health effect of OPA appears to be much stronger if measured as relative aerobic strain taking cardiorespiratory fitness into account compared to OPA measured as energy expenditure only. (Krause et al. 2015). Since the publication of this review, additional evidence has been published on the effect of OPA on all-cause mortality.

Regarding *cardiovascular disease mortality*, a systematic review of 19 prospective cohort studies showed no overall effect of OPA on CVD mortality (hazard ratio 0.98, 95% CI 0.88–1.09) and no differences by sex or between various CVD mortality outcomes (coronary heart disease mortality, stroke, and unspecified CVD) (Coenen et al. 2019). Although this review does not confirm adverse health effects of OPA with regard to CVD mortality, the lack of a beneficial health effect of OPA still indicates a differential health effect compared to LTPA, thus supporting a PA health paradox. In addition, one needs to consider that CVD outcomes such as coronary heart disease or heart failure with activity-related symptoms such as angina pectoris or dyspnea are prone to healthy worker selection effects that bias health risk estimates downward.

As we will describe in the following section, explanations for the PA health paradox mainly focus on cardiovascular mechanisms. It is therefore logical that a fair share of the evidence on the PA health paradox is based on CVD outcomes. In 2013, a systematic review on the effects of OPA and LTPA on CVD outcomes was published (Li et al. 2013). In this review, based on a meta-analysis, it was shown that high levels of LTPA were associated with reduced risks of CVD, with effect sizes of 0.66 for coronary heart disease, 0.72 for stroke, and 0.61 for unspecified CVDs. These findings were in contrast to those for OPA consistently showing

increased risk of CVD incidence with high levels of OPA, with relative risk effect sizes of 1.25 for coronary heart disease, 1.07 for stroke, and 1.47 for unspecified CVDs.

Additional evidence for differential effects of OPA and LTPA on CVD is provided by studies using *cardiovascular biomarkers* as outcomes. In a group of blue-collar workers, it was shown that accelerometer measured PA (i.e., sitting, standing, walking, and stair climbing) resulted in a significantly higher heart rate when conducted during work than during leisure time, leading to higher relative aerobic strain during work (Coenen et al. 2018b). In the same group of workers, accelerometer measured LTPA was found to be associated with lower resting heart rate, while, on the contrary, accelerometer measured OPA was associated with a higher resting heart rate (Hallman et al. 2017). A Belgian study found that high self-reported OPA was associated with an increased ambulatory blood pressure (Clays et al. 2012). In a study of Finnish workers, those with high OPA were found to be more prone to future increased progression of atherosclerosis compared with those with low OPA, and those effects were strongest among workers with pre-existing cardiovascular disease (Krause et al. 2007).

Although most of the evidence on the PA paradox relates to CVD outcomes, there is also evidence for other health-related outcomes, including cancer, musculoskeletal disorders, long-term sickness absence, and mental health.

Regarding *cancer* outcomes, studies have reported on comparable beneficial health effects for cancer mortality (Autenrieth et al. 2011) and prostate cancer (Hrafnkelsdóttir et al. 2015) for OPA and LTPA. Another study, however, supported the PA paradox by showing reduced risks for breast cancer for those engaging in high-level LTPA but increased risks for those with high-level OPA (Friedenreich et al. 2009).

Research on *musculoskeletal diseases* provides limited evidence on the association between metabolic equivalents of PA and musculoskeletal symptoms. However, there is a substantial body of evidence that OPA, when measured as body postures and movements, increases the risk for musculoskeletal symptoms. For example, studies have found an increased risk for low back pain from occupational heavy lifting (Coenen et al. 2014), prolonged occupational standing (Coenen et al. 2016), and other occupational demands such as carrying, pushing/pulling, awkward trunk postures, and whole body vibrations (Griffith et al. 2012). Occupational tasks such as repetitive handling, upper arm and neck flexion, and high manual forces were associated with neck and upper limb pain (van Rijn et al. 2010). There is some scientific evidence for LTPA being protective for musculoskeletal symptoms such as low back pain (Shiri and Falah-Hassani 2017). However, the evidence is not consistent, and the proverbial “tennis elbow” is a well-known example for LTPA-related musculoskeletal disorders. Still, there is some evidence for the PA health paradox regarding musculoskeletal outcomes. Similarly, high OPA increases the risk for *long-term sickness absence*, while high LTPA reduces this risk (Andersen et al. 2018). Moreover, a recent meta-analysis based on 98 studies and almost 650,000 participants showed that high LTPA was associated with high levels of mental health, while high OPA was associated with poor *mental health* (White et al. 2017). In

conclusion, the PA health paradox is not limited to physical health outcomes but also is relevant for work disability and mental health outcomes.

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## Mechanisms for the PA Health Paradox

A plausible explanation of the PA health paradox requires an overview of the potential underlying physiological mechanisms. Knowledge about both the acute and long-term physiological responses to PA provides a fundament for understanding the differential health effects of OPA and LTPA. Below, we describe ways in which similar PA can have different effects on health if performed at work compared to during leisure time.

PA of larger muscle groups over short time (from few minutes to an hour) at high intensity (e.g., stair climbing, cross-fit, and running) is known to lead to a concurrent increase in ventilation, heart rate, blood pressure, metabolism, energy expenditure, and inflammation markers. In the hours (24 or more) following PA, the autonomous and hormonal systems downregulate heart rate and blood pressure, called post-exercise hypotension (de Brito et al. 2019). However, this phenomenon is documented following high-intensity short-time exercise or LTPA only. Even though heart rate and blood pressure are elevated during the short duration of LTPA, the downregulation of heart rate and blood pressure lasting for several hours after the activity results in overall lower 24-h average levels (Pimenta et al. 2019). Since both heart rate and blood pressure are strong independent predictors of CVD and mortality (Korshøj et al. 2015a; Banegas et al. 2018), lowered 24-h average levels of heart rate and blood pressure are considered beneficial for the cardiovascular system and longevity.

Inflammation markers also initially increase during exercise, reach a peak up to 48 h after the exercise, and then return to baseline levels after 2–6 days of recovery time (Kasapis and Thompson 2005). Current evidence suggests that regular moderate PA may reduce inflammation markers over time, and this in turn reduces chronic disease and mortality risks. However, large controlled trials show conflicting results on PA and inflammation markers, and it is not yet clear what persons may benefit from what type of activity and if PA-induced long-term changes in inflammation markers actually result in lower morbidity and mortality (Ertek and Cicero 2012). Nevertheless, it is well established that regular intensity PA of short duration (predominantly occurring during leisure and exercise) can increase cardiorespiratory fitness and that higher levels of cardiorespiratory fitness are associated with lower resting heart rate and blood pressure and lower cardiovascular disease and mortality risks (Bahls et al. 2018).

In contrast, the opposite is happening when the PA is performed with similar or, more typically, lower intensity over several hours during work. This will lead to many hours of increased heart rate, blood pressure, and inflammation markers during work and without downregulation of these physiological factors, in the hours following OPA (Ertek and Cicero 2012). This results in overall increased 24-h levels of heart rate, blood pressure, and inflammation markers, all known to be harmful for the

cardiovascular system through mechanical stress and injury of the endothelium and deeper layers of the arterial wall, followed by inflammatory wall repair processes that lead to atherosclerotic changes, such as plaques and aneurysms (Thubrikar 2007). In the long term, this type of PA performed at work for several days per week and over several years can increase the risk for CVD and mortality. The long-term health effects of OPA can differ substantially depending on its intensity, duration, and recovery time. Long duration of OPA and high cumulative aerobic workloads, long working hours and weekend work, and respective insufficient recovery times have been shown to increase atherosclerosis (Krause et al. 2007; Wang et al. 2016), incident cardiovascular disease, and mortality (Coenen et al. 2018a; Li et al. 2013). The dose-response relationship and thresholds between OPA and health outcomes are not yet completely understood and may also differ for specific activities, such as constrained body postures (e.g., sitting or standing), degree of involvement of small muscle groups (e.g., in manufacturing work), degree of static work required (e.g., for holding tools or carrying objects), or performance of biomechanically and/or cardiorespiratory highly demanding tasks (e.g., heavy lifting). Low and moderate levels of OPA may exert their influence on health primarily through relatively small physiological changes that accumulate over years before causing clinically manifest chronic diseases (e.g., hypertension or ischemic heart disease), while high or peak levels of OPA may have more immediate health consequences (e.g., heart attack, sudden cardiac death, or hemorrhagic stroke).

PA can have beneficial or harmful effects at both leisure and work depending on its specific characteristics. The explanation of the PA health paradox is that the work and leisure domains comprise very different environmental settings and social constraints that influence the type of PA, body postures and movements, and their duration and intensity and determine rest and recovery periods. LTPA often includes dynamic movements of an intensity level that could lead to improved cardiorespiratory fitness, being performed over relatively short time periods (often less than 1 h) and with enough time for recovery. In contrast, OPA more often comprises static and awkward postures, repetitive movements, or monotonous activities being performed over long duration (for several hours or even an entire work shift), mostly without sufficient intensity to increase cardiorespiratory fitness and metabolism and frequently without sufficient recovery time. These contrasting characteristics of PA performed at work and leisure are causing different acute and long-term physiological effects, which in the end lead to the contrasting health effects reported in the epidemiological literature ranging from acute to chronic musculoskeletal symptoms, CVD, and mortality. In the following, we will describe how the different characteristics of OPA and LTPA lead to acute and long-term physiological adaptations explaining the PA health paradox. An overview of these various mechanisms relevant for cardiovascular health is given in Table 1.

## The Duration of PA

As described in the previous section, the duration of PA is of importance for the acute and long-term health effects of PA. While LTPA normally lasts for relatively short

**Table 1** Overview of mechanisms explaining the differential cardiovascular health effects of OPA and LTPA

		Occupational physical activity	Leisure-time physical activity
Activity characteristics	Types of activities	Prolonged postures and manual handling	Dynamic movements with large muscle groups
	Duration	Long periods (several hours or even a full shift, for many consecutive days, weeks, and even years)	Short periods (less than 1 h)
	Recovery	Little	Much
	Intensity	Relatively low (<60% of the maximum aerobic capacity)	Relatively high (>60% of the maximum aerobic capacity)
Physiological responses		Chronic increase in ventilation, heart rate, blood pressure, metabolism, and inflammation markers	Instantaneous short increase in ventilation, heart rate, blood pressure, metabolism, and inflammation markers
		Increase 24-h blood pressure and heart rate	Decreased 24-h blood pressure and heart rate
		Mechanical stress and injury of the arterial wall (atherosclerosis)	Fitness improvements
Health outcomes		Cardiovascular health deterioration	Cardiovascular health improvement
		Higher risk of mortality	Lower risk of mortality

time (often less than 1 h), OPA occurs over many hours per day and typically over many consecutive days. While the relatively short duration of conditioning LTPA can lead to reductions in 24-h heart rate and blood pressure, OPA performed over longer durations causes elevations in 24-h heart rate and blood pressure. Because elevated 24-h levels of heart rate and blood pressure are harmful for the cardiovascular system and strong independent predictors of CVD and mortality (Korshøj et al. 2015a; Banegas et al. 2018), these hemodynamic effects alone could explain the negative health effects of OPA.

## The Intensity of PA

To condition the cardiovascular system and to improve cardiorespiratory fitness, PA of a relatively high intensity is required. As a rule of thumb, the intensity needs to be of at least 60% of maximum oxygen consumption equivalent to about 60% of heart rate reserve (estimated as the difference between resting and maximal heart rate) for improving cardiorespiratory fitness (Åstrand and Rodahl 1986). During various sports (e.g., soccer, running, swimming) and certain daily activities (e.g., stair climbing, brisk walking, and cycling), the intensity of PA is relatively high and can reach this 60% intensity level. These activities predominantly occur during

leisure time. However, during work, the intensity of PA rarely reaches the 60% threshold (Jørgensen et al. 2019). In fact, even workers in manual jobs need to pace themselves and avoid breaking into sweats (one sign of reaching intensity levels sufficient for improving cardiorespiratory fitness) because they need to continue the same work for hours and usually in the same working clothes. Thus, even though workers in manufacturing, farming, construction, cleaning, elder care, and many other blue-collar and service sector jobs perform OPA for several hours per day, their level of cardiorespiratory fitness is not improved (Coenen et al. 2018b; Jørgensen et al. 2019). For example, cleaners have been observed to walk more than 20,000 steps per day without experiencing any improvements in cardiorespiratory fitness (Korshøj et al. 2013).

### **Prolonged Standing, Sitting, and Heavy Lifting**

Predominant body postures like sitting and standing also differ during work and leisure and may contribute to the observed PA health paradox. Generally, large fractions of higher socioeconomic groups hold jobs involving much sitting at work, such as office workers. Mostly sitting during leisure time has been consistently associated with poor health (van Uffelen et al. 2010). In contrast, the evidence regarding sitting at work has been summarized by early reviews as equivocal (van Uffelen et al. 2010) and has since remained inconsistent. Occupational sitting has been linked with increased mortality (Kikuchi et al. 2015) but also with better cardiovascular health outcomes when compared with mostly standing and/or walking at work (Hall et al. 2019; Smith et al. 2018). The simplest explanation for paradoxical health effects of occupational and leisure-time sitting could be that those who are on their feet all day at work prefer to rest after work and thus sit or lie (often to keep their feet elevated) a lot during leisure. The increased health risks of these demeaningly labeled “couch potatoes” may therefore be due to the combination of fatiguing OPA and a resulting extensive time sitting at leisure (Gilson et al. 2019). Accordingly, studies that identified daily hours of sitting and watching TV at home as health risks may have missed a root cause for this behavior: an exhausting combination of long work hours including high levels of OPA and prolonged upright work postures (Bláfoss et al. 2019). Another explanation for the divergent health effects of sitting at work and leisure can be due to differences in the degree of continuous sitting at work and leisure. Long continuous bouts of sitting are particularly harmful for health (Saunders et al. 2018). For blue-collar workers overall, long bouts of continuous sitting occur much more often during leisure than during work (Hallman et al. 2015).

Globally, and even in modern Western economies, large proportions of the work force, even a majority of workers in the lower socioeconomic groups such as farm workers, construction workers, industrial blue-collar workers, healthcare providers, and the growing ranks of low-wage service workers, are exposed to prolonged standing at work. Even relatively short bouts of standing at work of less than 2 h have been associated with increases in fatigue and acute discomfort, swelling, and



pain of the lower extremities and lower back in both laboratory and field studies (Coenen et al. 2016; Coenen et al. 2017). Prolonged standing has not only been associated with fatigue, discomfort, pain, and musculoskeletal disorders in feet, legs, hips, and the lower back (Waters and Dick 2015). It has also been identified as an independent risk factor for varicose veins and related venous disease complications (Tabatabaeifar et al. 2015); peripheral artery disease (Mäkivaara et al. 2008); accelerated progression of carotid atherosclerosis (Krause et al. 2000); the incidence of coronary heart disease, myocardial infarction, and heart failure (Smith et al. 2018); and cerebrovascular diseases such as transitory ischemic attack and stroke (Hall et al. 2019). For example, Smith et al. reported that the risk for heart disease doubled among Canadians who predominantly work in a standing position (with some walking) compared to those who predominantly sit at work (Smith et al. 2018). Hall and colleagues reported a similar twofold risk for transitory ischemic attacks (“mini-strokes”) among women with baseline CVD who were reported “sitting and standing about equally” in their current job, followed by 36% risk increases among those “mostly standing” at work (Hall et al. 2019).

Few other studies have investigated body postures at work separately from body postures during leisure time. Some recent studies have used accelerometers to investigate differences in body postures at work and leisure time (Gilson et al. 2019). For example, accelerometer measurements of manufacturing workers over several working days have shown that they, on average, perform static standing at work for 2.8 h and being on their feet for 5.4 h (Jørgensen et al. 2019). However, very few studies differentiate between sitting, standing, and other types of light PA because they classify PA exclusively by broad categories of energy expenditure that typically combine sitting and standing in a single “sedentary” or “low-intensity” category (Ekelund et al. 2019). These studies are therefore unable to detect the posture-dependent health risks. Epidemiological studies that do not assess work postures, or combine sitting and standing postures into a single low OPA reference category, will lead to conservative misclassification bias when assessing the effect of high-intensity OPA relatively to low-intensity OPA. This is because the so-called “low” OPA comparison group includes not just predominantly sitting workers with low disease risks but many workers exposed to prolonged standing at work who are at substantial higher morbidity and mortality risks. This contamination of the reference low-risk group by high-risk workers will dilute the overall OPA risk estimates in such studies. This may in part be responsible for inconsistent findings regarding the health effects of OPA in general and for studies referring to “light standing” or “sedentary” work in particular. Exposure misclassification is further compounded by the fact that most studies on work postures did not measure the degree and amount of static and dynamic work performed. A worker standing may actually perform additional demanding static and dynamic work, for example, holding and swinging a heavy hammer. But such activities have most often not been measured or accounted for. This limitation is true for exposure assessment by both self-report and accelerometers; however, simultaneous measurements of posture, trunk, and extremity movements using multiple wearable sensors or observer-based ergonomic job analyses could overcome this limitation.

Posture-dependent health effects are products of pathophysiological processes and forces, not primarily generated by active skeletal muscle-induced movements but mostly by gravitational forces during standing that lead to increased hydrostatic pressures in blood vessels. For example, compared to lying down, arterial blood pressure in lower extremities increases by about 60–80 mmHg during standing. In addition to the gravitational forces, maintaining one's balance during standing requires co-contraction of agonistic and antagonistic muscles, particularly in the lower extremities. These relatively static contractions increase extravascular pressures leading to compression of arteries running through or near these muscles, thereby increasing peripheral resistance in those arteries. This requires harder pumping work of the heart and increased blood pressure to overcome this resistance for delivering oxygen to these muscles and other peripheral tissues or organs. These two mechanisms alone – increased gravitational hydrostatic pressure and increased resistance of the peripheral arteries during prolonged standing – can lead to elevated blood pressure and functional and morphological changes in the blood vessels that, over time, result in stiffening of arteries (Wang et al. 2014) and atherosclerotic changes (Krause et al. 2000). These changes require even higher blood pressures to perfuse these arteries, thus generating a vicious cycle resulting in the development of hypertension, peripheral artery disease, and chronic kidney, cardiovascular, and cerebrovascular diseases. These mechanisms also operate during sitting, but to a much lower extent. This is because the vertical distance in height between the feet and the heart (determining the hydrostatic pressures) is much less during sitting, as is the need for static balancing muscle work, especially if the subject is being supported by back- and armrests, further reducing hydrostatic pressure and peripheral resistance.

Another pathophysiological hemodynamic mechanism triggered by a standing posture and the described increased hydrostatic pressures is venous pooling in the lower legs with plasma exudation into surrounding tissues, causing edema, swelling, and pain in the lower extremities (Antle et al. 2013) and reducing the circulating plasma volume (Lundvall and Bjerkhoel 1994). This will, in turn, increase the heart rate because of the need for the heart to pump the remaining blood volume more often through the body per unit of time, to deliver the same amounts of oxygen to tissues and organs.

Increases in heart rate due to change from a sitting to a standing position are observed during normal daily living at work and leisure (Coenen et al. 2018b). Since 24-h heart rates above a resting rate of 60 beats per minute are positively related to CVD and mortality (Zhang and Zhang 2009), the mechanism of heart rate increase through venous pooling provides an additional explanation for the detrimental health effects of prolonged standing. Finally, as already mentioned above, prolonged standing increases the risk for developing varicose veins, and these vessels in turn will increase the amount of venous pooling during standing creating another vicious cycle or feedback loop that further strains the cardiovascular system over time.

Because the total duration and degree of static standing is much higher during work than during leisure, it can be a potential explanation for the PA health paradox. For example, in the Danish DPhacto cohort, stationary standing was measured with accelerometers over several days in different occupational groups (Jørgensen et al.

2019). Manufacturing workers on average performed static standing at work for almost 3 h, while they stood for 1.6 h during leisure time. Moreover, the standing during work is likely to be more constrained and static than during leisure (particularly for blue-collar workers where static standing can be a requirement for performing the work tasks), thus imposing a more harmful effect during work than during leisure time.

Finally, upright work postures like standing are often combined with additional task-related muscle work that can be either static, such as holding tools or objects, or dynamic like hammering or a combination of both like in most common material handling tasks such as lifting and carrying of objects or persons. The static components of these tasks further increase peripheral vascular resistance and blood pressure with the detrimental consequences described above for prolonged postural work. The dynamic components of these additional tasks will also further increase blood pressure and heart rate and thus increase mechanical stresses in arteries that will cause micro-injuries of the arterial walls and a cascade of repair mechanism constituting inflammatory pathophysiological processes that cause atherosclerotic wall changes, which, in the long run, could lead to higher CVD incidence and mortality.

While the musculoskeletal health risks of manual material handling tasks have been extensively documented in the ergonomic and epidemiological literature, respective cardiovascular disease and mortality risks have rarely been studied. However, a few studies reported lifting or carrying objects to be predictive of cardiovascular diseases (Clays et al. 2012; Petersen et al. 2012). One recent Danish cohort study identified heavy occupational lifting at work as independent risk factor for ischemic heart disease with workers who reported carrying at least 10 kg at work experiencing an over 50% higher risk for ischemic heart disease, but no effect on all-cause mortality. Of note, the highest ischemic heart disease risks were experienced by male workers with occupational lifting who otherwise had lower levels of LTPA or OPA, indicating interactions between different types of PA (Petersen et al. 2012). Another Danish cohort study linked heavy occupational lifting to increases in blood pressure among users of antihypertensive drugs and to an increased incidence of hypertension among workers over 50 years old (Korshøj et al. 2019). Most recently, a study of 1.15 million Danish wage earners with 21.4 million years of follow-up that used a job exposure matrix to assess OPA reported occupational lifting to be positively associated in a monotone dose response up to a 9% (3–15%) and 27% (15–40%) increased risk of acute myocardial infarction in men and women who were exposed to more than 45 or 22 ton-years of occupational lifting, respectively (Bonde et al. 2019). However, these reported risks likely underestimate actual risks due to exposure misclassification, healthy worker bias, and overadjustment for factors that can be considered determinants (education, social position) of the OPA exposure.

## Recovery

Long durations of PA without sufficient recovery time (e.g., excessive endurance sports or long work hours) can cause fatigue and exhaustion and may increase the risk of cardiovascular disease (Krause et al. 2009). Sports medicine considers an imbalance between PA load and recovery as “overreaching” or “overtraining,” which can cause

injury and health impairments if sustained for longer periods of time (Elliott and La Gerche 2015). However, for most people, LTPA is of rather short duration (often much less than 1 h per day) with sufficient possibility for rest. On the contrary, in many occupations, work requires the worker to be physically active for several hours per day for several consecutive days, with limited possibility of rest periods within and between working days. This is particularly an issue in countries and job sectors without strict regulations regarding the number of working hours per day and week, paid vacation, and sick leave. Moreover, OPA is to a much lesser extent tailored to the individual person (e.g., age, cardiorespiratory fitness, symptoms, and fatigue) than LTPA. Thus, the differences in need for recovery and the ability to recover during work and leisure can also constitute a part of the explanation for the PA health paradox.

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## Future Perspectives for Strengthened Research and Prevention

The emerging epidemiologic evidence for the PA health paradox from a still inconsistent literature and several plausible physiological mechanisms have been described. Nevertheless, the existence of the PA health paradox has been questioned in a recent discussion paper that particularly questioned the epidemiological evidence for detrimental health effects of OPA (Shephard 2019). In contrast, despite of common methodological limitations (e.g., socioeconomic confounding), the positive health effects of LTPA are widely accepted and hardly ever questioned.

It is indeed important to critically discuss the evidence underlying the PA health paradox and to recognize inconsistencies and study limitations in future research. However, this examination needs to be applied to all domains of PA because inconsistencies and very similar methodological limitations exist also for the epidemiological evidence regarding the health effects of LTPA. For example, recent research among Finnish middle-aged men found no independent effects of LTPA on cardiovascular mortality (hazard ratio of 0.95, 95% CI 0.84–1.06) or all-cause mortality (hazard ratio of 0.99, 95% CI 0.94–1.04) among healthy men. Moreover, among the subgroup of workers with existing CHD, each additional weekly hour of LTPA resulted even in an elevated risk of 14% for cardiovascular mortality (hazard ratio of 1.14, 95% CI 1.04–1.26) and of 10% for all-cause mortality (hazard ratio of 1.10, 95% CI 1.03–1.18), respectively, in models controlling for 19 potential confounders including OPA (Krause et al. 2017). In the following, we discuss the most relevant limitations of the existing evidence of the PA health paradox and how these limitations ought to be addressed in future research. We also discuss how the existing evidence already provides new promising avenues for more effective disease prevention among working populations.

## A Need for More Evidence and from Other Geographic Areas and Worker Populations

It has been suggested that there is still limited evidence for the PA health paradox and that most of the epidemiological evidence is restricted to studies from mainly

Scandinavian and Western European countries (Shephard 2019). We believe that the relatively good working conditions in Western European and Scandinavian countries that frequently use advanced technologies and ergonomic approaches to limit excessive workloads, regulate work hours, mandate paid vacation and sick leave, and provide universal access to medical care for free or at very low cost would actually attenuate negative health effects of OPA. We therefore expect that studies from countries with overall higher OPA and less worker protections might find even stronger negative OPA health effects.

In recent years, researchers around the globe have addressed the PA health paradox. For example, in the last couple of years alone, several new studies originated from Germany (Bahls et al. 2018), Switzerland (Wanner et al. 2019), Finland (Krause et al. 2017; Mikkola et al. 2019), Norway (Hermansen et al. 2019), Japan (Sakaue et al. 2018), China (Fan et al. 2018), and the USA (Hall et al. 2019). Despite of this growing body of literature, there is a need for additional research on the PA health paradox from other parts of the world. As a first, feasible, and relatively fast step, researchers all over the world should investigate the PA health paradox in existing longitudinal cohorts. Such research should also study potential explanations and mechanisms underlying the PA health paradox. Future studies should not exclude workers with pre-existing health conditions but instead use stratified analyses to identify groups of people that are particularly vulnerable to the negative health effects of high levels of OPA and in need for targeted interventions. For example, the effects of high OPA among people with pre-existing CVD, lower levels of cardiorespiratory fitness, or who are exposed to additional cardiovascular risk factors with potential synergistic health effects such as job stress (Ferrario et al. 2019a), air pollution, and environmental heat should be studied.

## **Better Measures of PA Needed**

Most exposure assessments in existing epidemiological studies on the PA health paradox are based on questionnaires with relatively low validity (Koch et al. 2016). Also, most studies used rather crude categories for PA and often further merged these categories in the analysis stage, which may have led to misclassification bias. Future research should be based on more accurate PA assessment methods. Preferably, new studies should use device-based continuous measurements able to provide detailed information on temporal and compositional aspects of PA in all domains covering 24 h per day over multiple days. Moreover, additional PA characteristics need to be investigated including intensity, breaks, recovery time, postures, biomechanical loading, static work, relative aerobic workloads taking cardiorespiratory fitness into account, and cumulative workloads (using repeated measures and complete work histories). Wearable sensors such as accelerometers and heart rate monitors are now widely available and can be incorporated in large epidemiological studies. Although some cohort studies have already used accelerometer-based measurements of PA linked with prospective health outcomes (Ekelund et al. 2019), they often failed to differentiate between OPA and LTPA.

## Better Dealing with Confounding

Control for confounding factors may have been insufficient in some studies of the PA health paradox. However, potential residual confounding is often claimed as an alternative explanation for unexpected results regardless of the quality and comprehensiveness of confounder control. This includes whether, and if so, how accurate other confounding factors (including socioeconomic, body composition, lifestyle, and health factors) are measured. We argue that residual confounding (from socioeconomic or other factors) is not likely to explain the PA health paradox, as support for the PA health paradox is found in studies adjusting for, or stratifying on, socioeconomic position, enrolling participants from the same occupation only, or adjusting for virtually all known biological, behavioral, and psychosocial risk factors for CVD.

Nevertheless, more effective ways of confounding control should be employed. For example, individual participant data meta-analyses can deal with nonstandard confounder assessment across studies because they have the large sample sizes necessary for comprehensive confounder control by combining several existing cohorts for reanalysis and harmonizing adjustment for confounders across cohorts. Controlled experimental studies, such as randomized controlled trials, may be able to even control for unknown or unmeasured confounders as long as randomization is successful. As far as we are aware, there are no randomized controlled trials investigating the health effects of exposing people to high OPA vs. high LTPA. As such trials may not be feasible, alternative research designs need to be considered for making causal inferences in the face of some remaining uncertainty. Various examples of such alternative designs have been suggested in the literature (Schelvis et al. 2015). For example, a natural experiment of an occupational group making a transition from high OPA work to robotized physically inactive work could be analyzed. A suitable occupational group in such a study could be garbage collectors. Garbage collecting used to be a highly physically demanding job, but much of the manual work has now (at least for some workers) been taken over by machines. Studying this occupational group before and after such a major transition, in which no inherent changes to factors other than physical demands are expected, and comparing this group to a relevant reference group might shed light on the causality of the health effects of OPA.

## Opportunities for Improved Disease Prevention in Working Populations

As mentioned at the beginning of this chapter, current PA guidelines and other initiatives to improve PA among the general public are all based on the basic assumption of “the more PA, the better,” no matter the domain, environment, or context in which the PA occurs. The PA health paradox, however, suggests that this assumption may be wrong and that prevention strategies need to distinguish occupational from leisure-time PA. The potential benefits and risks of OPA also depend

on individual worker characteristics such as age, cardiorespiratory fitness, cardiovascular health status, and physical limitations due to other comorbidities such as pulmonary diseases or musculoskeletal disorders. There are large groups of workers in our societies who are at an increased health risk due to unfavorable combinations of these individual characteristics and specific OPA patterns. According to the current evidence, these vulnerable worker populations include (a) middle-aged and older workers with pre-existing cardiovascular diseases such as varicose veins, atherosclerosis, hypertension, or ischemic heart disease who are especially vulnerable to the potential detrimental effects of high-intensity OPA; (b) workers with prolonged standing or other static work postures; (c) workers restricted to sedentary work with infrequent bouts of high-intensity OPA (e.g., truck drivers performing heavy-lifting tasks during delivery); (d) low-wage workers working longer hours or multiple jobs without sufficient recovery time including immigrant workers additionally trying to cope with wage theft, job insecurity, blacklisting, or fear of deportation; (e) children, women, and workers with health-related physical limitations and low cardiorespiratory fitness required to perform OPA at intensity levels that exceed their physical capacities; (f) and blue-collar manufacturing workers and large numbers of workers in agriculture, construction, warehousing, or in the hospitality, healthcare, and retail sectors who are highly active at work and sedentary during their leisure time (Gilson et al. 2019) and workers with high OPA combined with poor psychosocial work environment (Allesøe et al. 2017; Clays et al. 2016; Ferrario et al. 2019b). Most of these workers are at a double disadvantage; they suffer the negative health consequences of high OPA and do not benefit from the beneficial health effects of conditioning LTPA.

One primary prevention objective is to fit physical work demands, leisure-time activities, and recovery time to the individual workers' capacities and needs. Existing PA guidelines seem to be of little help in this respect. For example, the 2016 European guidelines on CVD prevention in clinical practice do not differentiate between OPA and LTPA, recommend at least 150 min of moderate PA per week regardless of domain, and state that benefits of PA outweigh the risks while acknowledging that the "the lower and upper limit of aerobic PA intensity, duration, and frequency to exert a beneficially effect is unknown." These guidelines furthermore warn that "individuals who exercise only occasionally seem to have an increased risk of coronary events and sudden cardiac death during or after exercise" (Thompson et al. 2007) and advise that "clinical evaluation, including exercise testing, may be considered for sedentary people with cardiovascular risk factors who intend to engage in vigorous PA and sports" and that "especially for older and deconditioned individuals a relative intensity measure is more appropriate" (Piepoli et al. 2016, pp. 2344–2345).

In contrast, long-standing recommendations by work physiologists and the International Labor Organization (ILO) specifically address OPA and advise that the average relative aerobic workload during an 8-h work day should not exceed 30–33% aerobic workload (Bonjer and Parmeggiana 1971). These recommendations were developed in the 1960s based on physiological parameters of excessive exertion indicating an acute inability of the body to eliminate as much serum

lactate as it produced during PA; they were not considering chronic disease or mortality risks. A 22-year prospective cohort study supported this recommendation, finding that men without CVD at baseline who exceeded 33% of relative aerobic workloads had 64% (95% CI 10–142%) and 30% (95% CI 7–57%) increased risks of CHD and all-cause mortality, respectively (Krause et al. 2017). However, even values below that recommended average level of relative aerobic workload can increase morbidity and mortality risks in exposed workers. In fact, the same study of Finnish middle-aged men showed that each 10% of relative aerobic strain increased the risks of acute myocardial infarction by 18% (95% CI 8–28%) (Krause et al. 2015), CHD mortality by 30% (95% CI 14–49%), and all-cause mortality by 15% (95% CI 7–24%) (Krause et al. 2017). Therefore, keeping relative aerobic workloads below this established physiological limit is insufficient for prevention of CVD. Nevertheless, this limit represents a modest minimum goal for preventing excessive fatigue at the workplace. Achieving this minimum goal should be considered a first step in the desired direction of reducing harmful levels of OPA. For this threshold to be implemented, the relative workload is recommended to be measured under real-world conditions. This is because the relative workload of the worker does not only depend on the worker's physical capacity (determined by pre-existing cardiorespiratory conditions or the level of aerobic fitness) and physical work tasks but also other working conditions including air quality, noise level, environmental temperature, need to wear personal protective equipment, work-rest schedule, and psychosocial job stressors (Ferrario et al. 2019b). Ideally, all these factors should be considered, and recommendations should be tailored to the individual worker and specific work demands.

Reductions of excessive relative aerobic workloads can be achieved by three approaches: reduction in the absolute physical workload, increase in aerobic fitness, and increase in recovery time, either alone or in combination. Accordingly, some researchers have suggested to reduce CVD risks by exercise training at work of sufficient intensity to increase cardiorespiratory fitness to reduce the number of workers whose relative aerobic workloads exceed the maximum ILO-recommended level (Korshøj et al. 2012). A recent randomized workplace intervention trial among cleaners in Denmark showed that relatively few sessions of intensive aerobic exercise during paid worktime indeed increased fitness and reduced relative aerobic workloads. However, the intervention also resulted in significant increases in both resting and 24-h ambulatory blood pressure (Korshøj et al. 2015b). These mixed results prompted the authors not to recommend this approach at this time because of remaining safety concerns. Moreover, for aging workers and for workers with existing CVD or with exercise-limiting pulmonary or musculoskeletal disorders or other functional limitations, fitness training may not be feasible or insufficient to achieve adequate reductions in relative aerobic strain. While increased LTPA after work can be beneficial for individuals with low levels of OPA, results for individuals with high levels of OPA have been inconsistent (Clays et al. 2013), and fatigue, long or irregular work hours common in manual jobs, and scheduling issues may remain barriers for engagement in LTPA.



Primary prevention that is safe and not relying on individual workers' behavioral changes, especially among older workers with high OPA levels, may instead need to address the discrepancy of individual cardiorespiratory fitness and physical job demands by reduction of physical job demands, daily or weekly work hours, and increases of recovery time (Krause et al. 2009). While automation has reduced physical workloads over the past decades for skilled workers in some industries (e.g., motor vehicle production), workers in other industries have been faced with work intensification (e.g., in the growing healthcare, hospitality, and retail sectors) (Krause et al. 2005). In some sectors the heaviest work is now performed by low-wage immigrant workers who are underrepresented in national surveys and epidemiological studies (e.g., custodial, construction, farm, and hotel and restaurant workers). General public health messages exclusively recommending increased PA may be appropriate for the sedentary part of the working population and the subgroup of workers who tend to participate in workplace health promotion programs. However, such messages do not sufficiently address the sizable working populations performing heavy physical labor; the increasing proportion of aging workers with pre-existing chronic cardiovascular, pulmonary, or musculoskeletal diseases; or workers unlikely to receive an offer for, or to participate in, respective workplace health promotion programs.

In the absence of more controlled community-based intervention trials, it is difficult to compare the effectiveness of different approaches for primary disease prevention among workers with high OPA. It has recently been mentioned in the literature that two birds could be killed with one stone if we can design work in such a way that OPA becomes health enhancing (Holtermann et al. 2019). According to this idea, referred to as the Goldilocks principle, the aim is to design the work tasks, work organization, or environmental structures of the job in a way so that OPA becomes more similar to characteristics of LTPA and thus can contribute to improved health. However, the principle remains to be tested in different occupational groups during productive work.

Applying the precautionary principle of public health, the reviewed evidence has already important implications for the practice of occupational and rehabilitative medicine even in the absence of respective intervention trials. Primary disease prevention efforts may benefit from a reduction of the energy demands in physically demanding jobs. Jobs in agriculture, forestry, commercial fishing, construction, manufacturing, warehousing, cleaning, or retail are at especially high risk for excessive relative aerobic strain (Krause et al. 2017). Secondary and tertiary prevention efforts may be indicated for persons who do not have a sitting desk job. Occupational medicine and other occupational health professionals can assist in an individualized approach using inexpensive ambulatory heart rate monitoring during work hours to determine the ergonomic fit between individual aerobic capacity and workload. Specifically, relative aerobic workloads, estimated as percent heart rate reserve ( $\%HRR = (HR_{work} - HR_{rest}) / (HR_{max} - HR_{rest}) \times 100\%$ ) (Wu and Wang 2002) using wearable heart rate monitors and standard procedures estimating maximum heart rate ( $HR_{max}$ ) based on resting heart rate ( $HR_{rest}$ ) and age (Karvonen et al. 1957), can be used.  $\%HRR$  should be routinely assessed in non-

desk workplaces during placement of new employees and in the process of designing work modifications for employees returning to work after being diagnosed with CVD. Exercise testing and ambulatory electrocardiography (ECG) are indicated for workers with CVD and cardiovascular risk factors or for sedentary workers who plan to engage in high-intensity LTPA or sports per recommendations of existing guidelines (Haskell et al. 1989).

Intervention studies reducing physical job demands have so far only been conducted with the goal to reduce acute musculoskeletal symptoms through ergonomic interventions (using training, engineering controls, and changes in work organization). For obvious reasons, these studies did not evaluate CVD or mortality outcomes that require large samples and decade-long follow-up and more substantial resources. Nevertheless, ergonomic intervention studies could combine their traditional outcomes (fatigue, musculoskeletal pain, work-related injury, disability, return-to-work, productivity, costs) with short-term changes in cardiovascular risk factors such as blood pressure, heart rate, heart rate variability, pulse wave velocity, and arterial wall intima-media thickness at marginal extra costs. Similarly, large-scale epidemiological studies designed to evaluate real or simulated interventions for chronic musculoskeletal disease outcomes could, in addition to ergonomic exposure assessments, study cardiovascular disease and mortality outcomes assessed via record linkage with respective hospitalization and death registries.

Future intervention research needs to investigate the effectiveness and efficiency of possible interventions such as fitness-inducing exercise, increase of recovery time, and reduction of work hours and/or physical job demands. This is especially relevant today given growing high-risk populations of aging workers with pre-existing CVD and of particularly vulnerable low-wage immigrant workers that have been under-researched and underserved in occupational and public health.

Despite remaining questions about the PA health paradox and lack of evidence from intervention studies, our current understanding of the available physiological, ergonomic, and epidemiological evidence clearly indicates that more PA is not always better for health or longevity. Occupational and public health policies that reduce harmful excessive physical workloads, prolonged standing, long work hours, and the need for multiple jobs and that provide sufficient recovery periods and health-promoting PA at work and during leisure are promising complementary avenues for effective workplace-based disease prevention considering the PA paradox and its contextual root causes.

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### Abstract

This chapter provides an overview of work intensity in LMIC. Work intensity is measured by different constructs that capture work environment characteristics, which describe aspects of heavy workload, work organization and timing, conflict, and effort exerted to complete tasks, that may result in work-related stress. Research emanating from low- and middle-income countries (LMIC) on the predictors, prevalence, and outcomes of work intensity is limited, in part due to lack of resources and quality data. While evidence from high-income countries (HIC) indicates that intensification of work is damaging to health, social, and work-related well-being, studies from HIC cannot be generalized to LMIC which face unique challenges that exacerbate the vulnerability of workers. Distinctive factors such as collectivism, political instability, poverty, extended work days, high prevalence of precarious and informal work, limited labor laws, and poor regulation have a negative impact on workers in LMIC and exacerbate work intensity in ways not typically observed in HIC. There is current, albeit limited, evidence from low- and middle-income regions that provides an initial and partial understanding of the prevalence, determinants, and consequences of work intensity the regions explored. Drawbacks to existing occupational health research and literature are also discussed.

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### Keywords

Work intensity · Workload · Job demands · Time poverty · Informal workers · Collectivism

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## Introduction

Variations in national characteristics, such as GDP, economic growth rate, and pension policies play an important role in establishing work intensity and factors that may mediate or moderate its effects (Kortum et al. 2010; Bhagat et al. 2010; Mäcken 2019). Globalization, global shifts in the economic and social climate, and advancements in science and technology have led to increased deregulation and economic disparities around the world (Burton 2010; Muntaner et al. 2012; Benach et al. 2014; Zajc and Kohont 2017). This has resulted in changes to the labor market and work environment, intensification of work due to increased pressure and demands on workers (Benach et al. 2014; Zajc and Kohont 2017), and

marginalization of the average worker, with greater effect observed in developing countries (Burton 2010; Muntaner et al. 2012).

Workers in these regions are therefore under pressure to modify how they work and meet high demands for increased productivity while competing for limited jobs. While evidence from high-income countries (HIC) has demonstrated that intensification of work is associated with deleterious occupational, health (physical and mental), social, and family outcomes, low- and middle-income countries (LMIC) have not sufficiently quantified the risk and burden of work intensity factors, primarily due to lack of data (Kortum et al. 2010; Bhagat et al. 2010; Amponsah-Tawiah et al. 2013). This prevents LMIC from appropriately identifying and addressing this public health burden. The scarcity of evidence-based research on work intensity from LMIC (Bhagat et al. 2010) consequently limits evidence for occupational health interventions to HIC theories and research findings. This raises the question of whether the current foundation for interventions qualifies as evidence-based, since their validity is not firmly established in LMIC which have their own unique set of challenges and cultural perspectives that influence the labor market and work factors.

Investigation into the impacts of work intensity on workers' health and the quality of their life and work in LMIC is necessary given the complex interactions of micro and macro sociopolitical factors which render workers in these regions vulnerable. These factors include poverty wages, precarious or informal work, perilous work environments, few worker rights protections that are often not duly enforced, limited technology which may increase hours worked, high unemployment, greater competition for limited jobs in the formal sector, political instability, and poor health-care sectors (Fenwick et al. 2007; Benach et al. 2014; Zajc and Kohont 2017).

Taking all this into account, this chapter explores work intensity in LMIC. In the following section (“[What is work intensity?](#)”), work intensity is defined, and its indicators and measures are discussed. The section “[Distinctive Causes and Exacerbators of Work Intensity in LMIC](#)” deals with the unique root causes that contribute to and exacerbate work intensity in LMIC, in ways not typically observed in HIC, thereby providing an argument for the significance and relevance of exploring this topic in LMIC. The section “[Evidence from Africa, Southeast Asia, and the Western Pacific](#)” provides an in-depth discussion of the reviewed literature from sub-Saharan Africa, Southeast Asia, and the Western Pacific and reports the level/prevalence, determinants, and consequences of work intensity from the current evidence in each region. Rather than focus on all LMIC regions in the world, this chapter highlights regions where there is less research and higher concentration of low-income countries with limited resources. China, an upper middle-income economy, is excluded from the discussion, primarily because relative to other LMIC, it has a plethora of research on this topic. The section “[Drawbacks of Existing Literature](#)” summarizes the main pitfalls of the existing literature, after which the further challenges are discussed. The chapter closes with section “[Concluding Remarks](#)” offering some final observations. Through highlighting the current evidence, and gaps in the literature, we will call attention to the challenging position

many LMIC may have in identifying and addressing work intensity and its associated adverse effects.

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## What is work intensity?

Different theories and constructs have been used to capture aspects of work intensity in the literature. It has been described as a phenomenon that comprises components of time and effort related to physical and mental activities (Burke et al. 2010; Ozutku and Altindis 2013; Boxall and Macky 2014; Zajc and Kohont 2017). Work intensity in the literature is used to describe aspects of control over pace, scheduling of work, intensity of effort, time demands, emotional and physical workloads, tight deadlines, role overload, and additional characteristics of the psychosocial environment (Pierre Boisard et al. 2003; Burke et al. 2010; Kalleberg 2011; Ozutku and Altindis 2013; Boxall and Macky 2014; Zajc and Kohont 2017). When personal and organizational resources are not sufficient to cope with these varied demands and pressures, intensified work can result in work-related stress (Michie 2002).

## Measures of Work Intensity

The varying work intensity constructs mean work intensity can be measured by a range of different scales. The Job Content Questionnaire (JCQ), Effort-Reward Imbalance (ERI) Copenhagen Psychosocial Questionnaire (COPSOQ), and the European Surveys on Working Conditions, all of which measure aspects of work intensity, have been used extensively in the literature. Long hours and work intensity index (a form of time poverty) have also been used in different disciplines, as they help to account for formal and informal work, as well as unpaid domestic activities, which are often dually carried out alongside wage-earning activities by women in LMIC (Osorio and Wodon 2010; Floro and Pichetpongsa 2010; Arora 2015; Connelly and Kongar 2017; Orkoh et al. 2019). In addition to these instruments, researchers have used a range of questions pertaining to the work environment, effort exerted, and time, to determine work intensity in labor force participants. These measures are briefly discussed below; however more detailed descriptions of these constructs are available elsewhere (Karasek et al. 1981; Siegrist 1996; Kristensen et al. 2005; Burke et al. 2009; Osorio and Wodon 2010; Deery et al. 2010; Younès et al. 2018; Nappo 2019).

## Job Content Questionnaire (JCQ)

The JCQ has been used to measure psychological demands, job control, and job strain. Job control is composed of two subdimensions, skill discretion and decision authority (Karasek et al. 1981). Skill discretion refers to the development and use of skills and training, while decision authority refers to autonomy over work

organization and time (Karasek et al. 1981). Job demands represent psychological stressors in the work environment which include workload, working pace, conflicting demands, and time pressure within a particular job (Karasek et al. 1981). Low job control and high demands are independently associated with poor health outcomes in working adults. Job strain also referred to as the job demand-control model (JDC) uses job control and demands as the operational dimensions and is characterized by high demands and low control (Karasek et al. 1981, 1990). An updated version of the model also includes social support from co-workers and supervisors (Karasek and Theorell 1990). The JCQ has been validated and found to be reliable in different regions of the world.

### **Effort-Reward Imbalance (ERI)**

The ERI focuses on the principle of reciprocity and on macro-social factors such as job security, promotions, and salary (Siegrist 1996; Siegrist et al. 2004). The model postulates that stressful working conditions are due to an imbalance between high effort applied to a job and low macro-social rewards. Perceived efforts relate to the physical, emotional, and psychological demands of work activities. The rewards can include money, esteem, opportunities for advancement, and security (Siegrist 1996). Incongruence between applied effort at work and rewards received increases risk of negative health, social, and job-related well-being (van Vegchel et al. 2005; Mutambudzi et al. 2018). The ERI has been validated and found to be reliable in different regions of the world.

### **Copenhagen Psychosocial Questionnaire (COPSOQ)**

The COPSOQ includes common dimensions of quantitative demands and work pace and also incorporates dimensions of emotional and cognitive demands. In addition, factors such as work organization and job content, interpersonal relationships, and person-work interface scales are incorporated into the COPSOQ (Kristensen et al. 2005). Using these scales, the COPSOQ covers a broad range of work environment and psychosocial factors that describe work intensity. The linguistic reliability and psychometric properties of the COPSOQ have been tested and validated in LMIC (Sahani and Hassim Ismail 2005; Pournik et al. 2015).

### **European Surveys on Working Conditions**

The European Working Conditions Survey was initiated in 1990 to provide an overview of working conditions in Europe. The survey aims to provide a comprehensive picture of the everyday reality of men and women at work, by assessing factors such as employment status, duration and organization of work physical and psychosocial risk factors, health and safety, work-life balance, and financial earnings (Nappo 2019).

Similar to previously discussed instruments, it has been used extensively in different regions of the world (Benavides et al. 2014; Yoo et al. 2015; Nappo 2019).

## **Work Intensity Index**

Primarily used in the field of economics, work intensity is described as a form of time poverty (Osorio and Wodon 2010). Time poverty refers to engagement in work for a substantially greater number of hours than desirable (Osorio and Wodon 2010). This index is used primarily to assess gender inequalities and labor market disparities but may provide insights into work factors and public health. To provide a more accurate measure of the burden of work, this index also takes into account multi-tasking, which intensifies labor, meaning that a person works harder in each unit of time they are engaged in work activities (Floro and Pichetpongsa 2010; Arora 2015). For example, Arora indicated that 20% of women in a focus group in rural Mozambique had childcare responsibilities while working on farms. Activities such as fetching water or working in the fields were conducted while also carrying a child on the back (Arora 2015), making their work activities more laborious. Though scarcely used in occupational and public health research, this index would be particularly valuable in assessing work-related ill-health in LMIC.

## **Additional Scales and Instruments**

Scholars have also used varied items to establish work intensity in research studies. For example, Younès assessed work intensity using the statements: “I receive orders or contradictory indications,” “I have to provide an excessive amount of work,” “I have too much to think about,” “I face difficulties to conciliate work and family tasks,” and “I have the time to do my job” (Younès et al. 2018). Burke and colleagues examined the relationship of work intensity and work hours on health and work outcomes using a 15-item scale which included items “regarding unpredictable flow of work,” “availability to clients at all times,” and “a large scope of responsibility that amounts to more than one job” (Burke et al. 2009). In assessing coping strategies in call center workers, Deery et al. used the following items: “My job requires me to work very fast,” “My job leaves me with very little time to get everything done,” and “My job requires me to work very hard (physically or mentally)” (Deery et al. 2010).

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## **Distinctive Causes and Exacerbators of Work Intensity in LMIC**

It has been postulated that labor markets of countries cluster along geographical and historical lines, and these labor markets are predictive of population health outcomes at each level of economic development (Chung et al. 2010; Muntaner et al. 2012; Benach et al. 2014). It would therefore be negligent to generalize research on work-related health from HIC to LMIC. The root causes of work intensity in LMIC present

unique challenges often intertwined with other domains of life, health, and culture in each country. Different cultures identify with and perceive their jobs and job-related factors through a social and cultural lens constructed from their own values (Bhagat et al. 2010). In addition, some factors such as political instability, worker rights, informal or precarious work, poverty, and the commodity of time uniquely affect work and work outcomes in LMIC.

## **Work Culture in Collectivist Societies**

Workers in collectivist societies, i.e., societies where individuals value loyalty and cohesiveness and prioritize common goals over personal ambitions, may cope with work demands and role stress differently, compared to workers in individualistic societies such as the USA, UK, or Western Europe, who prioritize personal interests over common goals (Spector et al. 2004; Haar et al. 2014). Not all LMIC are collectivist societies; however, the majority of countries in non-western regions such as Africa and Asia practice collectivism. According to the literature, workers in collectivist societies in Africa and Asia have less job autonomy relative to their counterparts in individualistic society work settings in Europe and the USA (Bhagat et al. 2010). In addition, latent cross-cultural factors in collectivist societies may affect perceptions of work intensity and how it impacts other domains of life. This is demonstrated by several studies that have found individuals or societies with collectivist values to have greater organizational citizenship behavior, which makes them more invested in organizational priorities in lieu of personal ones. Such individuals are less likely to perceive their work as stressful even when demands and pressure at work are high. Factors such as working extensive hours, high workload, and undefined boundaries between domains of work and personal life are perceived with less negativity (Yang et al. 2012). These factors make workers in predominantly collectivist societies particularly vulnerable to being exploited and exposed to greater work intensity, with negative consequences on health and well-being.

## **Political Instability**

LMIC are more vulnerable to political instability, which impacts the economy and increases risk of adverse work conditions (Aisen and Veiga 2010). From a macro-level perspective, political instability can shorten policymakers' horizons, leading to the development of sub-optimal or continuously changing policies (Aisen and Veiga 2010). This can lead to volatile economic and work environments and leave the labor force unprotected by the law. In addition, corruption among politicians which is significantly more prevalent in LMIC (Svensson 2005) poses a substantial constraint on the economy and labor market (Dreher and Schneider 2010; Cooray and Dzhumashev 2018). Overlooked illegal activities by decision- and policymakers may consequently lead to hazardous working conditions and insubstantial wages and

compound the strain and instability experienced by employees (Olken and Pande 2012). This increases the likelihood of precarious and informalized work, making workers more vulnerable to work intensity and associated adverse health outcomes. Further, the activities and quality of working conditions of multinational companies which have over the past decades outsourced services and industry to LMIC, in part to maximize profits and benefit from weak or non-existing regulatory systems, can be greatly influenced by political instability. While some studies have indicated that multinational companies are linked to poor working conditions and high incidence of adverse work-related health outcomes (Kortum et al. 2010), others have indicated that these companies provide increased wages and better work conditions and make use of labor organizations and democratic institutions that are designed to improve work conditions of employees (Brown et al. 2004; Akinyemi 2016). Turbulent political environments with weak regulatory systems however are likely to attract companies that take advantage of corrupt environments and poorly established labor laws and regulatory systems.

### Long Work Hours and Time Poverty

Regularly engaging in work weeks of more than 48 h is considered to be working excessively long hours (Messenger 2018). According to the International Labour Organization, approximately a third (36.1%) of global workers have excessively long hours, and developing countries in Asia and the Pacific region (47.2%) have the greatest proportion of employees who have long work days (Messenger 2018). LMIC workforces disproportionately work long hours, which is in part compelled by very low wages, that often necessitate workers to work longer in order to manage financially (Benach et al. 2014; Messenger 2018).

Closely tied to the notion of long work hours is the concept of time poverty which focuses on populations that work long hours out of necessity and not choice, thereby paying particular attention to poor workers and those who would fall below the poverty line should their work hours decrease (Bardasi and Wodon 2010). These unavoidable long hours coupled with multitasking result in greater effort expended to carry out work (Arora 2015), often with minimal return on effort. In low-income countries in Africa, complex gender disparity issues emerge in relation to working long hours, time poverty, and multitasking. Due to the distribution of domestic and economic work, women have longer work days with a greater workload and often have to make difficult trade-offs which may compromise their health and well-being (Bardasi and Wodon 2010; Srivastava and Floro 2017).

While men are more likely to work long hours in paid work, women often have to multitask domestic and paid work. For example, in rural Africa, agriculture is the main economic activity, with average female labor share in crop production estimated to be approximately 50% in countries that include Malawi, Tanzania and Uganda (Palacios-Lopez and Kilic 2017). Women in agriculture however report dual responsibilities such carrying a child on their back while farming land (Arora 2015), thereby “working harder” during the unit of time dedicated to economic work



(Palacios-Lopez and Kilic 2017). Curiously, little research has been conducted in the African context to identify the harmful effects of work intensity among women working long hours, doing dual domestic and wage-generating jobs.

## Poverty

Disproportionately high levels of income poverty are another challenge in LMIC that define the labor market and influence varied work factors. Poverty which limits access to transportation, technology, and sanitation can exacerbate time poverty due to the time that has to be dedicated to completing tasks (Costa et al. 2009; Scheurlen 2015). Adults below the poverty threshold often have long work days allocated to low-productivity work, which brings in insubstantial wages. By the same token, the long hours worked prohibit the potential of increasing wages through other means (Osorio and Wodon 2010). Further, poverty and lack of opportunities prevent many individuals in LMIC from developing their skills and competence through education, training, and skills development which would improve occupational opportunities and earning potential (Wodon and Blackden 2006). These individuals are therefore ensnared in a vicious cycle that exposes them to greater work intensity, with limited return on time invested in wage-earning activities.

## Worker Rights, Precarious Employment, and the Informal Sector

While employment protection data is not readily available in most LMIC (Benach et al. 2014), high rates of poverty and risk of unemployment have made workers in LMIC increasingly vulnerable and willing to accept employment under poor working conditions and without seeking labor law protection (Klerck 2002). This unfortunately empowers employers to change the terms and conditions of employment without concern for how this may affect their employees. This, among other factors, has exacerbated precarious work and employment informalization (moving from the formal to informal sector), employment circumstances that further push workers beyond the scope of the labor law (Fenwick et al. 2007).

According to the International Labor Office, the majority of workers in Africa (82.8%) and Asia and the Pacific region (68%) are employed in the informal sector (International Labor Office 2018). This informal work is reported to have adverse consequences for workers and presents challenges in regulation, social protection, and safeguarding worker rights and humane working conditions (International Labor Office 2018). Precarious employment and the informalization of work present challenges in enforcing labor rights and leave employees at the mercy of their employers (Klerck 2002; Fenwick et al. 2007; Sankaran 2007). While some LMIC have redefined the definition of an “employee” to extend protection to workers not formally within a contract of employment, enforcement of labor laws is met with challenges such as lack of capacity to regulate and enforce these laws (Fenwick et al. 2007). The exclusion from the protection offered by labor

laws and lack of regulation makes workers in LMIC more vulnerable to heavy workloads and high job demands with little autonomy or rewards, which compounds their disadvantage through the manifestation of adverse health outcomes in regions with constrained health sectors.

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## **Evidence from Africa, Southeast Asia, and the Western Pacific**

Africa: A detailed literature search indicated that only 14 studies have been conducted in Africa, with most of the evidence coming from South Africa, Nigeria, and Ethiopia (Table 1). The most assessed work intensity constructs were job strain, job demands, and work overload. Job strain and workload prevalence were observed to be high in various occupations. Forty-four percent of Moroccan health-care workers had high-strain jobs (Giurgiu et al. 2015). Similarly, nurses in Ethiopia reported a 44% prevalence rate of high workload, and approximately 41% reported emotional demands (measured as emotional issues related to patient death) (Salilih and Abajobir 2014). Among nurses in South Africa, job demands that were found to be the greatest stressors included disproportionate administrative responsibilities, paper work, and high patient and client demands (Rothmann et al. 2006). In 29% of Ethiopian nurses, high workload was the chief source of dissatisfaction, and data indicated that a unit increase in workload resulted in a  $-2.66$  units decrease in overall job satisfaction (Semachew et al. 2017). Among male construction workers in Nigeria, similar prevalence of work intensity was reported. Forty-six percent of the construction workers reported psychological demands and mental workload, and 35% indicated they had low job control (Ekpenyong and Inyang 2014).

A study by Salilih and Abajobir in Ethiopia was the only study that examined determinants of work intensity in detail in Africa (Salilih and Abajobir 2014). Sex, marital status, shift work, prevalence of ill-health, and work department were significantly associated with stress in nurses, who reported that “workload” was the most frequent source of stress (44.4%). After adjusting for relevant covariates, they found that female nurses were twice as likely to experience work-related stress relative to their male counterparts. In addition, widowed and divorced nurses had a tenfold increased risk of work stress. Due to the HIV pandemic, at one point, mortality of young and mid-aged male adults was reported to be between 50% and 70% in some sub-Saharan African countries (Quinn et al. 2000). This increased the number of single-headed and female-lead households. Previous research has indicated that working single adults are more likely to report greater demands and work stress, due to lack of spousal support and long work hours, particularly when they have additional caregiving responsibilities (Amstad et al. 2011; Nomaguchi 2012; Mutambudzi 2017; Mutambudzi et al. 2017). This can result in work-family conflict (WFC) which is reportedly more prevalent among single parents and adults with unsupportive spouses (Amstad et al. 2011; Nomaguchi 2012; Mutambudzi 2017; Mutambudzi et al. 2017). Further, factors such as shift work and ill-health were also associated with increased risk of work stress. Working evenings and nights has been associated with sleep disorders, which impact work performance, increases

**Table 1** Research on work intensity from LMIC in Africa

Authors	Country	Objective	Independent variable	Dependent variable	Conclusion
(Abaraogu et al. 2017)	Nigeria	Investigate job stress dimensions and their relationship to work-related musculoskeletal disorders (WMSDs) among physiotherapists	JCQ	WMSDs	Over 80% of physiotherapists had WMSDs, and high job stress was reported. Physiotherapists had high levels of physical demands, high job control, and good social support
(Darboe et al. 2016)	Gambia	Investigate associations between ERI and self-reported health among nurses and environmental health workers	ERI	Self-reported health	Perceived high effort was a risk factor for poor self-reported health
(Ojedokun 2010)	Nigeria	Examine the associations between ERI and unethical behavior	ERI	Attitudes toward unethical behavior among police officers	ERI independently influenced attitudes toward unethical work behavior
(Peltzer et al. 2009)	South Africa	Examine the relationship between job stress and satisfaction and the prevalence of stress-related illnesses and risk factors among educators	ERI, JDC	Chronic illness	Work stress from teaching methods and low peer support were associated with hypertension. Lack of career advancement was inversely related to hypertension. Components of the JDC and ERI were associated with stomach ulcer and mental distress
(Uzoigwe et al. 2016)	Nigeria	Examination of work-family conflict (WFC) and the factors predicting it in professional women	WFC	Hours of work, job demand, and work overload	Hours of work, family responsibilities, job demand, and work overload were significantly correlated with WFC
(Amponsah-Tawiah et al. 2013)	Ghana	The effects of physical and psychosocial risk factors on work safety in Ghanaian miners	High job demands and low control over workload	Workplace safety measured as number of near misses, disabling injuries, and accidents	High job demands and low control over workload were associated with poor safety experiences.

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Table 1 (continued)

Authors	Country	Objective	Independent variable	Dependent variable	Conclusion
(Shihundia et al. 2016)	South Africa	Examine the effect of increased workload on quality documentation of patient information	Workload	Documentation	Workers with high workloads, unclear roles, and no control reported near misses more often than workers with reasonable work demands and adequate control over work
(Belaid et al. 2017)	Niger	Assess factors that influence the attraction and retention of health professionals working in rural areas in Niger	Workload	Retention of health professionals	Increased workload impacted quality of documenting patient information and resulted in incomplete information
(Semachew et al. 2017)	Ethiopia	Assess factors that influence job satisfaction	Workload	Job satisfaction	Workload among other factors negatively impacted attraction and retention of health professionals to work in rural areas
(van Doorn et al. 2016)	Nigeria	Investigate whether Nigerian nurses' emotional exhaustion and active learning were predicted by job demands, control, and social support	JCQ: Job demands Job control Social support	Emotional exhaustion and active learning	High workload decreased job satisfaction Emotional exhaustion was higher among workers with high demands and low supervisor support High control and high supervisor support were associated with active learning
(Ekpenyong and Inyang 2014)	Nigeria	Examine the association between worker characteristics, workplace factors, and WMSDs in Nigeria's construction industry	Physical demands and psychosocial risk factors which included: Decision latitude	Prevalence of WMSDs	Workplace factors with increased risk for WMSDs included psychological demands and mental workload, awkward movement of

(Negussie and Kaur 2016)	Ethiopia	Examine the relationship between the job demand-control-support model and job satisfaction in teaching hospitals	Psychosocial demands Mental workload Social support Job insecurity	head and arms, working against force or vibration, and fast work pace
(Salihih and Abajobir 2014)	Ethiopia	Assess levels of work-related stress among nurses	Job demand-control-support measured by JCQ	Job satisfaction decreased with high job demand and increased with social support. There was no effect from job control on job satisfaction
(de Beer et al. 2016)	South Africa	Assess employee well-being and the mediating role of burnout in the relationship between work overload and psychological ill-health symptoms, in financial service sector workers	Sex Marital status Illness Work shift Work unit  Work overload	Prevalence of work-related stress was high and impacted by gender, work shift, illness, marital status, and worksite or unit  A causal relationship was observed. Work overload predicted burnout, which subsequently predicted psychological ill-health symptoms
(Rothmann et al. 2006)	South Africa	(i) Examine the construct validity and reliability of the nursing stress indicator (ii) Identify differences between occupational stressors of professional and enrolled nurses	Job designation – professional vs. enrolled nurses	The most severe stressors included job-associated health risks, lack of recognition, and high workload due to insufficient staff, emotional demands of watching patients suffer, and demands of patients
(Rothmann and Essenko 2007)	South Africa	Assess the relationships between job characteristics, burnout, optimism, and ill-health in higher education support staff	Job demands and resources	Job demands, overload, and lack of resources were associated with burnout

workload, and is associated with greater likelihood of reporting high job demands (Van Laethem et al. 2015).

Consequences of work intensity in African studies were observed in the domains of health, family well-being, and work factors. Studies examining ERI provided support for the deleterious effects of high imbalance between effort exerted and rewards, predicting attitude toward unethical work behavior among police officers in Nigeria (Darboe et al. 2016) and negatively affecting reports of self-rated health and chronic illness in educators and health-care workers (Peltzer et al. 2009; Ojedokun 2010; Darboe et al. 2016). High job demands and job strain were associated with emotional exhaustion and musculoskeletal disorders in health-care workers and providers (Ekpenyong and Inyang 2014; van Doorn et al. 2016; Abaraogu et al. 2017). In miners, accidents and near misses were associated with high physical and psychosocial job demands and low control over work tasks (Amponsah-Tawiah et al. 2013). Among working women, in addition to their family responsibilities, job demands and workload increased WFC (Uzoigwe et al. 2016). Similarly these intensity constructs were associated with physical and mental ill-health (Rothmann and Essenko 2007) and health conditions such as hypertension, heart disease, stomach ulcers, asthma, and mental distress, as well as tobacco and alcohol misuse (Salilih and Abajobir 2014).

Most of the studies were conducted on health-care workers. This focus on health-care workers in African research is comprehensible given the fragility of health systems in this region. Health systems in sub-Saharan Africa are often overburdened, under-resourced, and struggle with retention of workers. For example, there is a well-documented shortage of nurses in LMIC, which is reported to increase workload (Salilih and Abajobir 2014). These shortages are consequences of inadequate compensation and incentives, unsafe working environments, poor career development opportunities, and inadequate training, which increase regional or international migration and brain drain (World Health Organization 2006; Anyangwe et al. 2007; Kinfu 2009; Darboe et al. 2016). This results in a local workforce that is understaffed, under high pressure, with high workloads and job demands, and struggling to meet the populations health needs, ultimately leading to burnout, low motivation, lower productivity, dissatisfaction, work absences, and early retirement (World Health Organization 2006; Anyangwe et al. 2007; Kinfu 2009; Delobelle et al. 2011; Aveling et al. 2015; Darboe et al. 2016).

Evidence of this was observed in the current literature. Among nurses and other health workers, job strain, ERI, job demands, long work hours, and workload contributed to perceived high levels of occupational stress, emotional exhaustion, poor self-rated health, and affected retention of nurses as well as ability to comprehensively complete documentation of patient records (Rothmann et al. 2006; Giurgiu et al. 2015; Negussie and Kaur 2016; van Doorn et al. 2016; Darboe et al. 2016; Abaraogu et al. 2017). Work intensity constructs were observed to affect well-being of health workers; however these factors may further burden the fragile health systems in Africa (van Doorn et al. 2016). Exposure of health-care workers to these deleterious work factors may negatively impact their health and the lives of the patients in their care, thereby undermining quality of services

provided which can potentially impact the cost of health care (Pierre Boisard et al. 2003).

It is important to note that only one study in Africa tested for instrument reliability and content validity (Rothmann and Essenko 2007), and the instrument, the Nursing Stress Indicator, is limited for use in nursing populations. No other study assessed validity of instruments that can be used across occupations and industries. While using previously developed instruments with good psychometric properties has numerous advantages, these instruments need to be culturally acceptable and appropriately translated, to be valid. It is therefore unclear whether instruments such as the JCQ and ERI which were constructed for high-income economies with different labor market participation patterns, labor laws, and culture accurately measure work intensity in the LMIC in sub-Saharan Africa. Studies in this region examining validity and reliability of the instruments that measure work intensity are needed, as the lack of validation studies draws some concerns about the current evidence and how useful the findings are.

## Western Pacific

Evidence from the Western Pacific region primarily came from Malaysia, Mongolia, and Vietnam (Table 2). The most utilized work intensity constructs were job strain, psychological demands, and work overload. Several studies assessed the reliability and validity of the JCQ and concluded that it was a reliable and valid tool for examining psychosocial and physical workplace demands (Edimansyah et al. 2006; Hadi et al. 2006; Hoang et al. 2013; Nehzat et al. 2014; Amin et al. 2015). While all validity and reliability studies were conducted in Malaysia and Vietnam, these studies provide support for JCQ in the Western Pacific populations that share similar work cultures throughout the region.

Prevalence of work intensity varied by assessment measure and work population. For example, approximately 76% of Mongolian doctors reported working extra hours (Bagaajav et al. 2011), while 21% of manufacturing workers in Vietnam reported job strain (Minh 2014). Among public university employees in Malaysia, 38% reported high job demands, 21% reported low decision latitude, and 25% reported high job strain (Yasin et al. 2012). Overall, clinical lecturers had a job strain prevalence rate of 34% compared to 6.9% in nonclinical lecturers. Teachers however had the highest prevalence of work intensity (Zamri et al. 2017) reported in this region. Malaysian secondary school teachers had an 85% prevalence rate of high psychological demands (Zamri et al. 2017).

There weren't any studies that assessed determinants of work intensity; however consequences of work intensity in this region were observed in the domains of mental and physical health, behavioral factors, and work factors. One study found significant associations between ERI and both personal and work-related burnout (Bagaajav et al. 2011). JCQ was found to be associated with depression (Hoang et al. 2013; Minh 2014). Specifically, an association was observed between the work intensity constructs JCQ, high psychological demands, and low social support, and

**Table 2** Research on work intensity from LMIC in the Western Pacific

Author	Country	Objective	Independent variable	Dependent variable	Conclusion
(Bagaajav et al. 2011)	Mongolia	Examine the prevalence of burnout among doctors and nurses in Mongolia, and identify the factors influencing their burnout	ERI	Burnout, measured by the Copenhagen Burnout Inventory: Personal Work-related Client-related burnout	Effort-reward imbalance influenced all dimensions of burnout, and overcommitment influenced personal and work-related burnout
(Hoang et al. 2013)	Vietnam	Validate the Karasek-JCQ in Vietnamese health personnel, and assess its association with depression	JCQ: Job demands and control	Depression	A valid Vietnamese version of the Karasek-Job Content Questionnaire was produced and composed of psychological demands, social support, decision latitude-autonomy, decision latitude-authority, and skill discretion. A significant but weak association between the validated JCQ scale and depression was observed
(Minh 2014)	Vietnam	Determine the prevalence and associated factors of work-related depression among the employees of a shoe manufacturing factory	JCQ, absenteeism, and perceived work conditions	Prevalence of work-related depression	High psychological demands, low social support, inadequate work protection materials, and work absenteeism increased prevalence of work-related depression
(Yasin et al. 2012)	Malaysia	Examine the relationship between job strain, smoking behavior, and smoking cessation among male employees in a smoking cessation program	JCQ: Job control Job demand Supervisor support Co-worker support Job insecurity	Smoking status	Men with higher co-workers' support and in "passive jobs" had a higher likelihood of succeeding with smoking cessation



(Zamri et al. 2017)	Malaysia	Evaluate the association of lower back, neck and shoulder pain with psychological distress and work-related psychosocial factors	<p>Job decision latitude</p> <p>Job skill discretion</p> <p>Psychological distress and JCQ:</p> <p>Decision authority</p> <p>Psychological job demands</p> <p>Skill discretion</p> <p>Co-worker support</p> <p>Supervisor support</p>	Prevalence of lower back pain and neck or shoulder pain	High job demands and low skill discretion were associated with lower back pain, while low social support was associated with neck and shoulder pain
(Huda et al. 2004)	Malaysia	Assess job strain and dissatisfaction among lecturers from schools of medical sciences	<p>Job factors:</p> <p>Department –clinical/nonclinical</p> <p>Created skill</p> <p>Supervisor support</p> <p>Co-worker support</p> <p>Psychological stressors</p> <p>Psychological job demand</p> <p>Psychological strain</p> <p>Psychosomatic strain</p> <p>Job dissatisfaction</p> <p>Job insecurity</p> <p>Non-job factors: Depression/life dissatisfaction</p> <p>Sleep problems</p>	Job strain and job dissatisfaction	Clinical-based lecturers experienced higher job strain relative to nonclinical lecturers. In addition, high psychological demands resulted in job dissatisfaction, while high decision authority was protective against job dissatisfaction
(Maizura et al. 2009)	Malaysia	Assess the reliability of decision latitude, psychological job demands, and social support – in a			Cronbach's alpha coefficients indicated that internal consistency was acceptable for decision latitude

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Table 2 (continued)

Author	Country	Objective	Independent variable	Dependent variable	Conclusion
(Amin et al. 2015)	Malaysia	Evaluate the psychometrics properties of the Malay version of the JCQ among nurses in Malaysia			and social support but low for psychological job demand. The authors concluded that overall, the JCQ is a reliable scale for assessing job stress in this group of workers
(Nehzat et al. 2014)	Malaysia	Assess the reliability and validity of the JCQ with research laboratory staff in a university			The authors concluded that the Malay JCQ is reliable and valid to measure psychosocial and physical stressors in public hospital nurses
(Hadi et al. 2006)	Malaysia	Assess the reliability and construct validity of the Malay version of JCQ among school teachers			JCQ is a reliable and valid tool for examining psychosocial work situations and job strain among research laboratory staff
(Edimansyah et al. 2006)	Malaysia	Assess the reliability and construct validity of the Malay version of the JCQ among automotive workers in Malaysia			The authors concluded that the JCQ is a reliable and valid tool for assessing job stress in school teachers
(Edimansyah et al. 2007)	Malaysia	Assess the relationship between psychosocial work factors and HRQOL in male automotive assembly plant workers	JCQ psychosocial work factors	Health-related quality of life (HRQOL)	The authors concluded that the JCQ is a reliable and valid tool for assessing job stress in a population working in the automotive industry. High skill and creativity and strong supervisor and co-worker support were associated with higher HRQOL, while high job demands decreased HRQOL.

(Rusli et al. 2008)	Malaysia	Assess the relationship between working conditions and stress, anxiety, depression, and quality of life	Job demand, job control, and social support	Stress, anxiety, depression, and quality of life	Job demands increased stress and decreased quality of life, while social support increased quality of life
(Edimansyah et al. 2008)	Malaysia	Examine the prevalence of self-perceived depression, anxiety and stress, and their relationships with psychosocial job factors	Psychosocial factors from the JCQ	Stress, anxiety, and depression	Psychological demands increased risk of depression, anxiety, and stress, and social support was inversely associated with depression and stress
(Achour et al. 2016)	Malaysia	The effects of Islamic personal religiosity on the relationship between job strain and employee well-being	Job strain	Well-being	Job strain significantly impacted well-being among employees. Religiosity moderated the effects of job strain on well-being
(Masilamani et al. 2012)	Malaysia	Determine the prevalence of job stress among secondary school teachers and the association between salivary cortisol, salivary IgA, and sociodemographic characteristics and the association between log cortisol, IgA levels, and job strain categories	Job stress measured using the JCQ	Salivary biomarkers of stress	The Malay teachers had a high prevalence of job stress compared with non-Malays (Chinese, Indians, and others)
(Hadi et al. 2009)	Malaysia	Assess the prevalence of stress and the associated factors contributing to it in Malay teachers	Job stress as measured by JCQ	Stress	Prevalence of stress was 34.0%. Age, duration of work, and psychological job demands were associated with stress

high prevalence of work-related depression in Vietnamese health-care workers (Hoang et al. 2013; Minh 2014). Among hospital personnel, ERI was a robust predictor of burnout (Bagaajav et al. 2011; Minh 2014; Amin et al. 2015). A series of four studies in manufacturing workers concluded that psychological demands in automotive workers were associated with lower quality of life, poorer mental health outcomes, self-perceived stress, and diminished quality of life (Edimansyah et al. 2006, 2007, 2008; Rusli et al. 2008). Impact of high job control on social relationships was reported by one study, which found a gradient effect whereby higher job control increased social relationships. This study also found that supervisory support was inversely associated with depression and stress (Edimansyah et al. 2008). The importance of supervisory support was also demonstrated in Malaysian teachers, who reported poorer health and higher job strain when supervisory support was low (Masilamani et al. 2012; Zamri et al. 2017).

Unlike studies in Africa that focused on health-care personnel, studies in the Western Pacific were primarily conducted in education personnel. This included primary and secondary teachers, as well as higher education lecturers and research staff. Constructs of work intensity were associated with low back pain, neck and shoulder pain, job dissatisfaction, and general well-being in teachers (Huda et al. 2004; Achour et al. 2016; Zamri et al. 2017). High decision latitude however was protective of health and job dissatisfaction, while religiosity moderated the effects of job strain (Hadi et al. 2009; Achour et al. 2016). The focus on educators may be due to several factors. Adults working in low-resource and deprived settings in LMIC are vulnerable to adverse general well-being and job performance outcomes due to general and financial stress and poverty (Schwartz et al. 2019). This coupled with increasing work intensity, higher demands, increasing work tasks, and continuously expanding job descriptions among teachers and professors has led to concerns of high resignation rates, poor quality of work, and burnout in this region and globally (Brante 2009; Masilamani et al. 2012; Jennings et al. 2017).

Poor conditions of schools and colleges, lack of adequate support and resources, and working with students from challenging backgrounds may compound work intensity and also contribute to emotional exhaustion and burnout (Glewwe et al. 2011; Shen et al. 2015). Teachers in low-resource areas lack of basic supplies, which leads to increased workload and higher work demands (Fehrler et al. 2009; Glewwe et al. 2011). In addition to impacting teacher well-being, these conditions are likely to affect student socioemotional well-being and performance (Spilt et al. 2011).

None of the Western Pacific or SE Asia studies assessed determinants of work intensity. Understanding the driving forces behind work intensity and associated stress is of great importance as it provides a better understanding of who may be at risk and how public policy and organizations can intervene to mitigate the identified problems. An adequate understanding of not only work intensity but its determinants is important to appropriately address its causes and associated health, work, and social outcomes (Lin et al. 2009).

## Southeast Asia

Research on work intensity in SE Asia has been conducted in Thailand, India, Sri Lanka, and Bangladesh (Table 3). Most studies examined work intensity primarily using the ERI model and the JCQ, both of which were found to be valid and reliable (Buapetch et al. 2008; Phakthongsuk and Apakupakul 2008; Phakthongsuk 2009). Few studies however reported work intensity prevalence. In Sri Lanka, senior officers and managerial assistance reported high ERI prevalence of 74.6% and 80.5%, respectively (Gamage and Seneviratne 2016). Approximately 50% of Indian academics reported that their workload interfered with teaching or research activities (Ahmad et al. 2015). Differences were evident in manufacturing workers, with approximately one in four foundry workers in India experiencing job strain (Mohan et al. 2008), while garment workers in Thailand reported ERI prevalence of 2%. High demands and job strain had prevalence rates that ranged from 4.8% to 53% (Jirapongsuwan et al. 2012; Kaewboonchoo et al. 2014).

Similar to other regions, work intensity negatively impacted physical and mental health, behavioral factors, work factors, and family well-being. Among health-care workers, work intensity constructs were associated with poorer health, family, and work outcomes (Jirapongsuwan et al. 2012; Kaewboonchoo et al. 2014; Li et al. 2017). High job control and low job strain had significant and positive correlations with family well-being, while high job demands negatively impacted family well-being (Jirapongsuwan et al. 2012). Increased workload among community health workers in Bangladesh was not found to decrease quality of care, but had a negative impact on personal and family lives (Puett et al. 2012). In the manufacturing industry, job strain in foundry workers (Mohan et al. 2008) was associated with adverse outcomes, and low reward for effort exerted was significantly associated with poor psychological outcomes in workers in the garment and electronics industry (Buapetch et al. 2008; Charoenpaitoon et al. 2012).

One study examined the association between job strain and psychological distress in pregnant women working full time and reported that job strain was a significant contributor to psychological distress (Sanguanklin et al. 2014). A large number of women within the reproductive age participate in the labor force in this region. For example, in Thailand 76% of women 15–44 years of age are employed (Sanguanklin et al. 2014). The literature has indicated that varied constructs of work intensity can lead to adverse reproductive health outcomes, through hormonal and neuronal pathways (Mutambudzi et al. 2011). Given the burden of adverse birth and pregnancy outcomes and the complex interactions with poverty and limited resources in LMIC regions, more research in this area is imperative.

Unlike other regions, evidence from SE Asia was not focused on one occupational group, but targeted various work populations, highlighting the diverse industries and challenges in the region. The diversity of occupational groups evaluated in the studies indicates the growth of different industries in part due to outsourcing from HIC. Outsourcing which refers to contracting out parts of production or service (Cheng and Cheng 2016) has been found to improve the economy of countries like

**Table 3** Research on work intensity from LMIC in South and East Asia

Author	Country	Objective	Independent variables	Dependent variables	Conclusion
(Maizura et al. 2009)	Thailand	Evaluate the effects of an ergonomic intervention on musculoskeletal disorders and psychosocial risk factors	Ergonomic intervention COPSOQ	Psychosocial risk factors and musculoskeletal conditions	Psychosocial risk factors which included work pace, influence at work, meaning of work, predictability, rewards, role conflicts, and social support from supervisors were significantly improved post intervention
(Li et al. 2017)	Thailand and China	Explore the associations between stressful work environments and tinnitus in Asia	Stressful work environments measured by: JDC ERI	Tinnitus	High job strain, high demand, and effort-reward imbalance were associated with increased the odds of experiencing tinnitus
(Charoenpaitoon et al. 2012)	Thailand	Determine the factors associated with depression among female workers in the electronics industry	ERI (in addition to other non-work-related predictors)	Symptoms of depression	Low rewards predicted depression among female factory workers
(Kaewboonchoo et al. 2014)	Thailand	Determine the relationship between job stress and intent to stay at work among nurses	Job stress measured using the JCQ	Intent to stay at work	Intent to stay at work was significantly correlated with supervisor support among the nurses with high job strain and with co-worker support among those with active jobs
(Jirapongsuwan et al. 2012)	Thailand	Examine job strain and family well-being among public health nurses	Job strain	Family well-being	51.5% of the nurses reported active jobs. Those with low-strain jobs had higher levels of family well-being relative to those with active and high-strain jobs
(Sanguanklin et al. 2014)	Thailand	Examine the direct and moderating effects perceived workplace	JCQ (job strain and perceived)	Psychological distress	Job strain was significantly associated with psychological

			support, perceived family support, and coping strategies on psychological distress on the relationship between job strain and psychological distress in pregnant women	workplace support)		distress. Social support and wishful thinking moderated the effects of job strain on psychological distress
(Buapetch et al. 2008)	Thailand	Thailand	Test the psychometric properties of the Thai version of the ERI Questionnaire in garment workers			The Thai ERI was found to be adequately reliable and with good content validity
(Phakthongsuk and Apakupakul 2008)	Thailand	Thailand	Evaluate the validity and reliability of two Thai JCQ – one with 22-item and a 45-item version			Decision latitude, supervisor support, and co-worker support had high internal consistency, but psychological demand had low internal consistency
(Sandhu et al. 2016)	India	India	Assess the association between occupational stress and nicotine dependence	Occupational stress measured by ERI	Nicotine dependence	An imbalance between effort and reward at work was associated with nicotine dependence
(Priyanka et al. 2016)	India	India	Investigate the relationship between work stress and nicotine dependence among law enforcement personnel	Work stress, measured using ERI	Nicotine dependence	There was no association between work stress and nicotine dependence
(Mohan et al. 2008)	India	India	Assess job strain prevalence in foundry shop floor workers		Job strain	25% of workers experience job strain in foundry industry. 29% between 31 and 45 had high strain
(Ahmad et al. 2015)	India	India	Determine the level of workload and job satisfaction among pharmacy academics in public and private universities in India	Workload	Job satisfaction	Academics at private institutions have a higher teaching workload. Almost 58% of all academics were satisfied with their workload; however assistant professors had low job satisfaction

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Table 3 (continued)

Author	Country	Objective	Independent variables	Dependent variables	Conclusion
(Tomy et al. 2017)	India	Assess prevalence of ERI and its association on chronic health, substance abuses, and workplace injuries	ERI	Chronic diseases, substance abuses, and workplace injuries	93% of tea pluckers reported ERI. Effort was found to increase with age. There were no significant associations between ERI and chronic diseases, substance abuses, or injuries
(Chopra et al. 2015)	India	Examine the relationship between perceived job stress and nicotine dependence in health and non-health students	Job stress measured using ERI	Nicotine dependence	ERI was found to be more in students of prevalence and was greater in health-care profession students (87.1%) compared to non-health-care students (78.3%). ERI was significantly associated with nicotine dependence (OR = 4.52)
(Gamage and Seneviratne 2016)	Sri Lanka	Examine the association between perceived job stress and hypertension among administrative officers	Job stress, measured by ERI	Hypertension	ERI and overcommitment were significantly associated with hypertension among SOs and MAs
(Puett et al. 2012)	Bangladesh	Examine the quality of preventive and curative care provided by two groups of community health workers (CHW) with different workloads in southern Bangladesh	Workload	Quality of preventive and curative care provided by CHW	Additional work load (i.e., caring for severe acute malnutrition) that included preventive and curative tasks greatly increased demands on CHWs' time. It was not associated with lower quality of care in well-trained and supervised CHWs, but negatively impacted CHWs' personal lives



India, through job creation, improved standard of living and infrastructure, and increasing the prevalence of women in the job market (Akinyemi 2016). It is however associated with negative outcomes such as increased risk of poor self-reported health, sickness absence, and work-related injuries (Kortum et al. 2010; Cheng and Cheng 2016). These adverse outcomes are a direct effect of economic pressures, poor occupational safety and health management, weak labor laws, and regulatory systems failure (Cheng and Cheng 2016).

Overall the current evidence from LMIC demonstrated the adverse effects of constructs of work intensity in low-resource regions, where high unemployment rates put pressure on a small and decreasing formal sector workforce to meet organizational demands and goals, with limited capital, resulting in poor health outcomes.

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## **Drawbacks of Existing Literature**

It is apparent that research on work intensity is much needed in developing countries to identify and combat its effects on health and well-being. The current evidence is limited and does not provide a comprehensive understanding of the magnitude of the public health problems associated with predictors and outcomes of work intensity. The main shortcomings of current literature can be summarized in three points.

## **Unique Factors That Influence Work Intensity in LMIC Are Largely Ignored**

The challenges faced in work environments in LMIC are often intertwined with unique factors driven by the cultural, sociopolitical, and economic climate. These factors, however, are rarely accounted for in existing work intensity theories and literature. For example, current work intensity constructs do not take into account aspects of cultural values that may impact organizational citizenship behavior and therefore a worker's acceptance of high work demands, workload, and extended hours due to their voluntary commitment to an organization (Cohen and Avrahami 2006; Györkös et al. 2012). As most collectivist nations emphasize social interdependence, theories from individualistic cultures aimed at explaining work intensity in the western world cannot be accurately applied in many LMIC. Further, work intensity theories and literature developed in HIC do not account for vital factors such as time poverty and informal employment, which shape the labor market in less developed regions, further diminishing their applicability to LMIC.

## **Study Design and Samples**

Much of the research conducted in LMIC presents several weaknesses in study design (Sumathipala et al. 2004). There is a lack of national-level, ongoing

representative cohort studies with detailed data on different industries, occupations, and health measures. These types of studies would allow for better understanding of how work factors differentially impact the working population. Small sample sizes, cross-sectional data, and a narrow focus on single occupations or industries limit the quality of data, the research questions that can be answered, causal inferences, and the ability to generalize the results to wider audiences.

## **Quantity and Quality of Submitted Research**

There is limited peer reviewed literature from LMIC on work intensity determinants and associated outcomes. Some scholars have argued that the number of publications does not reflect the amount of research in LMIC, as rejection rates of manuscripts are higher for work stemming from LMIC relative to HIC (Singh 2006). These high rejection rates may be due to poor quality reporting, inappropriate use of statistical methods, or poor study design, all consequence of inadequate training and limited resources (Sumathipala et al. 2004). Further, studies examining work intensity in LMIC are likely to be replication studies adapting methods from HIC to local settings. Replication studies may be viewed as lacking innovation and may have limited publication appeal (Sumathipala et al. 2004; Singh 2006; Oliver et al. 2015). It is however possible that there are more studies in occupational health from LMIC, but due to language barriers are likely published in non-indexed and non-English journals (Singh 2006).

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## **Future Challenges**

### **Low Resources for Great Need (10/90 Gap)**

Resources to conduct quality research in LMIC are scarce (Coloma and Harris 2009; Michael Igoumenidis and Sophia Zyga 2011). According to the WHO, less than 10% of global health research expenditure is spent on the health problems of developing countries, which have more than 90% of the world's burden of health (Viergever 2013; Amerson and Strang 2015). Structures that support research are also scarce which impedes collection of good data. The lack of resources not only limits ability to conduct this research but also reduces opportunities to train local researchers who know, understand, and have experienced the impact on labor market and work environment dynamics of the sociopolitical systems in their country and the challenges their communities face.

### **Research Agendas Set by HIC Funders**

As the majority researchers in LMIC have insufficient resources and weak infrastructure to support their own research (Michael Igoumenidis and Sophia Zyga

2011), much of the research is conducted by investigators from HIC. These HIC researchers are able to secure funding but may provide limited involvement opportunities to LMIC collaborators in the host country. Reliance on HIC for funding presents several challenges in occupational health and other fields. First, the research may not focus on the integral issues local workers have, or the countries' needs, but may be driven by the priorities and agenda of the funding organization (Coloma and Harris 2009; Franzen et al. 2017), thereby maintaining the gaps in knowledge, rather than addressing them. Second, despite the large amounts of funds pouring into developing countries, there is little investment in developing local capacity (Coloma and Harris 2009) to improve quality of research in host countries. Third, it raises concerns about protecting the rights of vulnerable populations and conducting culturally appropriate and ethical research (Michael Igoumenidis and Sophia Zyga 2011; Stapleton et al. 2014).

### **Few Well-Trained Local Researchers**

Majority of the research in LMIC (most of which is driven by external agendas) is directed toward infectious diseases that have disproportionately burdened health systems (World Health Organization Maximizing Positive Synergies Collaborative Group et al. 2009). Donor and research agencies primarily invest in public health and medical research focused on prevention, cure, and management of HIV/AIDS treatments, tuberculosis, and malaria (World Health Organization Maximizing Positive Synergies Collaborative Group et al. 2009; Collins et al. 2013). Research areas such as occupational epidemiology and health psychology do not traditionally bring in large amounts of external financial support, which may make it difficult to recruit and train local researchers in these fields specifically. Due to limited resources and research agendas set elsewhere, few researchers in LMIC have the opportunity to lead research projects. Among those involved in research, it is often not their peripheral responsibility. This unfortunately leads to reduced quantity and quality of research studies conducted and subsequently published.

### **Moving Beyond Downstream Interventions to Address Upstream Determinants**

To tackle some of the challenges relating to work in general and more specifically work intensity in LMIC will require a shift and renewed focus on the root causes of adverse occupational factors and work intensity. Policy and regulation protecting precarious and informal sector workers is needed given that these types of workers account for the majority of the labor force in LMIC. This includes resources to enable efficient regulation of labor laws and enforcement of policies that protect precarious and informal sector workers. Though international organizations such as the UN have led efforts to address poverty reduction as part of a long-term process of social, economic, and political transformation (United Nations Research Institute

For Social Development 2010), continued multidisciplinary efforts are needed to address these upstream determinants of the cycle of poverty that renders many workers in LMIC vulnerable. This however is a challenging task, with slow progress and in some instances limited success (United Nations Research Institute For Social Development 2010).

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## Concluding Remarks

As was reviewed in this chapter, LMIC have a unique set of complex and intertwined factors centered around culture, poverty, politics, poor work regulations and employee rights, and the changing structure of work, which leave workers in these regions more vulnerable to experiencing high work intensity and subsequent adverse outcomes. Current evidence from LMIC is limited but indicates that work intensity is detrimental to health and family well-being. The research however does not take into account the unique circumstances in these regions and is limited by the lack of national studies and longitudinal data to fully assess the prolonged effects of work intensity in nationally representative samples. Challenges in effectively assessing work intensity in LMIC persist; however there are potential solutions that may enable improved research and understanding of the burden of work intensity in low-resource areas globally.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [From National Labor and Social Policies to Individual Work Stressors](#)
- ▶ [Precarious Employment Conditions, Exploitation, and Health in Two Global Regions: Latin America and the Caribbean and East Asia](#)
- ▶ [The Demand Control Support Work Stress Model](#)

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# Impact of the Digitization in the Industry Sector on Work, Employment, and Health

# 16

Mathias Diebig, Andreas Müller, and Peter Angerer

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## Abstract

Digital innovations are expected to fundamentally change the way how products are designed and produced. With that, a change of the whole working environment for organizations as well as employees is expected. This change may yield to positive effects for employees' health such as a reduction of physically demanding work, but it may also yield to an increase of psychosocial stressors. This chapter focuses on the possible influence of digitization in the industry sector on different aspects of work. Work- and health-related correlates of digitization will be considered on three different levels of analysis. On the macro-level implications and consequences of digitization for the labor market will be discussed. On the meso-level implications for organizations in the industrial

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© Springer Nature Switzerland AG 2020  
T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_10](https://doi.org/10.1007/978-3-030-31438-5_10)

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sector will be outlined, and on the micro-level implications for individuals will be described. These implications on the micro-level focus on the three main themes (1) on-screen control activities, (2) human-robot interaction, and (3) monitoring of work performance and their relation to health.

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**Keywords**

Digitization of industry · On-screen control activities · Human-robot interaction · Monitoring of work performance · Health implications

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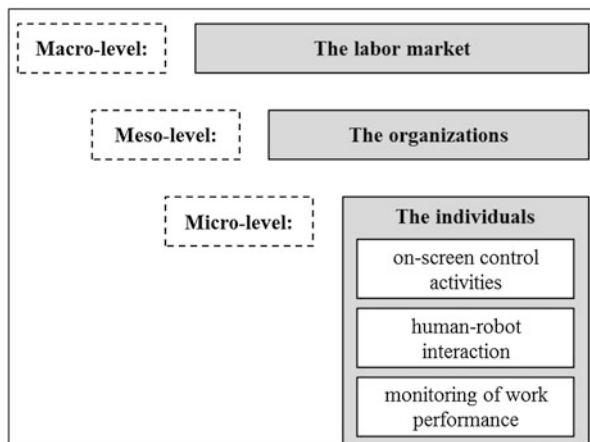
## Introduction

Historically, technological innovations have had a huge impact on employment and work design in the industrial sector. Inventions like the stocking frame knitting machine in 1589, the steam engine in 1712, the new assembly line introduced by Ford in 1913, as well as the adoption of computers and information technology beginning in the 1960s, they all have in common that they fundamentally changed processes and products in the industrial sector (Frey and Osborne 2017). In modern times, a further development of technology is assumed to result in a transformation of working conditions in general. More specific, progress in digital technologies is changing the way how products are designed and produced. For example, the Internet of Things and robotics are assumed to transform processes, products, and business models in the industrial sector basically. Particularly, automation in the production sector and digitization of the supply chain change the whole product cycle from design to lifecycle management of each product (European Commission 2016).

These outlined changes of the working environment in the industrial sector will be accompanied by changes in the work organization that may, on the one hand, result in positive effects for employees' health such as a reduction of physically demanding work. On the other hand, there is the fear that increasing digitization will also increase the risk of psychosocial stressors such as cognitive overload or other forms of mental burden on employees. It has been empirically shown that unfavorable psychosocial stressors can have long-term negative effect on health (Nixon et al. 2011). These may affect the cardiovascular system, the musculoskeletal system, but also the mental health of employees (Kivimäki and Steptoe 2018; Theorell et al. 2015, 2016).

It is difficult to draw straightforward conclusions on possible effects of this technological transformation in the industrial sector on health. Therefore, within this chapter three different levels of analysis will be presented to overcome this shortcoming. For each level, in the first instance, a reflection of the possible impact of digital innovations on work design will be summarized and then related to health outcomes of the work force. Starting with the macro-level labor market, turning to the meso-level of organizations, and ending with the micro-level of individuals will

**Fig. 1** Overview of level of analysis to structure relations between digitization and health in this chapter



structure the argumentation in this chapter. At first, a definition of the term digitization will be presented (cf. Fig. 1).

The aim of this chapter is to outline consequences of this fundamental shift of working conditions for organizations and their employees in the industry sector as well as for the workforce as a whole. This chapter puts a special focus on the current state of research on possible novel stressors that may be particularly relevant in the course of a changing world of industrial work from an occupational medicine as well as work psychology perspective. The chapter particularly focuses on the industrial sector.

## Digitization and Health

### What Is Digitization of Work in the Industry Sector

The term digitization in the working context subsumes several important technological inventions that mainly deal with the interconnection of hardware through self-communicating software over the internet. This aspect is best described with the term Internet of Things that represents the interconnection between objects and people through communication networks. Within the industrial sector, the Internet of Things provides the means of communication for objects that interact together (European Commission 2016). This interaction is subsumed under the term cyber-physical system. Cyber-physical systems refer to an automated, software-based interaction between physical systems with embedded software (such as robots, machines, or vehicles) and global data networks with application systems (Hirsch-Kreinsen 2016). The term digitization can be defined as an interconnection of all components of the supply chain within a factory to enhance production efficacy as well as flexibility by using self-controlling, automated data exchange between all

components of the supply chain. This results in a smart factory that works fully self-organized without external navigation (Bauernhansl et al. 2014).

## Macro-Level Consequences of a Digitized Industry: The Labor Market

The overall question on this level of consideration deals with the core aspect whether digitization will have an impact on employment. Will most occupations or jobs be replaced by robots or machines? Will the consequences be the same for highly skilled and well-educated individuals in comparison to people with a lack of necessary skills who perform routine tasks?

In the literature, there is no common opinion on effects of digitization on future employment. Estimates vary between employment gains and employment losses of nearly half of the workforce (Dachs 2018). Within this ongoing discussion about the impact of digitization on the labor market, there are two opposing viewpoints: a rather optimistic viewpoint (cf. Arntz et al. 2017) and a rather pessimistic viewpoint (cf. Frey and Osborne 2017). The optimistic viewpoint states that digital innovations may be the driving force behind employment growth in the long run. This argumentation builds up on the premise that digitization might have directly negative but indirectly positive effects on employment. These positive effects may be accompanied by efficiency improvements and price reductions, together with the opening up of new markets (Evangelista et al. 2014). Further, it is assumed that new job roles may emerge this focus on the new division of labor between humans, machines, and algorithms (World Economic Forum 2018). These new job roles are estimated to outweigh roles that may be displaced by a shift in the division of labor between humans and machines. Contrarily, the opposing pessimistic viewpoint builds up on the premise that occupations mainly consist of various routine and non-routine tasks. The assumption is that particularly occupations with mostly routine tasks will be substituted by robots (Dachs 2018). Therefore, routine intensive occupations that mainly consist of tasks following well-defined procedures may be substituted because these tasks may be easily performed by software algorithms (Frey and Osborne 2017).

If the pessimistic viewpoint will best predict the future labor market, then individuals who solely conduct routine tasks with a high probability of automation will probably have to face unemployment, since it might be difficult for them to find a job. Empirical research on unemployment and health points out that being unemployed is related to poor mental health status (Paul and Moser 2009), lower psychological and physical well-being (Herbig et al. 2013), and an elevated risk of all-cause mortality (Roelfs et al. 2011). Following the theoretical propositions of the deprivation model, distress among unemployed people arises due to a lack of important functions of employment (time structure, social contact, collective purpose, status, and activity). These functions of employment correspond to psychological needs that, as a consequence, lead to distress when not fulfilled by employment in modern societies (Paul and Moser 2009).

To conclude, it is currently difficult to clearly estimate possible consequences of digitization in the industry sector on the labor market. The estimates should mainly depend on the probability of how certain activities of employees may be automated and on whether new jobs are created by digitization that replace the jobs that have been deleted. Yet, estimates are mostly conducted on the profession level (Frey and Osborne 2017). This profession level neglects information about possible job-level variation resulting in a measurement error (Arntz et al. 2017; Dachs 2018), because profession-level operationalization does not respect potential variation within professions. It is conceivable that a certain profession may contain different tasks depending on the place or enterprise where an individual is working (Arntz et al. 2017).

### **Meso-Level Consequences of a Digitized Industry: The Organizations**

Considering consequences of a digitized industry on the level of industrial enterprises, the initial question is whether enterprises need to invest in new technology to ensure efficacy and productivity. Hirsch-Kreinsen (2016) states that whether enterprises invent technological innovations will strongly depend on their pressure to innovate and to rationalize the production cycle. It is assumed that technology-intensive, medium-sized, and highly innovative firms of the mechanical engineering and metal industries will be at the forefront of digitization as well as enterprises in the logistics that already rely on standardized processes and rapid growth. By contrast, large-scale producers that have already progressed in highly automated production technologies do not have the need to invest in new technology since they already use specific and novel automation logics. Similarly, small- and middle-sized enterprises with limited resources and capabilities probably will hesitate investing in digital technologies (Hirsch-Kreinsen 2016). It is assumed that these enterprises would not risk investing a large amount of money while it is unsure whether the investment will return. Most small to medium enterprises, therefore, won't be willing to invest in technological experiments with uncertain results. Also, these enterprises regularly focus on products that are highly standardized and do not rely on high flexibility. This results in an only small need to modify the current production cycle.

Initial research on possible correlates of the introduction of new technology within organizations for occupational health interventions at work has shown that changes in working environments are also accompanied by changes in the feasibility of health campaigns as well as interventions (Diebig et al. 2018). These changes might involve the adaption of methods of risk assessment or the communication of the process of the whole intervention cycle (Nielsen et al. 2010). Therefore, adaptations of existing methods of health interventions toward the needs of new conditions of work are necessary.

To sum up, there is no clear rationale to estimate the probability that enterprises will invest in digital technologies to enhance productivity. Yet, these investments depend on characteristics of the enterprises as well as markets in which these



enterprises operate in. This instance may also be related to the labor market since enterprises that do not have the need to change their production environment, because they rely on a rather traditional style of working, will probably keep their workforce, and will not invest in the modification of basic working conditions. This may result in fewer jobs that might be replaced by robots or machines. Yet, it is assumed that working conditions will change due to new technology in the next years and, with that, organizational activities to promote employees' health will also be changed.

## **Micro-Level Consequences of a Digitized Industry: The Individual**

In this final part of the chapter, relations between digitization and health on the level of the individual are described. The focus will be set on three main topics that are assumed to be core aspects of a changing work organization due to innovations that stem from novel digital technologies. These topics are (1) on-screen control activities, (2) human-robot interaction, and (3) monitoring of work performance. This focus bases on novel working conditions in a smart factory. In a smart factory, the human individual acts at the human-machine interface and primarily monitors the cyber-physical system on-screen (Vogel-Heuser et al. 2017). These on-screen control activities depict one core element of a digitized industrial work. In addition, there are several robot assistance systems that may support individuals within their work process, e.g., robots that are placed on the shop floor are able to perform and undertake single process steps to work together on a certain product. This type of work between individual and robot is called human-robot interaction (HRI). Also, within this new form of production work there are huge amounts of data that are generated, processed, and analyzed. These data also contain information about human work performance that may be monitored by supervisors (Hirsch-Kreinsen et al. 2015). This monitoring of work performance is the third emerging element of a digitized industrial working environment.

### **Health Correlates of On-Screen Control Activities**

On-screen control and monitoring activities in the industrial production are expected to increase steadily and will, as a result, account for a large proportion of specialized jobs in the future (Reinhart 2017). Evidence of typical problems associated with increased on-screen control activities are mainly presented in research on the topic of aerospace (Salas and Maurino 2010). Automated intelligent systems that control and coordinate the operation of a wide variety of machines have already been implemented in this field. These automated systems usually require only human pilot control (e.g., autopilot in the aircraft cockpit) or control by other groups of people. An active intervention is usually only required in the exceptional case of emergency or if certain actions cannot be conducted by the system and need, therefore, to be carried out independently by the pilot. Research on cockpit control has shown that long-term attention is associated with very high demands on the person who controls the cockpit that results in increased stress levels (Warm et al.

2008). A particular challenge in carrying out control activities on the screen is, generally, the maintenance of a constant high level of attention over a long period of time, because usually an active intervention is only necessary in the event of a breakdown. These attention requirements are associated with different indicators of stress and may have health-related negative consequences for the individual.

Research has demonstrated that it is more difficult to maintain one's attention in less challenging, monotonous tasks than in cognitively challenging tasks (Langner and Eickhoff 2013; Robertson and O'Connell 2010). Simply monitoring a screen, for example, to control and to operate certain procedures, can create a sense of monotony. Basic research on monotony at work shows that it is related to low satisfaction with one's own work activity and increased stress (Melamed et al. 1995). In an experimental study, a relation between activities on the monitor perceived as monotonous and boring by the participants with different indicators of stress as well as decreasing attention was revealed (Thackray et al. 1977).

The demand to maintain one's attention in monotonous, intellectually less challenging tasks is called vigilance (cf. Robertson and O'Connell 2010). High vigilance is typically required for tasks that are characterized by simple signal processing. This involves a discovery or discrimination of presented stimuli which, as a consequence, calls for an individual's response (e.g., the flashing of a warning light and then turning a switch). The sustained maintenance of attention is assumed to be accompanied by a depletion of attention-grabbing resources as well as general mental fatigue (Temple et al. 2000). Fatigue caused by simple tasks that require continued attention is associated with increased stress as compared to more complex tasks requiring a higher level of activity (Warm et al. 2008). In addition, tasks with increased demands on vigilance are associated with an elevated release of stress hormones (Belkic et al. 2004). In addition to these possible effects of fatigue, a sense of boredom may arise during on-screen control activities (Langner and Eickhoff 2013) that may also result in low job satisfaction and increased stress levels (Loukidou et al. 2009).

Similarly, the occurrence of system failures that interrupt the appropriate performance of work has been identified as a main cause of stress resulting from on-screen control activities. In this case, stress arises when technical problems occur. Due to the high relevance of software in the industrial production, a new source of malfunctioning has been added to the working environment of employees. Many functions in complex software algorithms remain hidden from the user. As a result, emerging problems can often only be fixed by third parties due to the increasing complexity of technical applications and are, therefore, time-consuming for the user. This leads to interruptions in the work process, which may have a negative effect on well-being of employees (Rothe et al. 2017). Further, studies have revealed a direct relationship between system crashes or other software problems with frustration and stress (Smith et al. 1999).

However, malfunctions of technical systems should not be considered completely detached from the individuals' attention. It has been shown that danger signals are often not detected when an individual's attention is focused only on sections of the screen and not on all elements of it or when these malfunctions are unexpected due to

a very high degree of trust in the reliability of the overall system (Sarter et al. 2007). In general, too much confidence in a control system is a common source of error as the system produces information that is not being checked by the individual for correctness. For example, a study with pilots has shown that pilots still followed a flight route proposed by the computer although the route was considered dangerous from a human perspective (Wickens and Alexander 2009). Furthermore, the longer a system works without error or interruption, the lower the probability of detecting a failure (Manzey et al. 2012). If individuals already have little attentional resources available – as for instance elderly people – it will be less likely to intervene in the event of an incident, since the user will not discover the necessary signals from the system (Mund et al. 2010). In sum, individuals' performance in control-related monitoring activities is poor and stressful, if rare and unexpected events occur.

To conclude, in the area of on-screen control activities work tasks should be designed so that vigilance is not required over a long period of time. Also, times of heightened attention should alternate with those of low attention. It is also important to design complex, highly automated digitized systems in such a way that they provide sufficiently comprehensive and sufficiently comprehensible feedback about their current status in order to make it as easy as possible for employees to check their functionality.

### **Health Correlates of Human-Robot Interaction (HRI)**

It is assumed that collaboration between humans and robots will increase in the industrial production. Industrial robots that are universally applicable multi-axis motion machines whose movements with respect to sequence, paths, or angles are freely programmable and are guided by sensors.

The type of collaboration between human and robot can vary in terms of the division of tasks, the spatial and temporal proximity in the interaction, the degree of autonomy, and the morphology of the robot (see Onnasch et al. 2016). The division of labor between humans and robots ranges from a largely spatially and temporally separate cooperation to a simultaneous and flexible coordination in order to achieve common work goals. The robot is able to perform different tasks in collaboration (e.g., exchanging information with humans, manipulating workpieces) and to act in different autonomous ways (e.g., selecting information, selecting decisions). Also, the robot may have a rather functional or humanoid, respectively, zoomorphic appearance.

Against the background of these various conceivable variants of HRI, a general assessment of its stress-elevating potential is difficult to evaluate. Therefore, different constellations of its stress-elevating potential can be assumed for different forms of HRI. In general, however, it is expected that in the case of a narrow – i.e., a simultaneous and flexible division of tasks – cooperation between human and robot, the design of the HRI has a greater relevance for employees' stress than in the case of a spatially and temporally separate cooperation. In an initial qualitative interview study on potential stressors associated with the introduction of HRI in modern industry, Körner et al. (2019) identified that particularly technical problems, poor

usability, low situation awareness, or increased requirements on employees' qualification are perceived by employees.

In addition, ergonomic design aspects, such as usability or user satisfaction, may positively influence the actual interaction between human and robot (Prewett et al. 2010). Important design aspects for a good HRI are also the speed of the movements of the robot (Or et al. 2009) and its predictability (Dehais et al. 2011). All of these aspects can affect the stress level of employees.

In addition, personal factors like individuals' attitudes toward the interaction with robots or their fears also seem to be important factors influencing human-robot interaction (Nomura et al. 2008). For example, Broadbent et al. (2011) observed that people who imagine robots to have a humanoid appearance displayed a higher blood pressure rise in HRI and reported more negative emotions than individuals who imagine a robot to be an abstract box-shaped machine.

For the area of HRI, it should be noted that classical features of good work design (see Hackman and Oldham 1980) continue to be relevant assessment criteria for HRI. When assessing the psychosocial risk potential of HRI, it is important to check whether HRI features include work characteristics such as autonomy, completeness of the work task, or skill variety. Therefore it is conceivable, for example, that in HRI the common task is vertically shared, so that the human individual plans while the robot only executes simple tasks. Ideally, these criteria should therefore already be considered prospectively when planning workplaces with HRI. In addition, it is particularly important to consider the basic design criteria for the development of human-robot systems already during their construction phase (including speed and predictability of motion sequences). Likewise, employees should be introduced to an interaction with a robot and possible fears of individuals should be taken seriously by the organization.

### **Health Correlates of Monitoring of Work Performance**

Surveillance at work is basically not a novel phenomenon and technical capabilities of surveillance have increased since the mid-80s. Such monitoring technology is described by the term electronic monitoring and surveillance systems (EMS). The classic application of EMS is the computer. The EMS is able to collect diverse data ranging from capturing every key movement and program used to automatically examining e-mail content. Examples from other areas include detailed recording of the duration and content of telephone calls, typically in call centers, or work done by home and field workers, traced by location technology on mobile phones or in company cars. According to an estimate by the American Management Association in 2005, 76% of all US companies regularly rely on EMS (American Management Association 2005). With new technical systems performance-related data can now be recorded and summarized in many other industries. In the industrial production, organizations have the ability to monitor employee performance just in time relying on various performance indicators (such as the number of manufactured products or time per product produced) that can be tracked.

Not only in Orwell's novel surveillance has something threatening: for example, workplace surveillance is mainly discussed in the context of its adverse effects. Since

the mid-90s, research has been seeking a more neutral view highlighting positive effects of EMS and exploring contextual conditions under which an EMS can be implemented efficiently. This is because effects of EMS on employees are determined by the way how such a system is introduced and used (Alge 2001).

On the one hand, the monitoring of the work performance can have positive effects. For example, certain production monitoring systems allow employees to easily plan their individual work steps and to better use their time-related resources (Cascio and Montealegre 2016) to work more efficiently. In this context, monitoring of work may improve employee performance (Bhave 2014). On the other hand, monitored persons, according to research literature on workplace surveillance in general, may respond with increased stress. EMS may record employees work performance seamless and – due to performance records – regardless of where and when supervisors control the performance. Therefore, it can be assumed that the burden of surveillance increases steadily. Stress due to EMS might results in increased strain of employees (Aiello and Kolb 1995). In a series of experiments, individuals who worked under monitoring conditions experienced elevated blood pressure and increased heart rate (Henderson et al. 1998). In addition, burnout has been increasingly observed among call center employees under increased surveillance (Castanheira and Chambel 2010).

In addition to the immediate consequences of EMS with regard to physiological responses, there is an increased risk of negative long-term health effects resulting from the EMS. Electronic surveillance limits autonomy of individuals and increases work demands (Cascio and Montealegre 2016). These increased demands help to explain effects of heavy surveillance on burnout (Castanheira and Chambel 2010). High demands with low control and little autonomy are the core features of ill-working conditions according to Karasek's demand-control model (Karasek 1979). Extensive research has shown that this form of work stress substantially increases the risk of cardiovascular diseases or mood disorders (Theorell et al. 2015, 2016). Moreover, EMS may increase the perception of overall organizational injustice (Alge 2001). This, in turn, is associated with an increased risk of stress-associated diseases such as heart attack and depression (Kivimäki and Steptoe 2018).

If the monitoring of the work performance is perceived as unfair and non-transparent by the employees, this can lead to a categorical denial from the employees (Cascio and Montealegre 2016). Moreover, if the primary function of monitoring is – as identified by the employees – controlling work, EMS not only leads to stress and poor well-being for employees (Castanheira and Chambel 2010) but also to reduced motivation (Rietzschel et al. 2013).

Research has shown that monitoring work performance of individuals does not necessarily need to have a negative impact on workers. An important influencing factor is how supportive an organization that carries out the surveillance is generally perceived by the employees. Organizations may prevent a categorical denial from the employees toward monitoring their work activity by increasing the employees' identification with the company and increasing their loyalty to the company (Spitzmüller and Stanton 2006). A supportive culture in the specific case of an EMS allows workers to influence the concrete design of the EMS. Early research

has already shown that the impression of having control over the system has a dampening effect on the stress response of monitored employees (Kolb and Aiello 1996). It is also considered beneficial when groups are the central unit of monitoring but not individuals and if monitoring refers to work performance only. Whether the monitoring is perceived as fair also depends on how the data is collected and used, whether data collection is accurate, and whether the guidelines of EMS affect all individuals of a group equally, not focusing on only some individuals (Cascio and Montealegre 2016). In some cases, employees are uncertain about the purposes for which the recorded data is used. But it is this information about the purpose of the surveillance that is particularly important for employees to reduce possible negative impact on their stress levels (Alge 2001).

To conclude, in the field of work performance monitoring, it seems important that the supervised staff is informed transparently about purpose and objectives of the monitoring. Employees should also have an influence on the specific design (i.e., which performance parameters are recorded in which way) of the monitoring measures in order to participate in the design of one's own workplace. In addition, surveillance systems may negatively impact established characteristics of well-designed work such as organizational justice or autonomy. Conversely, a good organization of work may contribute to a health-promoting working context for surveillance. Due to increasing technological possibilities that enable organizations to measure and register work processes, a work environment without EMS is hardly imaginable. Since health consequences of EMS will, therefore, become more important for the psychosocial risk assessment, there is a considerable need for research in this area in order to be able to provide rules that comply with practice.

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## Conclusion

In sum, correlates of digitization with health indicators can only hardly be derived from primary studies that examine direct effects of new digital technology with health. In contrast, most empirical studies have examined side-effects of new technologies with different indicators of stress and subjective well-being. Yet, this research stream has outlined potential harmful as well as health-promoting effects that should be considered while designing work in the digital age.

Traditional theories of work stress, e.g., the job-demand-control model, that assumes that the interaction of mental strain with certain work characteristics results in the development of health impairments (Karasek 1979) may help to explain potential harmful effects of a digitized working environment. In the original demand-control model, these work characteristics feature time pressure, autonomy, job decision latitude, or mental underload. Within a changed working environment strongly pre-structured work processes may lead to a decrease of autonomy at work. The same applies for human-robot-interaction that is structured by decreasing decision latitude of employees due to fixed working schedules. This shows a strong overlap with the theoretical considerations of the job-demand-control model. To sum up, it can be stated that sound knowledge on possible new working conditions

already exists. Yet, it is important that this knowledge is used to expand existing instruments of a healthy job design around these new content areas. The challenge, accordingly, is to redefine criteria of humane work such as autonomy to a digitized working environment.

Therefore, it is important to have a closer look at potential contextual conditions that influence the relation between digitization and health. This knowledge on context conditions helps to design the workplace for employees in the industrial sector that is highly affected by innovative digital technologies to ensure a healthy workplace for individuals. Also, more research is needed to clearly define consequences of digitization on the labor market since these estimates do strongly depend on the methodology applied. Yet, scientific literature suggests that effects of digitization on health may be much more noticeable on the micro-level (i.e., the individual) since an investment in innovative technologies is more likely within certain specialized industrial companies instead (cf. meso-level consequences on an organizational level) of an all-encompassing rollout on all industrial organizations.

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## Cross-References

- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [Precarious Employment Conditions, Exploitation, and Health in Two Global Regions: Latin America and the Caribbean and East Asia](#)
- ▶ [Social Distribution of Occupational Hazards](#)
- ▶ [Underemployment, Overemployment, and Mental Health](#)
- ▶ [Work–Life Balance: Definitions, Causes, and Consequences](#)

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# Childhood Determinants of Occupational Health at Older Ages

# 17

Morten Wahrendorf and Panayotes Demakakos

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## Abstract

Occupational health research increasingly recognizes the necessity to adopt a life course perspective that considers different stages of the life course to explain health later on. This approach includes not only studies that demonstrate the long-term effects of work and employment conditions on health beyond working life but also an increasing number of studies that recognize that working conditions are often related to disadvantaged circumstances at earlier stages of the life course, including childhood socioeconomic disadvantage, psychosocial adversity, and poor-quality parenting. The present chapter therefore provides an

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_12](https://doi.org/10.1007/978-3-030-31438-5_12)

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overview of life course models and research that link early life and childhood conditions with adverse work and employment conditions and adult health. Concluding remarks underline that working conditions should not be isolated from the broader life course context, especially early life and childhood factors, and point to open issues for future studies.

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**Keywords**

Early life conditions · Life course epidemiology · Employment histories · Working conditions

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## Introduction

Early life and childhood are key stages of human development that are linked to numerous health outcomes in adulthood. Epidemiological research has examined early life and childhood exposures to explain health outcomes across the life course with a focus on older ages where morbidity and mortality peak. This has substantially added to our understanding of health and disease development in adulthood (Ben-Shlomo et al. 2016) and led to the realization that studying critical periods of human development, trajectories, and pathways over the life course should be an integral part of any inquiry into disease causation. Such a life course approach – combined with the conceptual framework of the social determinants of health – shifts our attention to fundamental causes or “upstream” factors and the societal context. This had led to a considerable expansion of the dominant paradigm of risk factor epidemiology: from a static to a more dynamic one. As a result, health is now considered the product of multiple factors that interact over the life course within societal, historical, and cultural contexts.

## Models of Life Course Epidemiology

To understand better the links between early life and health at older ages, life course epidemiology has proposed different conceptual models. These models help to elucidate the way disease develops across the life course (Kuh and Ben-Shlomo 2004). The main life course health models are the following: the accumulation of risk model, the pathways model, and the critical-sensitive period model (Kuh et al. 2003).

The accumulation of risk model is based on the idea that people are exposed to multiple risk factors over the life course and that ill-health is a product of the accumulation of these risk factors across the life course (Kuh et al. 2003). The accumulation of risk model is in essence an “attrition” model that represents ill-health as the product of a process of gradual loss of health reserve, where each risk factor exerts an independent effect on health. The more the “insults,” and the more powerful they are, the greater the health damage and the earlier its manifestation. The

implicit assumptions of this model are the differential exposure to risk factors, both in terms of intensity and timing of the exposure, and differences in vulnerability, resilience, and availability and access to protective factors. Everyone is exposed to multiple risk factors and their cumulative effect, but some individuals are exposed earlier and much more than other. The accumulation of risk model also implicitly presupposes that risk factors often cluster together either concurrently (several risk factors at the same time) or longitudinally (several risk factors across the life course). If severe health-damaging exposures start accumulating early in life, especially in combination with limited access to protective factors and low levels of resilience, then this likely will expedite the normal wear-and-tear of bodily functions with some individuals never being able to achieve their full health potential and experiencing a lifetime of suboptimal health.

The pathways model is based on the idea that there are pathways that enable and mediate the association between an initial exposure and an adverse health outcome. In contrast to the risk accumulation model (where each risk factor exerts an independent effect on health), the assumption is that the action of a risk factor, usually early in life, triggers and catalyzes the action of other risk factors and initiates a long-term sequence of risk, which leads to increased risk of ill-health, disease, and death. This sequential process is causal in the sense that each part of it is caused by a previous part and will cause the next one. The conceptualization of this process as sequential contributes to a better understanding of the hierarchical and chronological ordering of the different interacting factors but obscures the fact there might be multiple interconnected pathways leading from an initial exposure to ill-health. For example, there are multiple interrelated biological, behavioral, psychological, and social pathways that link social disadvantage in childhood with ill-health later in life. The pathways model is an accumulation of risk model in the sense that it presupposes the cumulative action of multiple risk factors as a necessary condition for health to deteriorate and disease to develop, but in addition, it is a model that concentrates on the pathogenic processes leading to ill-health and highlights the importance of mediating factors. The focus on the process and mediating factors not only improves our understanding of disease aetiology but most importantly helps to identify prevention targets at different stages of the life course – parts of the causal pathways that are amenable to change and can be targeted by prevention strategies.

The critical-sensitive period model focuses on the long-term health consequences of the action of risk factors during periods that are critical for human development (Ben-Shlomo and Kuh 2002). The core idea is that the action of risk factors during periods of maturation and development, when the brain and other systems, organs, and functions in the human body are particularly plastic and sensitive to external stimuli, has the potential to bring about permanent bodily or functional changes that can reduce the health potential and increase the risk of disease and premature death later in life. There is no consensus about the subtle differences between critical and sensitive periods, and these terms have been used loosely and interchangeably to describe important periods of human development. It can be supported that a critical period is a developmental stage during which the action of risk factors will irreversibly affect normal development (Kuh and Ben-Shlomo 2004; Voss 2013). A

sensitive period is a developmental stage during which the action of risk factors can be disproportionately damaging, but is neither irreversible nor necessarily inhibitory of normal development. Critical periods can be seen as a subset of sensitive periods (Voss 2013).

An example of a critical period is the period of fetal growth. Risk factors that affect fetal growth and in utero development can inflict irreversible lifelong health damage. The archetypical application of the critical period model is the fetal origins hypothesis by Barker, which postulates that inadequate nutrition in utero, as measured by birth weight, will result in increased risk of obesity, metabolic abnormalities, and cardiovascular disease in adulthood (Barker 1990; Barker et al. 2002). A key aspect of the critical-sensitive period model is latency; the health consequences of the pathogenic action of risk factors during critical-sensitive periods of human development might be latent and take decades to realize and manifest as disease at older ages. Another key feature is that of “biological programming”; the action of risk factors during critical-sensitive periods of human development triggers a cascade of subclinical biological changes, which decades later might result in disease. The critical-sensitive period model is not an accumulation model. Under this model, no accumulation of “insults” is necessary for disease to develop at older ages; the action of a single risk factor during a critical period of development is potent enough to initiate a biological cascade that would result in disease later in life. Further, it does not presuppose the existence of multiple adult mediators. In fact, it postulates that the opposite can also be true; a damaging exposure in early life or childhood can directly via biological mechanisms be associated with disease later in life with little, if any, mediation by adult factors.

Taken together, the three life course health models describe and specify how early life and childhood factors may lead to poor health at older ages. These models are not supposed to be mutually exclusive and can act in parallel. But each model has a different focus; risk factors may either have direct independent consequences if they occur during a critical period (critical period model) or indirectly affect health through intermediate factors (pathway model) or cluster with additional risk factors that each negatively affects health later on (risk accumulation model).

## **The Three Childhood “Pillars” of Lifelong Health**

Given the importance of socioeconomic position (SEP) within the social determinants of health framework, and a voluminous literature suggesting a causal association between SEP and health, effort has been put to examine the role of childhood SEP and adult health. There is extensive evidence suggesting associations between childhood SEP and adult health outcomes. Galobardes et al. found that lower childhood SEP is associated with increased risk of all-cause and cause-specific mortality (Galobardes et al. 2004). They found particularly strong inverse associations between childhood SEP and mortality from stomach cancer and hemorrhagic stroke mortality, while childhood SEP was also inversely associated with mortality from coronary heart disease, lung cancer, and respiratory-related diseases and

possibly external and alcohol-related causes. Furthermore, a recent review found significant associations between lower maternal and paternal education and suicide risk (Orri et al. 2019). Childhood SEP is also inversely associated with the risk of cardiovascular disease, especially stroke (Galobardes et al. 2006), diabetes (Demakakos et al. 2012; Tamayo et al. 2010), and established adult cardio-metabolic risk factors such as obesity (El-Sayed et al. 2012; Slopen et al. 2012), reduced physical activity (Elhakeem et al. 2015; Juneau et al. 2015), and chronic inflammation (Liu et al. 2017; Milaniak and Jaffee 2019). In relation to cancer, lower SEP in childhood is associated with increased risk of stomach and lung cancer and possibly colorectal, liver, cervical, and pancreatic cancer (Vohra et al. 2016).

Another set of childhood risk factors that has been proven to be a major determinant of lifelong health are adverse childhood experiences. Adverse childhood experiences (ACEs) are an umbrella term for a variety of negative exposures and experiences in childhood including experiences of neglect, abuse, having been brought up in a risky and adverse family environment, having lived in children's home or with foster parents, and unfavorable life events and circumstances such as the parental death and being reared in a single-parent family. All these powerful and overwhelming negative experiences can affect human development and consequently adult health in different ways. It was the original ACE study in California, USA, that has sparked interest in childhood experiences of abuse and risky family environments as major determinants of adult health (Felitti et al. 2019). Since then, there has been a growing interest in ACE and their association with health (Herzog and Schmahl 2018; Hughes et al. 2017). Most major chronic diseases are positively associated with ACE including cardiovascular disease (Appleton et al. 2017; Su et al. 2015), diabetes (Huang et al. 2015), and cancer (Holman et al. 2016), while unhealthy behaviors such as substance abuse and sexual risk taking and mental health problems are very strongly associated with ACE (Hughes et al. 2017; Norman et al. 2012).

A third emerging factor, which is important for human development and consequently for adult health, is the parent-child relationship and one's childhood experiences of parenting (Demakakos et al. 2016). The focus here is not on abusive parents or neglectful parenting, which is best classified as ACE, but rather on everyday parenting style and practices, the ordinary interaction between parent and child within the normal behavioral range, and what is transmitted through this relationship to the child. An unsatisfactory problematic relationship with parents that is characterized by limited care and affection, overprotection, autonomy restriction, and lack of parental involvement can be a chronic stressor from which influence the child cannot easily escape.

Most people have been brought up by natural or adopted parents, and consequently their relationship with their parents exerted a catalytic formative influence on their cognitive, emotional, psychosocial, and physical development. The relationship with one's parents is one of the most important social relationship one may have in their lifetime. From a child's perspective, the relationship with the parents is the single most important relationship during the period between birth and adolescence. Evidence suggests that experiences of poor-quality parent-child relationship and

parenting are associated with multiple developmental problems including a dysregulated stress response (Lupien et al. 2009), obesity (Sleddens et al. 2011), risky behaviors, and aggression (Chan and Koo 2010; Kawabata et al. 2011). There is also evidence linking poor quality parent-child relationship with adult psychopathology (Weich et al. 2009), but very limited research has focused on the effect of poor-quality stress-generating parenting on the offspring's physical health at older ages. Recent findings suggest that poor-quality parenting style, characterized by limited maternal and paternal care, overprotection, and autonomy restriction, is associated with an increased risk of all-cause mortality, incident and prevalent cancer, and adverse reproductive outcomes (Demakakos et al. 2016, 2018, 2019), but more research is needed to establish how damaging is poor-quality stress-generating parenting for offspring's health over the life course.

On the basis of both theory and empirical evidence, it can convincingly be argued that the three factors, socioeconomic disadvantage, psychosocial adversity, and poor-quality parenting, are major childhood exposures that have the potential to determine health over the life course and should be conceptualized as the three childhood "pillars" of lifelong health. The interrelationships between these three exposures have yet to be fully understood in relation to health over the life course. A recent review suggested that ACE are associated with low childhood SEP and should not be examined as decontextualized "individual" characteristics but rather as products of socioeconomic position and social disadvantage (Walsh et al. 2019). Given the complexity of this association and the existence of different types of ACE, it is clear that much more research is needed on this key issue – especially when evidence has convincingly showed that ACE are associated with adult health independently of childhood SEP (Kelly-Irving et al. 2013).

## **Adult Mediators: The Case of Work Stress and Adverse Working Conditions**

The risk accumulation and the pathways models require the action of adult factors to enable, catalyze, and effectuate the influence of childhood exposures on adult health. Labor force participation and working conditions are known to be strongly associated with health at older ages with unemployment, adverse working conditions, and work stress being major risk factors for health (Marmot et al. 2006). Based on these assumptions and the centrality of work in adult life, adverse working conditions and work-stress can be important adult mediators linking childhood disadvantage and psychosocial adversity with health at older ages. The critical-sensitive model is mostly about the biological cascade that childhood exposures initiate, which involves different stress-related biological pathways including immune, neuroendocrine, and epigenetic pathways that can jeopardize health in adulthood with little mediation by adult factors (Agorastos et al. 2019). While the possibility of a direct biological effect is very real, it does not preclude the possibility of synergies and interactions between the biological cascade that was initiated by the childhood exposure and adult factors. In fact, such synergies are expected given that many of



the stress-related biological adaptations affect multiple domains of human life. In the case of adverse working conditions, it is expected that a person with a dysregulated stress response would be more vulnerable to work stress, while ACEs are known to be associated with a greater allostatic load (Danese and McEwen 2012), which effect on human health would only be exacerbated by adverse working conditions.

The rest of the chapter will examine how early life conditions, in terms of the three major childhood exposures described above (socioeconomic disadvantage, psychosocial adversity, and poor-quality parenting) may be related with adverse working conditions and present existing evidence.

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## **Why Should Early Life and Childhood Circumstances Lead to Adverse Employment Histories and More Stress at Work?: Some Conceptual Thoughts**

To answer the question why early life and childhood exposures are linked to adverse working conditions, it appears helpful to study this association in the light of three potential mechanisms: (1) social causation, (2) stress responsiveness, and (3) health selection.

### **Social Causation**

Probably the most obvious explanation for why early life and childhood conditions are linked to poor working conditions follows the idea of “risk accumulation” (Dannefer 2003), where people growing up in a context of socioeconomic adversity are more likely to end up in poor jobs – especially through lower educational attainment. This includes working in jobs that generally involve more stress (e.g., low-skilled occupation) and affect one’s entire career pattern (Caspi et al. 1998) leading to discontinuous and precarious careers. Likewise, psychosocial adversity and poor-quality parenting during childhood may also impact later life working conditions. Early life and childhood may therefore be seen as the starting point in one’s work trajectory with obvious implications for the nature of jobs one has and their working careers.

### **Stress Perception**

Stress theory postulates that the experience of job stress is determined not only by the nature of a job but also by individual perception of the situation faced (or “appraisal”). Specifically, according to transactional models of stress processing (Lazarus and Folkman 1984), situations are only perceived and recognized as stressful, if individuals appraise the situation as challenging or threatening and believe that the available resources are not sufficient to cope with the threat (often labeled “primary” and “secondary” appraisal, respectively). This means that there is no uniform perception of the same stressor and that not all individuals who face the same working conditions

will report the same levels of stress. A personal report of stress depends not only on the nature of the job but also on individuals' appraisal of the situation and available resources and coping abilities (McLaughlin et al. 2010). These coping abilities may be less adequate for people who grew up under disadvantaged circumstances during childhood (Kristenson 2006), which may be a "critical" or "sensitive" period for the development of effective coping skills and strategies. Psychosocial adversity and poor-quality parenting may be particularly important, and disadvantaged children may be at higher risk of perceiving and reporting more stress in adulthood (McEwen 2012). Studies showing that the developing child brain is more receptive to adversity than the adult brain further support our hypothesis that childhood is a critical period for the development of effective appraisal and coping skills. These studies show that the recurrent experience of stress during childhood affects both the size and the structure of the brain and the threshold at which stress regulation is activated at older ages (Shonkoff et al. 2009; Sapolsky 2004). In these cases, it is less the nature of the job and more the underdeveloped coping abilities that lead to an increased perception and recognition of stress at work at older ages (Kristenson 2006; Yoshikawa et al. 2012; Ohtaki et al. 2017).

## Health Selection

A third explanation of why early childhood conditions may be linked to experiencing higher levels of stress at work has as a starting point one's health status in childhood and its consequences for one's career and later work and employment conditions. Specifically, because adverse childhood conditions are often accompanied by poor health, it is likely that children with poorer health are selected into unfavorable jobs in adulthood. Young people with chronic illnesses or disabilities, for example, may be less likely to gain a high educational degree, which in turn influences opportunities on the labor market (Caspi et al. 1998). Poor health, therefore, may force to enter occupations with less reputation and employment security, that is, to work under precarious and stressful working conditions.

In summary, early childhood may be linked to different levels of stress during working life in three ways: (1) early life and childhood adversity including socio-economic disadvantage may influence the nature of subsequent working careers and the jobs a person has (social causation), (2) early life and childhood adversity may influence the extent to which work and employment conditions are perceived as stressful and stress response (stress responsiveness), and (3) early life and childhood adversity leads to poor childhood health, which, in turn, may influence opportunities in the labor market (health selection).

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## Empirical Evidence

The next section reviews evidence on the association between early life and childhood factors and adverse employment during adulthood. The term adverse employment includes both psychosocial stress during working life and career

characteristics. The review relied on a search in popular databases (e.g., Pubmed and Scopus) and studies that have been collected over the years in own reference management systems. The section does not aim to provide a systematic literature review but rather to summarize current empirical evidence. Only studies that were published in peer-reviewed journals were considered. Table 1 lists all the studies and presents some key characteristics, such as a brief description of the sample, the study design, as well as how childhood conditions and adverse employment were measured and a brief summary of the main finding.

With regard to study design, many of the examined studies analyzed birth cohorts (Elovainio et al. 2007; Power et al. 2002; Power and Matthews 1997; Kuh et al. 1997) or cohorts of adolescents (Westerlund et al. 2012; Hemmingsson and Lundberg 2006). In these studies, information on childhood conditions usually referred to life circumstances at birth or childhood. However, most of these cohorts, especially those using birth cohort data, are still relatively young and consequently can only be used to assess working conditions up until midlife (Kuh et al. 1997; Westerlund et al. 2012). In contrast, a growing number of studies examined the association between retrospectively collected information on childhood conditions and current work and employment conditions (Hardcastle et al. 2018; Sampasa-Kanyinga et al. 2018; Wang et al. 2018; Flores and Kalwij 2014). Finally, some studies used data where both childhood conditions and working conditions were measured retrospectively. In that case, information on working conditions also covered an extended time frame that included characteristics of entire working careers (Hoven et al. 2017; Wahrendorf and Blane 2015; Wahrendorf and Siegrist 2014).

In relation to the measurement of childhood conditions, measures were heterogeneous across studies and covered different aspect of the three childhood “pillars” described above (socioeconomic disadvantage, psychosocial adversity, and poor-quality parenting). Measures either summarized different types of adversity into an overall index or “adverse childhood experience (ACE) score” (Hardcastle et al. 2018; Wahrendorf and Blane 2015; Westerlund et al. 2012; Sampasa-Kanyinga et al. 2018) or investigated the impact of individual childhood factors (e.g., Power et al. 2002). More specifically, studies measured dimensions of childhood adversity that pertained to child abuse (Sampasa-Kanyinga et al. 2018), problematic family environment (Power et al. 2002), relationships with parents, and mental and physical illness of parents (Westerlund et al. 2012; Power et al. 2002), housing quality (Wang et al. 2018; Wahrendorf and Blane 2015), educational support (Power et al. 2002; Kuh et al. 1997), the experience of major life events (Kuh et al. 1997; Westerlund et al. 2012), as well as material and socioeconomic circumstances during childhood. With the exception of three studies (Westerlund et al. 2012; Hardcastle et al. 2018; Sampasa-Kanyinga et al. 2018), all other studies also considered father’s occupational position (at birth or during childhood).

Turning to the measurement of adverse employment during adulthood, some studies focused on individual perceptions of stress at work (often measured according to the DC-Model or ERI (Hintsala et al. 2010; Wahrendorf and Siegrist 2014; Westerlund et al. 2012; Elovainio et al. 2007)). Other studies used more “objective” factors that describe employment situations (e.g., unemployment (Flores

**Table 1** Overview of studies investigating associations between early childhood and adverse employment during adulthood

Author, year	Sample	Study design	Measure of early childhood	Measure of adverse employment history	Main finding
Hardcastle et al. (2018)	2881 men and women in England and Wales (aged 18–69 years)	Representative cross-sectional study in 2015 with retrospective information on childhood conditions	Index measuring adverse childhood experiences (ACEs) based on nine forms of abuse and family dysfunction before 18	Current employment situation (unemployment and long term sickness absence)	ACEs are related to unemployment and long-term sickness absence, irrespective of educational attainment
Sasmpasa-Kanyinga et al. (2018)	14,518 working men and women aged 20 to 74 in Canada	Representative cross-sectional study in 2012 with retrospective information on childhood abuse	Childhood experience of violence questionnaire (CEVQ) covering physical abuse, sexual abuse, and witnessing family violence	Various measures of current work stress, incl. self-perceived work stress, job insecurity, and stress according to the demand-control model (measured in terms of single dimensions and job strain)	Child abuse is associated with all measures of work stress (irrespective of current occupational position, education, income, and lifetime mental disorders)
Wang et al. (2018)	1390 working men and women age between 31 and 41 years in Australia	Cohort study (baseline 1985 with two follow-ups (2004–2006 and 2009–2011))	Socioeconomic position (SEP) at the age of 12 (incl. education and occupation of parents, number of rooms, and home ownership), as well as school-related factors (e.g., engagement) and health during childhood	Effort-reward imbalance (ERI; measured as ERI-ratio)	Poor childhood health is related to higher ERI, but no consistent associations were found between childhood SEP and the ERI-ratio
Hoven et al. (2017)	5857 men and women aged 70 or older in Europe	Cohort study with retrospective information on employment histories	Occupational position of main breadwinner at the age of 10	Typology of late life employment histories (derived with sequences analyses)	Early adversity is associated with discontinuous histories

<p>Wahrendorf and Blane (2015)</p>	<p>10,272 retired men and women in Europe (aged 50–80)</p>	<p>and childhood conditions (SHARE) Cohort study with retrospective information on employment histories and childhood conditions (SHARE)</p>	<p>Index combining four measures of adverse socioeconomic conditions at age 10 (books in the household, father's occupation, overcrowding, and housing quality)</p>	<p>Labor market disadvantage through involuntary job loss, low main occupational position, and episode of unemployment</p>	<p>and histories with preliminary retirement For both men and women, childhood adversity was related to labor market disadvantages</p>
<p>Flores and Kalwij (2014)</p>	<p>25,296 observations (based on 5999 men and 7614 women, aged 50–64)</p>	<p>Cohort study with retrospective information on childhood conditions (SHARE)</p>	<p>Three measures of adverse socioeconomic conditions at age 10 (books in the household, father's occupation, and overcrowding)</p>	<p>Employment situation at older ages (in paid work or not)</p>	<p>Higher childhood SEP is related to higher employment probability at older ages. Same is true for childhood health</p>
<p>Wahrendorf and Siegrist (2014)</p>	<p>11,181 retired men and women in Europe</p>	<p>Cohort study with retrospective information on childhood conditions (SHARE)</p>	<p>Index combining four measures of adverse socioeconomic conditions at age 10 (books in the household, father's occupation, overcrowding, and housing quality)</p>	<p>Stressful work based on work stress in main job (referring to core dimension of the DC- and ERI model) and an overall assessment of the entire occupational career, as well as labor market disadvantage through involuntary job loss, low main occupational position and episode of unemployment</p>	<p>Childhood adversity is both related to stressful work and labor market disadvantage. Links between early childhood and stressful work are partly explained by labor market disadvantage</p>

(continued)

Table 1 (continued)

Author, year	Sample	Study design	Measure of early childhood	Measure of adverse employment history	Main finding
Westerlund et al. (2012)	673 men and women in Sweden (aged 43 in 2008)	Population-based cohort study (aged 16 at baseline in 1981, and 4 follow-ups till 2008)	Index counting the presence of six conditions at age 16: Residential mobility, residential crowding, parental loss, parental unemployment, parental physical illness, and parental mental illness	Job strain (incl. single scales) at age 43 based on the demand-control questionnaire (DCQ)	No consistent association between early childhood and probability of high job strain, but support for higher vulnerability (for AL) once persons with adverse childhoods are exposed
Himisa et al. (2010)	6435 British men aged 35–55 years	Cohort study with retrospective information on childhood conditions (Whitehall II study)	Socioeconomic position (father's education and occupational class), and number of siblings	Job demand and job control (based on the JCQ-questionnaire) and organizational justice	Low job control was related to low parental education or social class and greater number of siblings. Results for job demands and organizational justice were less consistent
Elovainio et al. (2007)	4293 men and women in Finland (aged 31 at follow-up)	Prospective birth cohort study (baseline 1966 and follow-ups at age 14 and 31)	Father's occupation at birth and educational factors at age 14 (learning difficulties, teacher ratings, school absence)	Job strain (incl. single scales) at age 31 based on the demand-control questionnaire (DCQ)	Lower parental occupational position is linked to psychosocial stress, particular low control, and job strain
Hemmingsson and Lundberg (2006)	49,323 men in Sweden (aged 40–53 during follow-up)	Prospective cohort study with young Swedish males (aged 9–11) based on census data from 1960 and follow-ups in 1985 and 1990, combined with	Father's occupation at birth, overeducation till the age of 16 and 9–11 (given by parents)	Job control (measured indirectly on the basis of occupational titles when respondents were 39–41 years)	Adverse childhood circumstances were clearly linked to lower job control during adulthood

Power et al. (2002)	12,537 British men and women (at the age of 33)	administrative data (death register till 2002)	Birth cohort study (1958 British birth cohort) baseline in 1958 with repeated follow-ups till the age of 33	Fathers occupational position at birth, housing tenure at age 11, overcrowding before age 16, as educational support from parents (reading and interest shown in education), family moves, parental divorce or death during childhood, alcoholism in the family	Fathers occupational position at birth	Reported job insecurity at age 23 and 33, unemployment before age 33, work demands and level of job control at age 33	Adversity during childhood is associated with poor working conditions during adulthood, including job insecurity, unemployment, and psychosocial work factors
Power and Matthews (1997)	11,407 British men and women (at the age of 33)	Birth cohort study (1958 British birth cohort) baseline in 1958 with repeated follow-ups till the age of 33	Birth cohort study (1958 British birth cohort) baseline in 1958 with repeated follow-ups till the age of 33	Fathers occupational position at birth	Fathers occupational position at birth	Unemployment episode till the age of 33, experience of job insecurity at age 23 and 33, negative psychosocial work characteristics	Negative association between higher occupational position and adverse working conditions till the age of 33, including job insecurity and poor psychosocial conditions
Kuh et al. (1997)	1628 women aged 43	Birth cohort study (1946 British birth cohort) baseline in 1946 with 19 follow-ups	Birth cohort study (1946 British birth cohort) baseline in 1946 with 19 follow-ups	Fathers occupation at age 11, family size, parental education, death of parent, divorce of parents during childhood	Fathers occupation at age 11, family size, parental education, death of parent, divorce of parents during childhood	Time spent in current job, months not in paid work, between 36 and 43	Adverse childhood circumstances are linked with economic success, most importantly via educational attainment

and Kalwij 2014; Hardcastle et al. 2018; Power and Matthews 1997)) or characteristics of entire employment careers (e.g., involuntary job losses or typology of histories (Hoven et al. 2017; Wahrendorf and Siegrist 2014)).

Despite heterogeneity in the measurement of childhood adversity, the overall picture clearly points to an association between adversity during childhood and adverse employment during adulthood. In the case of psychosocial work characteristics, this holds true for perceived job insecurity (Power et al. 2002; Power and Matthews 1997), perceived stress at work (Hemmingsson and Lundberg 2006; Wang et al. 2018), and an overall career assessment (Wahrendorf and Siegrist 2014). In addition, there are associations between childhood adversity and unemployment (Hardcastle et al. 2018; Flores and Kalwij 2014), discontinuous employment histories, and weaker labor market attachment (Hoven et al. 2017 ; Kuh et al. 1997).

Some studies explored the role of potential mediators in these associations. Education was found to be an important mediator (and to reduce associations once considered), but most studies suggest that educational attainment could not entirely explain the reported associations (Hardcastle et al. 2018; Power et al. 2002). The same held true for occupational position or income during working life (Wahrendorf and Siegrist 2014). While this finding suggests that education or occupational position partly explain the association between childhood factors and working condition, it also suggests that parts of the association between childhood factors and work stress and adverse employment remain largely unexplained. It remains unclear, however, if the unexplained part is due to differences in coping abilities.

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## Summary and Concluding Remarks

This chapter provides a summary of some core perspectives of life course research and illustrates how these could help to understand better occupational health within a life course framework. The focus was on three different childhood factors, childhood SEP, psychosocial adversity, and poor-quality parenting, and the chapter described how these factors may be linked to poor working conditions during adulthood. Despite heterogeneity in their measurement, evidence suggests that these three childhood factors are related to adverse employment during adulthood, both in terms of work stress or adverse employment histories. The majority of studies indicates that adverse working conditions are due to social causation or “risk accumulation” (where poor childhood conditions lead to further disadvantages later in life). However, much more research is needed to understand the underlying mechanisms. For example, the role of coping abilities in explaining differences in adverse employment remains largely unclear. In this context, a pertinent question would be to examine if childhood adversity increases one’s vulnerability to adverse employment and the role of coping mechanisms in this association. Despite the necessity to investigate the role of coping mechanisms in greater detail, this chapter also shows that a more critical and systematic measurement of childhood factors is needed, with a measurement approach that goes beyond the use of adverse childhood experience (ACE) summary scores (Appleton et al. 2017; Kelly-Irving and Delpierre



2019; Lacey and Minnis 2019). Along these lines, the chapter distinguished between three different childhood factors, childhood SEP, psychosocial adversity, and poor-quality parenting, and described how each of these three factors could lead to poor occupational health later in life.

To conclude, in relation to occupational health research, this chapter suggests that life course epidemiology is much more than just linking work exposures to health at older ages. Adverse employment during adulthood is often a part of greater trajectories of disadvantage that often started in early life and childhood. Although more research is needed to understand the implicated mechanisms, this chapter illustrates how a life course framework could help to understand better occupational health and highlights a growing number of studies in this field. Future research should add to our understanding of the role of childhood factors in employment and health in adulthood and elucidate how childhood factors are related to adverse employment and poorer health at older age – this may help to develop more effective prevention programs and policies.

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# The Demand Control Support Work Stress Model

# 18

Töres Theorell

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## Abstract

The chapter first gives a historical background starting with the introduction of the demand control by Karasek in 1976 and the extension of the model with social support by Johnson and Hall in 1988. Societal debates and previous theoretical job stress models available at the time are described. In the next segment, assessments of the three components of the model in epidemiological studies are described and discussed, ranging from worker self-ratings of the work environment to job exposure matrices and expert ratings. This is followed by a summary of findings based upon epidemiological studies, with a discussion of relative risks and attributable fractions. Ischemic heart disease, depression, and atrial fibrillation are some of the disease outcomes discussed. The final discussion is about physiological links between the model and disease outcomes.

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_13](https://doi.org/10.1007/978-3-030-31438-5_13)

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**Keywords**

Job strain · Active work · Passive work · Demand control support model · Ischemic heart disease · Depression · HPA axis

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**Introduction**

The demand control support (DCS) model has been unusually successful as a survivor in psychosocial epidemiology. It was introduced by Karasek in 1976 and is still used actively and extensively in research.

The DCS was formulated in a historical period during which assembly line work had a strong position. The basic principle – division of labor – in assembly line production has been used for many 100 years in several cultures in the world but became very important during the industrial revolution in Europe. Adam Smith discussed this principle extensively in his *Wealth of Nations* (1776). In the late nineteenth century Frederic Taylor introduced his *scientific management* which was a refined version of assembly line production. In the late 1960s and in the 1970s, there was a strong political reaction against scientific management which was regarded as an abuse of workers. This was part of the 1968 youth revolution which resulted in the occupying of universities in Europe and North America and an orientation towards the left in national political movements. The Scandinavian countries were regarded as progressive and the mostly social democratic governments in our countries instituted laws that aimed at reduced abuse of workers at the assembly line. The Scandinavian labor policy stimulated the rest of the world. As an important part of this international movement representative reviews of the working conditions for American employees were performed at the Institute for Social Research in Ann Arbor in the USA, for instance.

During the 1960s, research on psychosocial working conditions had already been established. The most widely accepted scientific model at the time was the Person Environment Fit model (PE fit) which had been introduced by researchers in Ann Arbor (see Sales and House 1971; Kahn 1974). The principle applied in this model was to measure the characteristics of the job and the characteristics of the employee. The aim in employment according to this theory would be to match these two components. In line with the general political development during the 1970s critique was formulated against this principle. It was stated that the application of the PE fit model would lead to overemphasis on the individual disregarding the environment – changing the individual to fit the environment rather than changing the environment to fit the individual. In accordance with this, the growing new movement stated that there should be more emphasis than previously on the characteristics (physical as well as psychosocial) of the work environment and in particular on its organization. Due to the fact that assembly line work was very prevalent, this particular work principle was given a prominent role in the formulation of questions about the psychosocial work environment. Therefore, when Karasek started the work that resulted in the demand control model, questions about psychosocial and physical

working conditions were available both in American (Work Environment Surveys 1969, 1972 and 1977) and in Swedish Surveys (the longitudinal “Level of Living Survey” 1968, 1974 and onwards).

Robert Allen Karasek grew up in St Louis, Missouri, and was trained as an architect at the Princeton University. After his graduation he came as a Fulbright grant holder to Sweden, in order to work in an architect’s office in the old town of Stockholm. He has described that this office was working on a big new community in the outskirts of the city, Skärholmen. He saw the three-dimensional model of this and compared it to a model of the old town at its side in the office. He saw that they were approximately of the same size but realized that the old town had been erected slowly during several 100 years, whereas Skärholmen was to be planned and erected within a few years. Would it really be possible to adapt human needs to external living conditions with such short notice? Pondering about these problems he decided to spend the rest of his life in sociology and was accepted as a doctoral student in sociology at Massachusetts Institute of Technology. He focused his work on working conditions. The more general questions regarding how cities are planned and built were focused on how jobs are organized and how organizations have arisen. He knew that there were valuable population survey studies mentioned above on working conditions both in Sweden at the Institute for Social Research at the Stockholm University and at the corresponding institute in Ann Arbor.

In his thesis work, Karasek (1976) made a synthesis of two accepted theories regarding the psychosocial work environment – *stress theory* and *alienation theory*. Stress theory states that high demands result in high levels of energy mobilization, whereas alienation theory states that the more alienation a subject feels from what he or she is doing the more dysfunctional reactions will arise. Stress theory had a strong basis in Sweden with a heavy emphasis on physiological correlates of stress. This had been stimulated by von Euler’s discovery of the important role of catecholamines in stress reactions and by a number of studies of stress related variations in urinary excretion of adrenalin and noradrenalin by two Swedish researchers, Lennart Levi (1972) and Marianne Frankenhaeuser (Frankenhaeuser et al. 1976; Lundberg and Frankenhaeuser 1980). Alienation theory which had been established internationally not only in work studies but more generally in studies of societies (Taylor 1968; Bullough 1970) had also been established in Swedish theory and transdisciplinary approaches had been established. Bertil Gardell, an influential work psychologist in Sweden, had adopted this theory in his studies of industry and service work and also established collaboration with the psychophysiological stress researchers (Frankenhaeuser and Gardell 1976).

Karasek’s innovative combination of the two dimensions rapidly became empirically possible to test (Karasek 1976) because work questions corresponding to the stress dimension (which he labeled psychological demands) and to the alienation dimension (which he labeled decision latitude) were available in the American epidemiological surveys of the working populations. These dimensions clearly came out in statistical factor analyses performed by Karasek. However, already at an early stage it became clear that there were subdimensions both in psychological demands and in decision latitude. There are both quantitative (amount of work per

time unit) and qualitative (how difficult) aspects of demands and in alienation theory there were two aspects of decision latitude that had already been established – the extent to which the worker can influence decision regarding his/her work (decision authority) and the possibility the worker has to develop skills so that he or she can take control over work (skill discretion). The result of Karasek's first studies was based upon a series of cross-sectional American and Swedish population surveys. Psychological demands and decision latitude were combined as orthogonal x- and y-axes in a two-dimensional plot. Psychological symptoms were explored in different parts of the plot and a powerful confirmation of Karasek's hypothesis was shown, symptoms worsened when psychological demands were high and decision latitude low (job strain). It should be pointed out, however, that Karasek in his thesis was more interested in the diagonal hypothesis, the beneficial effect on "life outside the job" when high psychological demands were combined with high decision latitude. This *stimulation axis* has been almost forgotten for many years but is re-invented for instance in new epidemiological research on retained cognition with increasing age.

I started collaborating with Karasek in the late 1970s as a member of a group of American and Swedish cardiologists and epidemiologists (see Karasek et al. 1981, 1988). I had some importance when the model was "translated" into physiological theory and the current relevant literature was summarized adding several field experiments to the empirical evidence (Karasek and Theorell 1990). During our extensive discussions during the early 1980s, I also heard Karasek mention the third part of the model, the support dimension, as a potentially important addition. Empirical epidemiological work, however, which allowed the addition of it to the demand control support model, was made by the American sociologists Johnson and Hall (1988) who used a large Swedish population survey for this work during a period when they were working in Sweden. The combination of low support and job strain was labeled *iso-strain* (Johnson et al. 1989). In theoretical discussions based upon Johnson's previous experience as a typographer, he emphasized some of the theoretical complexities in the interplay between control and support – a strong group support automatically raises the level of decision latitude.

Before I proceed to a review of the vast literature that has been produced about the demand control support model, I would like to emphasize that the formulation of the demand control support model by Karasek arose in the context of a need for valid and high qualitative assessments of job characteristics. It was a reaction against overly individualized interpretations of problems with stress at work. Against this background it is interesting that doctoral students nowadays come to me criticizing the demand control support model because they find that it *individualizes* stress problems at work. I was very surprised when I faced it since this is exactly what the introduction of the model wanted to counteract. However, part of the explanation may be that students and their young teachers (who may not have read the original texts) sometimes use the word *ability to control* work when they explain the concept decision latitude. Ability indeed refers to the individual and his/her capacity to exert control. This is clearly not the essence of the decision latitude concept which refers to the possibility that *the organization of the work environment gives the employee to*



*exert control* over his/her work situation. The two subdimensions of decision latitude mentioned above get into our mind, and I would formulate the underlying key questions in the following way.

*What possibility does the work environment give the employee to influence decisions over his/her work situation?* In practice this is translated into everyday democracy in the workplace (decision authority).

*What possibility does the work environment give the employee to learn strategies to solve unexpected problems that may arise at work?* In practice this is translated into plans for effective long-term learning for employees for effective coping with problems that may arise at work (skill discretion).

A common question after lectures in this field is: How do you know that the associations you observe in this field are not due to common variance. This argument is particularly relevant in cross-sectional studies of “soft endpoints” such as depressive feelings. The argument starts from the assumption that part of the variance in reporting depressive feelings is the same the variance in reported exposure (in this case psychological demands and decision authority and skill discretion). If the people who report adverse psychosocial working conditions are the same as those who report depressive feelings, spurious positive relationships may arise. We recently performed a cross-sectional twin study illuminating this question (Theorell et al. 2016b). It showed that although there was a moderate genetic contribution to self-reports of psychological demands, decision authority, and skill discretion as well as to self-reported depressed feelings, the relationship between adverse job conditions and depressive feelings could not be explained by genetics.

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## Measures of the Demand-Control-Support Model

The overriding goal (measuring the essential aspects of the work environment rather than individual characteristics of the employee) has guided the choice of questions or statements included. Typical examples of statements catching *decision latitude* included in the original Job Content Questionnaire (JCQ) constructed by Karasek on the basis of the US Quality of Employment Surveys 1969, 1972, and 1977 were: “I have a lot of say in my job” and “I keep learning new things in my job” (aspects of decision authority and skill discretion respectively). Corresponding examples for the assessment of *psychological demands* were “There are no conflicting demands in my job” and “I have time to do my work” and for *social support* “My supervisor shows concern for me” and “My coworkers are helpful.” JCQ was used in its original form from the 1970s. Its psychometric properties were described in Karasek et al. (1982) and have been presented and discussed for instance in the book *Healthy Work* (Karasek and Theorell 1990) and in an international comparison which showed that it works satisfactorily in widely different settings – USA, Canada, Japan, and The Netherlands (Karasek et al. 1998) although there are also some nontrivial differences in the interpretation of question formulations in different countries. The JCQ has been the golden standard for the assessment of the demand control support model ever since. It has five statements about psychological demands and

ten statements about decision latitude (six about decision authority and four about skill discretion). The subjects use a five-graded scale for assessing how well (“intensity” principle) the statement applies to their work, and a summary score is created. Differences in numbers of statements for the dimensions are accounted for. The use of the JCQ is protected. Recently Karasek and co-workers have been working on a JCQ 2.0 questionnaire which will include measures based upon not only individual self-ratings but also more collective assessments of crucial aspects of the work environment.

During an early phase of the development, a shorter and modified scale (DCQ) was developed for use in studies with repeated observations (Theorell et al. 1988). This questionnaire (which has a frequency – not intensity – format with four response alternatives ranging from never to almost always for each question) only comprises the psychological demands and decision latitude components. In some studies, six questions about social support have been added but these are not directly comparable to those in JCQ. The five psychological demands questions are very similar to those in JCQ, but there are only six questions about decision latitude – four about skill discretion and two about decision authority. The psychometric characteristics of the shorter DCQ(S) have been described on the basis of a longitudinal Swedish population survey (Chungkham et al. 2013).

Although most epidemiological studies have used the JCQ, there are also some European studies that have used the shorter DCQ. With regard to psychological demands and decision latitude, the two instruments are similar (Karasek et al. 2007). Several modified instruments have been used and in the large IPD (Individual Participant Defined) Work Consortium which is a European collaborative network of researchers an effort was made (Fransson et al. 2012) to find sufficiently common denominators in these different versions of the JCQ. A solution with partial demand and control scales with at least half of the questions from the original versions seemed to assess the same underlying concepts as the complete instruments. Based upon such compromises, a number of “pooled” epidemiological studies have been performed. These short IPD (Individual Participant Data) instruments have been criticized because it has been felt that they lack sufficient precision (Choi et al. 2015). It has been pointed out that problems both with underestimation of job strain and underestimation of the strength of association may arise with these shortened questionnaires (Theorell 2014). These problems may be amplified when job strain is defined as a situation in which demands are rated above the median and control below the median. This “median split” operationalization of job strain is the definition most frequently used in epidemiological studies – including in the IPD Work Consortium studies. The problem is that most subjects in a population study center their ratings around the medians, and this means that a large group of subjects with very similar scores will assign themselves more or less randomly to either the job strain or the comparison group. This may lead to a dilution of associations between job strain and outcome. Methods that create more contrast are to be preferred theoretically.

The dominant methods for assessing demand, control, and support at work are based upon self-rated questionnaires. Such ratings are potentially influenced by

individual factors which have nothing to do with aspects of the work organization (which are the real targets). Accordingly there is a need for more objective measures which are hard to obtain in psychosocial research. However, two assessment principles have been used in the creation of more objective measures, namely, Job Exposure Matrices (JEM) and expert assessments of the work environment.

JEMs have been used extensively in nonpsychosocial work environment research, mainly in research on exposure to chemical agents at work. The first example of a study relating the demand control model to an illness outcome was a cross-sectional study of the relationship between job strain and cardiovascular disease in the USA (Karasek et al. 1988). It was based upon the US national health survey (HES) and the US health and nutrition survey (HANES). This survey had no self-rated data on working conditions, and therefore, a JEM was constructed (Schwartz et al. 1988). On the basis of the international occupation codes, means for psychological demands and decision latitude were computed for each one of a full range of occupations in the American occupationally active population. Means were constructed specifically for male and female, older and younger and experienced versus unexperienced workers in each occupation. JEMs including psychological demands and control (decision latitude) have subsequently been constructed in several countries, for instance, Sweden and France. Johnson et al. (1996) used a Swedish JEM when they examined the relationship between decision latitude and cardiovascular morbidity and mortality in the Swedish working population. The JEM made it possible to study accumulated effects of low decision latitude on morbidity and mortality. A further analysis of the relationship between JEM and self-report was made in a large case-control study of risk factors for myocardial infarction in Stockholm, the SHEEP study (Theorell et al. 1998). When inferred data (JEM) were used as standard it was shown that in patients with a recent first myocardial infarction the specificity (true negative rate) for self-reported low decision latitude (lowest quartile) was the same (84%) as for referents in the normal population. The sensitivity (true positive rate) was lower but of the same magnitude for patients and referents (53% for patients and 46% for referents). In the corresponding way, the sensitivity for self-reported psychological demands (highest quartile) was 83% in patients and 82% in referents. The sensitivity for self-reported demand was lower (28% for patients and 31% for referents). These findings illustrate that self-reported and JEM-based measures of decision latitude are comparable. They also indicate that for psychological demands, JEM-based exclusion of subjects with high demands may be useful but identification of subjects with high demands is imprecise. Another conclusion was that in patients with a recent myocardial infarction *having recently become a patient with coronary heart disease* did not by itself seem to be of major importance to self-reporting of decision latitude and psychological demands at work.

Expert ratings have been used in psychosocial research to a relatively limited extent although such assessments of the psychosocial work environment have had a tradition in previous scientific studies (Volpert 1974; Hacker 1978). In a Swedish population study (WOLF) of occupationally active men, self-ratings of psychological demands and decision latitude were compared both with expert ratings and

occupation-based JEM scores (Hasselhorn et al. 2002; 2004). The results showed that for decision latitude there were in general good correlations between all the three assessment methods, whereas for psychological demands the associations were much weaker. Part of that could be due to the fact that JEM-based dimension psychological demands were based upon too few questions. However, such findings are in line with early US findings (see Healthy Work 1990, p. 338) which showed that 45% of the reliable variance in decision latitude can be explained by occupation, whereas only 7% of the reliable variance in psychological demands can be explained by the subject's occupation. This seems to confirm that the dimension psychological demands are more influenced by individual factors than is the dimension decision latitude.

A relevant development during later years is that the education level in the working population in many countries has increased. This means that the level of skill discretion has increased. In some studies, the decision authority component has therefore been representing decision latitude.

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## Findings in Epidemiological Studies

Karasek's first examinations were cross-sectional studies of the relationship between the demand control model and psychological health. They were soon followed by studies of the relationship between the model and cardiovascular disease. The first prospective study of the model's predictive value in relation to development of symptoms of cardiovascular disease was published on the basis of the Swedish Level of Living Survey (LNU) in 1981 (Karasek et al. 1981). Studies of cardiovascular disease have been successively refined over the years. Relevant cardiovascular risk factors not directly related to the work situation such as smoking habits, serum lipids, obesity, and diabetes have been included as confounders in case-control and prospective studies. A difficulty has been that myocardial infarction, the outcome that is widely accepted by cardiologists and epidemiologists, is relatively uncommon in the working population. The statistical power in many of the published prospective studies had therefore been too low resulting in diverging findings. Accordingly, during recent years efforts were made to combine several prospective studies in Europe. The underlying idea was to search for "sufficiently similar and reliable" questionnaires assessing demand and control in the different cohort studies. Fransson et al. (2012) formulated and published such a strategy for assessment of demand and control in the IPD Work collaboration. Similarly, the outcome measure myocardial infarction was standardized in advance. The rationale behind these precautions "in advance" was that "fishing" for statistically significant findings should be avoided. This included the operationalization of "job strain" as the combination of a score above the median for psychological demands and below the median for decision latitude. In the IPD Work Consortium, each epidemiological study used its own median since there were slight dissimilarities between the different questionnaires being used. Accordingly, comparisons between the countries were not possible since each country served as its own standard.

After the assessment principles taken by the IPD Work Consortium had been published, the analysis of the prospective relationship between job strain (defined according to the “median split” operationalization) and a first episode of objectively defined coronary heart disease was published (Kivimäki et al. 2012) – based upon 200,000 participants. The odds ratio of developing coronary heart disease among working subjects with job strain was in the order of 1.3. This finding was not substantially changed after adjustment for conventional risk factors such as smoking, diabetes, and blood lipids. In addition, a significant excess risk associated with job strain was found for both men and women and for high and low social class participants. In this study a comparison was also made between findings in unpublished and published European studies. The results showed that the odds ratio was higher in the published studies but still significant in the unpublished ones – indicating mild publication bias. In one analysis, the “delayed” association was studied which means that a time window of 3 years was introduced between the psychosocial job assessment and subsequent onset of coronary heart disease. This did not affect the magnitude of the association which indicates that the observed main association was not confounded by subclinical symptoms preceding the onset of coronary heart disease.

The finding of an odds ratio in the order of 1.3 for job strain (defined according to the median split definition) in relation the development of coronary heart disease in the general working population seems to be in line with an increasing number of publications. A systematic review (Theorell et al. 2016a) based upon prospective and case-control studies of high and medium high quality showed that there is a consistent relationship of approximately this magnitude. Interestingly the odds ratio in the included case control studies were in the same order of magnitude as in the prospective studies. In addition, a funnel plot of all the included studies indicated that publication bias was not a methodological problem.

The two reports on job strain and coronary heart disease from the IPD Work Consortium prompted a vigorous scientific debate. Choi et al. (2015) criticized the assessments in the IPD Work Consortium stating that the methodology applied would lead to both misclassification and underestimation of the prevalence of job strain.

On the basis of the IPD Work Consortium study, Kivimäki et al. (2013) also published an analysis of the interplay between job strain and “unhealthy life style” (current smoking, physical inactivity, heavy drinking, and obesity). The conclusion was that subjects with a healthy life style and job strain had half the incidence of coronary heart disease compared to those with unhealthy life style and job strain and that accordingly a healthy life style might substantially reduce the effect of job strain. This also prompted a debate regarding where to put the emphasis in preventive work – on improved work environment or on propaganda for individual healthy life style.

A closer look (Theorell 2014) at the relationship between number of lifestyle risk factors in groups with and without job strain in the IPD Work cohort revealed that there is indeed very little added risk going from “no job strain” to “job strain” (from 2.62 to 2.69) when participants (14,000 participants) have at least two of the lifestyle risk factors. But for those with no lifestyle risk factors ( $N = 55,000$ ) and for those

with only one such risk factor ( $N = 33,000$ ), job strain increases the risk from 1.00 (reference group) to 1.27 and from 1.47 to 1.87, respectively. From a population perspective, we should pay attention to these risk increases in the lower end of the lifestyle risk ladder.

Accordingly, it is likely that a population approach to job strain might pay off in reduction of coronary heart disease incidence since there are indeed many subjects with no or only one unhealthy life habit, and the IPD study showed that there was a significant excess incidence in this group.

Another point that has been discussed at length is whether there is really a true multiplicative interaction between high psychological demands and low decision latitude in increased health risk. Ingre (2015) pointed out that nearly all of the effect of job strain on coronary heart disease risk was attributable to the effect of low job control. Theorell et al. (2016a) came to a similar conclusion in their review of all published articles of high and medium high quality. When separate analyses of the effects of psychological demands and control on coronary heart disease were made, only the control variable showed a significant association with coronary heart disease risk. It should be pointed out, however, that the relative importance for coronary heart disease of these two main components has varied over the decades. During the 1990s, we had the impression that high psychological demands were more important than lack of control. My own impression is that the joint use of psychological demands and decision latitude is of importance to the stability of the findings and is helpful in work environment work. Assessments of social support add further precision. In addition, the use of the “median split” operational definition of job strain may not be optimal. Hallqvist et al. (1998) showed on the basis of the Swedish SHEEP study that alternative formulations creating more exposure contrast might provide higher risk ratios. Similar findings were reported by Landsbergis et al. (1994) in their longitudinal study of ambulatory blood pressure.

In a review by Kivimäki and Steptoe (2018), it was pointed out that job strain is more important in subjects with known coronary heart disease (who run the risk of developing a new illness episode). The odds ratio was shown to increase from 1.3 to 1.6. It has also been shown in an IPD Work study (Kivimäki et al. 2018) that manifest metabolic disease increases the magnitude of the association between job strain and risk of death considerably.

There are reviews of the effects of the two main components of the demand control model (Theorell et al. 2015) on the likelihood of developing depressive symptoms. In this case the included studies were all prospective. Accordingly, case control studies were not accepted. The effects of job strain and low decision latitude were investigated in relation to increase in depressive symptom levels (with the use of standardized symptom questionnaires distributed before and after the follow-up period), and both parameters were associated (with a moderately high level of evidence) to be associated with increased risk of developing depressive symptoms. Again there was no unequivocal evidence for psychological demands per se. Madsen et al. (2017) made similar conclusions from IPD Work findings. Leisure-time physical activity, tobacco smoking, alcohol consumption, obesity, and life-style risk factors are in various ways related to job strain, and in consequence with this

there is also a significant relationship between job strain and increased risk of developing diabetes 2. Job strain seems to influence illness risk both directly through endocrine and immunological mechanisms and indirectly through adverse life style.

During later years, the demand control support model has been studied in relation to other kinds of outcomes. Acute exacerbations of asthma as well as chronic obstructive lung disease, inflammatory bowel disease, and cancer were not associated with job strain in IPD Work studies. This may make sense since those disease outcomes are related to other kinds of pathophysiological mechanisms than cardiovascular disease. On the other hand, a study based upon the Swedish prospective WOLF study showed that there is a strong relationship between job strain and the development of atrial cardiac fibrillation. It is known from studies of the electrical conduction system in the heart that this is very sensitive to activation of the sympathoadrenomedullary system. Atrial fibrillation is an important condition from the population point of view since atrial fibrillation strongly increases the risk stroke development. In a somewhat different research direction, the more general outcome long term sickness absence has been related to job strain (Mutambudzi et al. 2018). And finally the model has been used for explaining loss of healthy life years between the age of 50 and 75 (Magnusson Hanson et al. 2018). On the basis of a large prospective study, it was calculated that accumulated exposure to job strain resulted in a loss of 2.0 healthy life years among men and 1.5 such years in women.

Karasek's initial hypothesis regarding the passive-active axis as protecting the body has re-entered the publications. Pan et al. (2018) showed in a prospective study of elderly using accumulated JEM assessments of psychological demands and decision latitude that life-time exposure to the combination of a high psychological demands and high control ("active" jobs) predicted preserved cognitive functions. This is consistent with the hypothesis formulated by Karasek in his thesis work in 1976 and by Karasek and Theorell 1990.

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## Physiological Links to the Demand Control Model

Physiological links to the demand control model played an important role in the early stages of the development of the underlying theory (Karasek and Theorell 1990). It was hypothesized that increasing job strain would activate the sympathoadrenomedullary system and the hypothalamo-pituitary-adrenocortical (HPA) axis resulting in elevated blood pressure, cortisol excretion, and serum lipids. It would also suppress the regeneration via decreased activity in the hypothalamo-pituitary-gonadal (HPG) axis resulting in lowered excretion of sex steroids, DHEA-s (dehydroepiandrosterone sulfate, a precursor of sex steroids), and growth hormone, hormones which increase regeneration activity in the body. Many studies have been published on the relationship between exposure to job strain and cortisol secretion, but findings have been conflicting. This may be due to too small study groups, varying methodology and insufficient understanding of the importance of circadian rhythm and the complicated relationship between healthy cortisol reactions

to stressful environments and physiological exhaustion after long-lasting exposure to job strain potentially resulting in attenuated responses and low flat circadian variation (Karlson et al. 2012). Studies with repeated observations during longer periods such as those of ambulatory blood pressure variations assessed during working hours (Schnall et al. 1998; Trudel et al. 2018) have shown that exposure to job strain is associated with increasing blood pressure levels. One of the early studies (Theorell et al. 1988, 1990) showed in male participants who were exposed to spontaneous variations in job strain that there was evidence of increasing blood pressure as well as decreasing plasma testosterone levels during job strain periods. In another study with repeated observations of heart rate variability in male workers Collins et al. (2005) showed that periods of job strain were associated with decreased activity in cardiac vagal control (which is related to the HPG axis activity) as well as increased sympathetic activity during working hours. Physiological theories are discussed more extensively in other chapters of this book.

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## Conclusion

The demand control support model has turned out to be a robust theoretical model. Against the odds it has survived as a tool in scientific studies despite the fact that the period after its construction could be characterized as a period with profound changes of the working life in the whole world. The scientific endeavors with the model have included epidemiological, physiological, and interventional research. The model's success may be due to its simplicity and the essentiality of its core component control which is related to some very basic elements in human life, touching existential philosophy and Freud's ego fight.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Regeneration and Anabolism: The Good Perspective](#)
- ▶ [The Associationalist Demand–Control \(ADC\) Theory](#)
- ▶ [Work Stress and Autonomic Nervous System Activity](#)

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# Effort-Reward Imbalance and Occupational Health 19

Johannes Siegrist and Jian Li

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Small parts of this chapter were written with close reference to the chapter “A theoretical model in the context of economic globalization” by Johannes Siegrist, published in “Work stress and health in a globalized economy: The model of effort-reward imbalance,” edited by J. Siegrist and M. Wahrendorf, Springer International Publishing Switzerland, Cham 2016 (pp. 3–19).

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*, Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_14](https://doi.org/10.1007/978-3-030-31438-5_14)

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**Abstract**

This chapter provides a comprehensive review of one of the leading theoretical models of health-adverse psychosocial work environments, effort-reward imbalance. It discusses the economic and socio-demographic context of the model's applications, its theoretical foundation, and its distribution across working populations. In the main sections, empirical support of its explanations of stress-related mental and physical disorders is illustrated, and complementary knowledge on potential psychobiological pathways is presented, based on experimental and quasi-experimental findings. Subsequently, the model's usefulness in designing worksite interventions and in justifying the implementation of distinct social and labor policies is discussed. The chapter ends with a demonstration of extensions of the model's core principle of failed reciprocity in costly transactions beyond paid work. These extensions concern socially productive activities, such as house and family work, volunteering, informal help, as well as close social relationships and exchange in educational contexts. Concluding remarks briefly point to the model's strengths and open issues that need further inquiry.

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**Keywords**

Social reciprocity · Employment relations · Psychosocial stress · Coronary heart disease · Depression · Intervention studies

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**Introduction**

To a large extent, the nature and distribution of work-related disorders among employed populations depend on the stage of societal and economic development. With the *epidemiologic transition* that occurred as a secular trend in economically advanced societies during the twentieth century, chronic noncommunicable diseases became major determinants of life expectancy and mortality. Today, these diseases are also widely prevalent in midlife and early old life, thus affecting the economically active workforce (GBD 2016). Even more so, if one analyzes the contribution of chronic diseases to the overall work-related mortality, one observes that they account for a substantial part. For instance, in a recent estimate based on data from the 28 member states of the European Union, it turned out that about 80% of all deaths from work-related diseases were attributed to cardiovascular and circulatory diseases and to cancers (Takala 2019). The epidemiologic transition has only partially determined the *aging process of modern societies*, another secular trend that resulted in a substantial increase of the senior population (Christensen et al. 2009). Extending the duration of working life is one major consequence of population aging. This is due to an increasing pressure on national pension systems toward cost containment. As a consequence, the statutory eligibility age for full pension has been gradually postponed in many countries (OECD 2017).

The epidemiologic transition and the accelerated aging process of populations in modern societies define *relevant demographic contexts* for the analysis of

associations between work and health. Yet, there is a third major trend with even larger potential impact, the recent development of *economic globalization* in conjunction with groundbreaking *technological advances*. In fact, in high-income and rapidly developing countries, the nature of work and employment underwent significant changes. *Employment sectors* shifted from industrial mass and lean production toward service delivery and information/communication technology-driven jobs. Along this change, physically strenuous jobs and exposure to noxious physical and chemical hazards became less frequent, thus improving the overall working conditions through automation and through investments in occupational safety and health. At the same time, a rapidly growing economic globalization, defined by large flows of transnational capital, trade, and workforce, increased competition and augmented pressures for cost containment. Consequently, large parts of the workforce experienced an increase of job demands and work intensity, often in combination with job instability and job insecurity (Gallie 2013). This *shift from material or physical work stressors to psychosocial, mental, or emotional work stressors* resulted in an augmented burden of work-related ill health in terms of *stress-related physical and mental disorders*, such as cardiovascular, metabolic, and affective disorders (see below).

As one of the main characteristics of economic globalization, free-market principles in conjunction with innovations in *information and communication technology* spread over the world. With the far-reaching advances of automation and artificial intelligence, human jobs are increasingly being replaced by machines, and a digitalized production is now threatening workers in low-skilled routine jobs (OECD 2019). At the same time, a transnational labor market with the entry of millions of working people from China, India, and the former Soviet bloc countries into the global labor pool aggravates competition and urges employers to reduce labor costs, often so by implementing distinct restructuring strategies (off-shoring, downsizing, outsourcing). Among the many changes in the world of work, the *transformation of employment relations* had particularly far-reaching consequences for working people and their well-being. This transformation is best described as a *rise in nonstandard employment*. In high-income countries, during the last century, formalized employment relations with long-standing continuity were widespread, supported by national labor and social policies and well-organized trade unions. The economic globalization, fueled by neoliberal policies, increasingly replaced these arrangements by more flexible nonstandard employment contracts, such as temporary agency-based work, part-time work, fixed-term contingent work, self-employment, and independent contracting. As described by a prominent expert, “the standard employment relationship, in which workers were assumed to work full-time for a particular employer at the employer’s place. . .was eroding. . .which led to a growth in precarious work and transformations in the nature of the employment relationship” (Kalleberg 2009; p. 3). A weakening of legal regulations occurred by neoliberal market forces, and many large organizations governed by public employers who offered stable jobs were privatized, shifting the risks of work from employers to employees. As the service sector is constantly growing and as telecommunication promotes mobile (including home-based) work, more diversified

and flexible working-time arrangements are now available, and part-time work is rising. This heightened flexibility is instrumental in improving the work-life balance. Yet, with the expansion of nonstandard employment, the negative sides of flexible arrangements become apparent as well. Increased job instability and insecurity and involuntary part-time work combined with risk of in-work poverty, forced mobility, and periods of unemployment are experienced by a substantial part of workforces in high-income countries (Gallie 2013).

In conclusion, significant societal and economic developments in recent decades have changed the nature of work and employment and its impact on workers' well-being. With accelerated population aging and growing healthy life expectancy, the length of working life is increasing, and the overall quality of work has been improved as a result of technological progress and an expansion of service and computer-based jobs. The psychosocial work environment is becoming more important, at the expense of physically strenuous and hazardous jobs that dominated the period of industrialized production. At the same time, with the rise of economic globalization and groundbreaking technological innovations, a growing competition at work is promoting work pressure, job insecurity, and risks of unemployment. In this context, the transformation of traditional long-term employment relations into more flexible, often precarious nonstandard arrangements is considered a major significant shift. Here, it is important to understand how this shift affects the health and well-being of workers.

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## **Stressful Effects of Nonstandard Employment: The Model of Effort-Reward Imbalance**

Worldwide, more than half of the global labor force is confined to informal employment.

Informal work is characterized by low job security, irregular (or even missing) income, and restricted (or totally absent) social protection (ILO 2016). Although its majority is located in developing countries, informal employment is still present in high-income countries, and some recent developments of deregulated labor markets, such as growth of the “gig” economy, tend to increase the risks associated with informality. In contrast, formal employment relations are defined by reciprocal obligations connecting employers and employees. Typically, these obligations are specified in work contracts regulating task demands, working time, wages and salaries, and participation in social security arrangements. Beyond the legal work contract, there are some implicit, non-specified expectations ensuring reciprocal cooperation and trust. The legal framework of employment contracts varies considerably across countries, ranging from minimal standards of formality to narrowly defined obligations and expectations. With the liberalization of capital, trade, and labor markets and with increasing economic power of transnational corporations, the regulatory impact of national governments has been diminished. Therefore, efforts of establishing supranational regulations to ensure basic human rights at work are

important. The “Social Protection Floor Initiative” put forward by the International Labour Organization (ILO 2013) is one such prominent policy effort.

In a world of work with rapidly changing tasks, job profiles, and organizational arrangements, and in times of rapid impact of automation, digitalization, and virtualization of work, the *explicit and implicit contractual expectations connecting employers and employees* define a *crucial element of stability and predictability*. This holds particularly true for nonstandard employment relations. Given the centrality of these expectations, any *violation* of contractual agreements is likely to evoke massive *stress reactions* among workers as it threatens their sense of control at work and the continuation of their occupational rewards. There is reason to believe that such *contractual violations*, if repeatedly experienced, *adversely affect the health of workers*. In fact, this is the *central assumption* of the theoretical model of work-related stress termed “effort-reward imbalance.”

As explained in this chapter, this model focuses on the work contract. Surprisingly, several previously developed, highly influential theoretical concepts of work-related stress put their focus on job task content and organizational features of work rather than on the work contract. For instance, this holds true for *person-environment fit theory* (Edwards et al. 1998), where stress arises from a misfit between the abilities and needs of the working person and the requirements and opportunities of the work environment. In this model, a misfit between appraised demands that are defined by job requirements and role expectations and personal abilities to meet these demands is considered a powerful source of stress-related poor well-being (Edwards et al. 1998). With its emphasis on “subjective misfit as the critical pathway from the person and environment to strain” (Edwards et al. 1998, p. 32), this model puts more weight on individual adaptation to given work environments than on changing work environments and employment relations. To some extent, this also holds true for the concept of *organizational injustice* with its emphasis on fair procedures of treating employees, of appropriate leadership behavior, and of improved flows of information and communication within organizations (Greenberg and Cohen 1982). Originating from organizational psychology and management science, this model does not address broader labor market and economic contexts. Moreover, it is difficult to see its application to more recent developments of distant, home-based, or virtual work disconnected from established forms of division of work within stable organizations. The *job demand-control* (or “*job strain*”) *model* (Karasek and Theorell 1990) while rooted in a sociological approach focuses on distinct job task characteristics. It claims that task profiles defined by high psychological demands and a low level of decision latitude or skill discretion increase working people’s stress, whereas active jobs combining high demands with decision authority and skill development exert beneficial effects on well-being and personal growth (Karasek and Theorell 1990). Despite its theoretical and practical importance, the basic notions of this approach reflect a world of industrial rather than postindustrial production, where employees are performing their work in hierarchically structured organizations with inherent forms of division of labor.

“Effort-reward imbalance” has been proposed as a distinct theoretical approach to work-related stress that addresses more recent economic developments by focusing



on the contractual arrangements at work as a core element of how work affects health and well-being (Siegrist 2016). Given the rise of nonstandard employment with its growth of insecure and precarious work, and given a deregulated labor market in a context of high economic competition, the nature and quality of employment contracts gained renewed prominence. The next section describes this model in more detail.

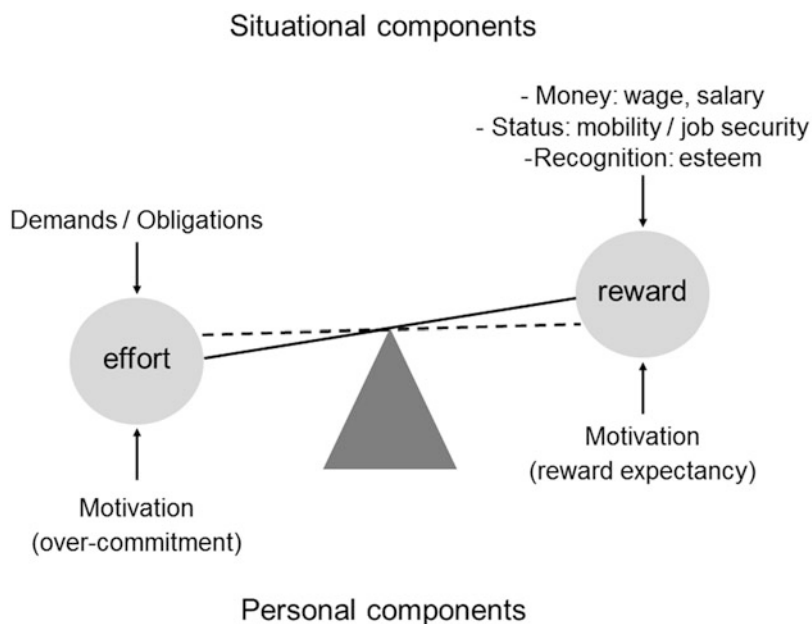
## The Theoretical Model and Its Measurement

To analyze and explain associations of modern working life with workers' health, a theoretical model is required. Theoretical models are developed with the aim of reducing the complexity, diversity, and variability of the world of work by selectively focusing on distinct components and their interactions that are assumed to produce tangible effects on workers' health. These components are delineated at a level of generalization that allows for their application in a wide range of different occupations. Proposing a theoretical model is a creative intellectual activity and, at the same time, a risky endeavor, as an empirical test of its propositions may fail. To this end, a model needs to be measured by a standardized assessment approach, and its recurrent empirical test provides the basis of accumulating new explanatory knowledge. The selective focus of the effort-reward imbalance model has been put on the principle of social reciprocity in costly transactions. *Social reciprocity* has been identified as a fundamental, evolutionary stable principle of collaborative human exchange (Gouldner 1960). According to this principle, any costly transaction provided by person A to person B that has some utility to B is expected to be returned by person B to A, where this activity should meet some agreed-upon standard of equivalence. Failed reciprocity results from situations where service in return is either denied or does not meet the level of equivalence. To secure this equivalence in costly transactions, social contracts have been established. The work contract is one such type where efforts are expected to be delivered by employees in exchange for rewards provided by the employer. Three basic types of rewards are transmitted in this case: salary or wage (financial reward), career promotion or job security (status-related reward), and esteem or recognition (socio-emotional reward). Importantly, contracts of employment do not specify efforts and rewards in all detail, but provide some room for flexibility and adaptation.

The model of effort-reward imbalance asserts that experiencing a lack of reciprocity in terms of high cost spent and low gain received in turn elicits negative emotions of anger and frustration and associated bodily stress reactions, with adverse long-term consequences for health. Effort-reward imbalance (ERI) at work occurs frequently under specific conditions. *Dependency* is one such condition, defined by situations where workers have no alternative choice in the labor market. For instance, unskilled workers, elderly employees, or those with restricted mobility or reduced work ability may be susceptible to unfair contractual transaction. *Strategic choice* defines a second condition of failed reciprocity. Here, people accept high cost/low gain in their employment for a certain period, because they tend to improve their

chances of career promotion in a highly competitive job market. A third condition points to the model's intrinsic component "overcommitment." As the notion of effort at work implies both an extrinsic demand to which the working person responds and a subjective motivation to match the demand, these two aspects are explicitly distinguished in this model. "Overcommitment" identifies a cognitive-motivational pattern of *coping with demands* characterized by excessive work-related striving. Overcommitted people may expose themselves more often to high demands, or they exaggerate their efforts beyond what is formally needed. As a result, they experience more often high-cost/low-gain situations than their less-involved colleagues. These three conditions occur with different frequencies in occupational groups, in employment sectors, and in varying socioeconomic and sociocultural contexts. The model's claim may therefore be relevant for working populations in several parts of the world but specifically in labor markets in times of a globalized economy (see Fig. 1).

At the *measurement* level, the ERI model is assessed by three scales, "effort," "reward," and "overcommitment," composed of Likert-scaled items. The psychometric properties of the original and the short version of the questionnaire were tested in several languages, and the fit of the data with the theoretical structure of the model was recurrently confirmed (Montano et al. 2016). A brief review of empirical findings on adverse health effects of effort-reward imbalance is given in a later part of this chapter. These findings relate to one or several of the following hypotheses:



**Fig. 1** The model of effort-reward imbalance at work. (Based on Siegrist 2016)

1. Each model scale exerts separate effects on the health outcome under study, usually in a dose-response relationship.
2. The size of effect on health produced by a combined measure quantifying the imbalance between high effort and low reward (“effort/reward ratio”) exceeds the size of effect produced by single scales.
3. Overcommitment moderates the effect of the effort/reward ratio on health (higher effect size when scoring high on overcommitment).

In summary, this sociological model emphasizes the *core social role of paid work* in adult life and its manifestation through contractual arrangements. These arrangements are embedded in the larger opportunity structure of the labor market that affects people’s unequal life chances, including the quality of work and its effects on health and well-being. By these links social inequalities at work are related to health inequalities. Being confined to jobs defined by high cost and low gain, being locked in unrewarding work environments, and experiencing recurrent relative deprivation negatively affect the health and well-being of working people. Before these adverse health effects are illustrated, we ask what is known so far about the social distribution of stressful work in terms of effort-reward imbalance.

## Social Distribution of Stressful Work

In modern societies, life chances are largely determined, either directly or indirectly, by people’s position in the labor market and in the occupational division of labor. Socioeconomic position (SEP) is considered a core indicator of the unequal vertical distribution of life chances across society and is usually assessed by one or several of the three indicators “level of education,” “level of (household) income,” and “level of occupational position.” The higher the people’s socioeconomic position, the higher their access to relevant material and nonmaterial resources, power, and privileges. Importantly, people in higher socioeconomic positions also exhibit better health, with lower burden of morbidity and premature mortality (Marmot 2004). While a consistent association of quality of work, as measured by physically strenuous and hazardous job conditions, with socioeconomic position has been demonstrated, leaving those in lower positions at higher risk of poor quality of work (Lahelma et al. 2009), the *social gradient of adverse psychosocial working conditions* is less well documented. Here, we briefly discuss results of social-epidemiologic investigations of associations between SEP and effort-reward imbalance at work.

Two cross-country comparative investigations provide a consistent result. The first study analyzed associations of ERI with three indicators of occupational position (status, class, skill level) in 11 European countries, using data from the first wave of the survey of aging, health, and retirement in Europe (Wahrendorf et al. 2013). For all three indicators, a social gradient was observed, with higher stress among those in lower positions. This finding was replicated with the SEP indicator “educational degree” in an investigation of 16 European countries, where a more

recent data wave of the study mentioned was analyzed, together with data from the English Longitudinal Study of Ageing (Lunau et al. 2015). Social gradients of stressful work were particularly steep in Eastern and Southern European countries. However, a recent review pointed out that there are also findings that failed to demonstrate a social gradient of the effort/reward ratio (Dragano and Wahrendorf 2016). These studies were conducted in Denmark, Sweden, and the United Kingdom. The main reason for this inconsistency is attributable to higher levels of psycho-mental effort among working people with higher SEP, whereas the distribution of occupational reward rather consistently follows the social gradient (Siegrist et al. 2004). This latter aspect holds also true for physical effort, a component that has not been adequately measured in the frame of this model.

All three dimensions of low occupational reward follow this social gradient: job security, promotion prospects and pay, as well as esteem and recognition. For instance, a European survey with data from 28 countries documents a steep social gradient of job promotion prospects. While about 58% of all managers agreed that there are good prospects for career advancements, only 22 of those in elementary occupations agreed (Eurofound 2017a). In this large panel study on working conditions, the European Working Conditions Survey, a “reward” indicator was constructed, including data on fair pay, promotion prospects, and job security (Eurofound 2017b). When trends over time were considered, mean scores of occupational rewards remained rather stable from 2005 to 2015. Interestingly, in 2015, a steep social gradient of rewards was observed, based on the differentiation of nine hierarchically ordered occupational groups. Similarly, rewards were higher among those with permanent employment contracts compared to those with fixed-term contracts and those with less secure jobs, and the same was true for working people with a low degree of predictability of their working time. When data were analyzed according to occupational sectors, participants employed in financial services and in education scored highest on rewards, whereas those working in the sectors of transport, industry, and agriculture scored lowest. In view of the significance of nonstandard employment, a further finding deserves attention. Participants were asked whether they experienced a change in the number of employees in their workplace over the past 3 years. Those who reported that the number of employees decreased a lot showed significantly lower scores of occupational rewards than those with a stable workforce, whereas those who experienced a slight or large increase exhibited higher scores of reward (Eurofound 2017b). These results underline the close links between quality of work, as analyzed at the meso-level of organizational arrangements with macro-level developments, such as changes of the labor market and differential proportions of occupational sectors.

The *significance of occupational rewards for social inequalities* of working and living conditions becomes even more apparent if one extends the core notions of the theoretical model to cover people’s *occupational trajectories*. Analyzing rewards in a life course perspective rather than with restriction to the current or main occupational status enables researchers to study patterns of risk accumulation or disruptive changes across individual work histories. In one such approach, *three critical career characteristics* were identified that prevent workers from meeting the basic material

and socio-emotional needs through the allocation of appropriate rewards, such as security, continuity, promotion, fair pay, and appreciation. These characteristics are described as follows: (1) *precarious career* (e.g., temporary contract and repeated job change), (2) *discontinuous working career* (e.g., involuntary interruptions in terms of episodes of unemployment or weak labor market attachments), and (3) *cumulative disadvantage* (e.g., continued deprived occupational position) (Wahrendorf et al. 2018). In all these instances, one or several dimensions of recompense are frustrated, often triggering a sense of being locked in a totally unrewarding social environment. These critical trajectories follow a social gradient, such that workers in lower socioeconomic positions are exposed more often to them than their less-deprived colleagues. In a large cohort study in France, where 23,652 employed men and women aged 45–60 were recruited from 22 different health examination centers, the social gradient of all 3 patterns of critical career characteristics was demonstrated, with the highest prevalence among participants in the lowest occupational positions (Hoven et al. 2019). Moreover, these critical trajectories were associated with low occupational rewards in participants' current occupational position. For instance, based on multilevel Poisson regression models adjusting for age, sex, and education, the relative risk of experiencing low reward in the current job was 1.33 (confidence intervals 1.24;1.42) among those reporting cumulative disadvantage compared to the risk of those with less stressful trajectories (Hoven et al. 2019).

In conclusion, stressful psychosocial working conditions, as defined by the ERI model, are distributed unequally across the social structure, leaving a higher burden among those in lower socioeconomic positions. Similar associations were obvious from distinct labor market developments threatening the stability and continuity of employment, such as recessions and financial crises, resulting in increased downsizing and redundancy. *Low occupational reward* was the model's component that was linked most strongly with these *socially deprived conditions*. This latter observation held true irrespective of whether reward was assessed in participants' current occupational position or as a result of their critical career trajectories. Against this background, it is important to know how these conditions of stressful work affect the health and well-being of employed populations.

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## Adverse Health Effects of Effort-Reward Imbalance at Work

The recurrent *experience of failed reciprocity* at work evokes *negative emotions* of anger and frustration and elicits *psychobiological stress reactions* within the organism. Feelings of unfair treatment, of violated trust or broken promise are emotionally painful, and encounters of unjust exchange at work trigger negative affect even under conditions of chronicity, partly bypassing conscious information processing. These negative emotions activate distinct areas in the brain reward circuits, including nucleus accumbens, anterior cingulate cortex, and insula (Schultz 2006). This activation suppresses the production of dopamine and oxytocin, that is, neurotransmitters associated with pleasurable emotions and stress-buffering properties. Moreover, activation of the insula is associated with the experience of physical and

emotional pain (Singer et al. 2004). Recent neuroscience research demonstrates that insular activation is modulated by the magnitude of loss following effort, and that the intensity of positive stimulation of the *brain reward circuits* depends on the amount of effort previously expended (Hernandez Lallement et al. 2014). This evidence from neuroscience research is in accordance with basic assumptions of the ERI model. Importantly, *threat or loss of reward* related to a person's core social role is associated with an extensive *arousal of distinct stress axes* within the organism, specifically the hypothalamic-pituitary-adrenocortical stress axis and the locus coeruleus-norepinephrine-autonomic system-adrenal medullary stress axis (McEwen 1998). Sustained activation of these stress axes in the organism may trigger states of *allostatic load* within several regulatory systems of the body, and these states of allostatic load contribute to the development and onset of *stress-related physical and mental disorders*, such as coronary heart disease or depression (McEwen 1998; Steptoe and Kivimaki 2012).

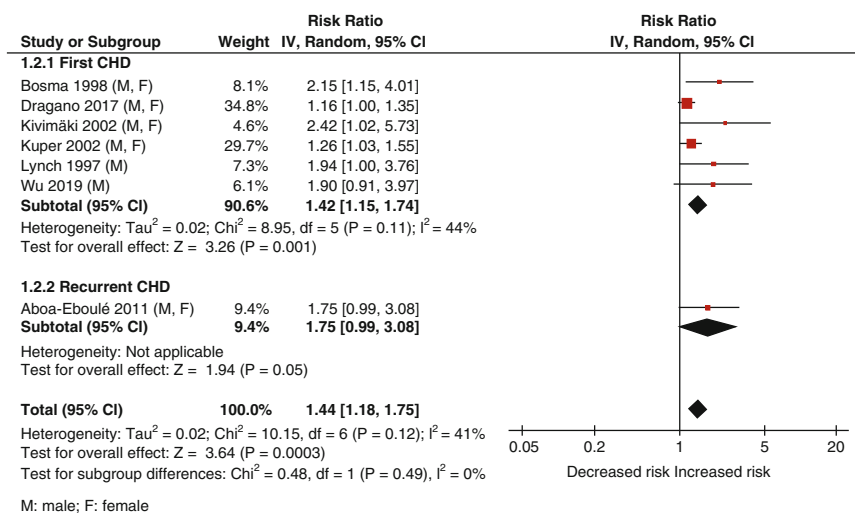
While there is substantial knowledge on potential pathways linking the experience of effort-reward imbalance at work with the development of stress-related disorders, empirical confirmation of these associations is required. *Two research traditions* contribute to this aim. The *first tradition* concerns *prospective epidemiologic cohort studies*, and the second tradition deals with experimental or quasi-experimental study designs. Prospective cohort studies are considered a gold standard of observational research, due to the fact that work stress is assessed at baseline in a population free from the disease under study. This working population is then followed up over a period of years, and the occurrence of new disease manifestations is analyzed in association with exposure to previously assessed stressful work. Elevated relative risks or odd ratios of disease incidence are calculated, adjusted for relevant confounders, such as concurring risk factors of the disease under study, and the statistical significance of this elevated risk is calculated by comparing it to the risk in the group of workers who were free from stressful work. This statistical information needs to be complemented by data on mediating processes obtained from the *second type of research tradition*, i.e., *experimental and quasi-experimental or naturalistic investigations*, where the experience of effort-reward imbalance is analyzed by monitoring its association with distinct psychobiologic markers. Stress hormones (e.g., cortisol), markers of inflammation and immunity (e.g., C-reactive protein, natural killer cells), and measures of cardiovascular activity (e.g., heart rate, heart rate variability, blood pressure) are prominent examples of psychobiologic markers explored in work stress-related research. The following two sections provide a brief account of relevant research findings on associations of ERI at work with stress-related disorders, where two disorders deserve priority, given their significance for population health and given a substantial body of research on their associations with stressful work: coronary heart disease and depression.

## Evidence from Epidemiologic Investigations

Globally, *cardiovascular diseases (CVD)* are a major determinant of mortality, accounting for about a third of total mortality (McAloon et al. 2016). *Coronary*

(or ischemic) heart disease (CHD) and stroke contribute most to this burden of mortality. In 2012, in Europe, CVD accounted for 48% of total mortality (McAloon et al. 2016). Although the incidence of CHD has been considerably reduced during the past 40 years, morbidity and premature mortality from this disease still play an important role in modern societies, and this equally holds true for working-age populations (GBD 2016). Work stress is only one of a number of risk factors of CHD identified in epidemiological studies (Steptoe and Kivimäki 2012). Given the scientific challenge of defining and measuring work stress in reliable and valid ways, and given the logistic problems of conducting large-scale cohort studies with long-term follow-up and appropriate bias control, this research only recently witnessed major scientific progress. Today, there is solid evidence of an *increased relative risk of CHD among working people who experienced work stress in terms of the demand-control (or job strain) model* (Kivimäki and Steptoe 2018). After adjustment for relevant confounders, an increased relative risk of 40–50% has been documented, based on more than a dozen prospective cohort studies. These risks are critically elevated if subclinical cardiovascular pathology is already present (Kivimäki and Steptoe 2018), and work stress additionally increases the risk of recurrent CHD after recovery from a first cardiac event (Li et al. 2015).

Whereas the *demand-control model* represents the leading theoretical concept of research on work stress and CVD (mainly CHD), the *ERI model* has offered a *complementary explanation* of this association. Starting in the 1990s, several cohort studies demonstrated effects of work stress in terms of this model on incident fatal or nonfatal CHD or CVD of comparable size, even after adjusting for the effects of the demand-control model. Figure 2 summarizes the *findings from seven longitudinal studies* on this association. Importantly, two cohort studies, the British Whitehall II



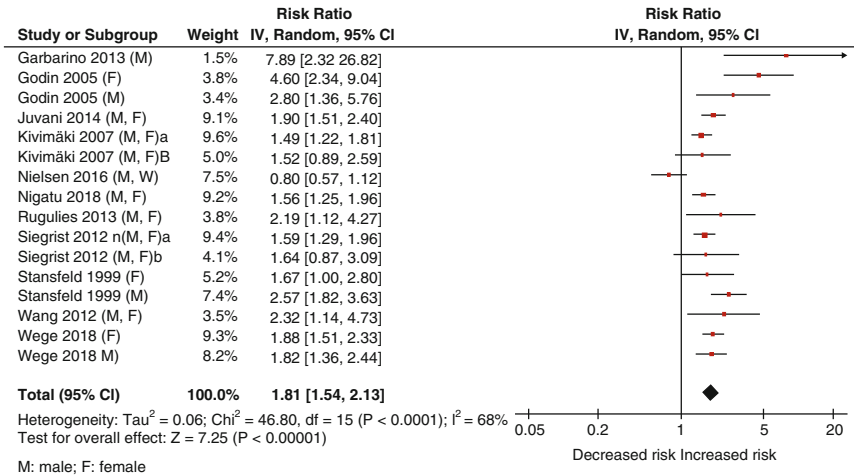
**Fig. 2** Meta-analysis of cohort studies on the association of effort-reward imbalance with cardiovascular disease (mainly CHD)

study (Bosma et al. 1998), and the Finnish blue-collar study (Kivimäki et al. 2002), found independent associations of similar size of these two models that were included in a competitive model test. One investigation reported this association among those who returned to work after recovery from their first cardiac event (Aboa-Eboulé et al. 2011). Overall, a significantly elevated risk ratio of 1.44 was observed. More recently, additive effects of the two models were reported in a multi-cohort study of 90,164 individuals from 11 European prospective cohort studies (Dragano et al. 2017).

In these studies, effects of work stress on CHD were adjusted for important *cardiovascular risk factors*, such as hypertension, elevated blood lipids, and markers of atherosclerotic development, the major pathophysiological process promoting CHD. This statistical control runs the risk of overadjustment because these conditions too can be influenced by chronic stress at work. In fact, a number of longitudinal studies document associations of ERI with the development of hypertension and with progression of atherosclerotic arterial plaques. For instance, in an investigation of 1595 white-collar workers in Canada, work stress and blood pressure were assessed twice over a 3-year period. Among women aged 45 or older with a high level of ERI at both times, the cumulative *incidence of hypertension* was 2.78 times higher than in unexposed women of the same age. Additionally, men and women scoring high on overcommitment had higher mean blood pressure at the end of follow-up than those scoring low (Gilbert-Ouimet et al. 2014). In a study of 940 Finnish men, *progression of carotid intima media thickness* – a marker of atherosclerotic development in arteries – was analyzed with regard to work stress over a 4-year period. Men with effortful jobs in combination with low salary – the only reward component assessed in this study – exhibited a significantly faster progress than the remaining groups (Lynch et al. 1997). Additional information on links between work stress and markers of cardiovascular function is given in section “[Evidence from Experimental and Quasi-Experimental Investigations](#).”

*Depression* is the second chronic disorder to be discussed here due to its significance for public health and the substantial amount of research available on its association with stressful work. Globally, depression and coronary heart disease continue to be the two leading causes of premature mortality and life years lost due to disability (GBD 2016). In working-age populations of high-income countries, depression is prominent due to its prevalence – an estimated 12-month prevalence of 6–7% – its duration, its comorbidity risks, and its role as a leading cause of disability pension (Kessler et al. 2003). While there are different diagnostic types and different degrees of severity of depression, most studies are concerned with *depressive episodes*, as defined by ICD diagnostic criteria. These episodes are identified by clinical interviews conducted by psychiatrists, by assessment of psychometrically validated tests defining clinically relevant depressive symptoms, or by self-reported physician diagnoses. For three of the theoretical work stress models mentioned, there is *robust evidence* on their contribution toward explaining *elevated risks* of newly manifested *depressive episodes or depressive symptoms*: the model of *organizational injustice*, the *job strain or demand-control model*, and the *effort-reward imbalance model*. For each one of these models, a systematic review, in part





**Fig. 3** Meta-analysis of cohort studies on the association of effort-reward imbalance with depression

combined with a meta-analysis, is available: organizational injustice (Ndjaboulé et al. 2012), demand-control (Theorell et al. 2015), and effort-reward imbalance (Rugulies et al. 2017). Taken together, findings from more than two dozen cohort studies reveal similar effect sizes on risk of depression attributable to each one of the three models. The overall effect points to an *almost twofold-elevated relative risk of depression among people reporting stressful work* as compared to those without stressful work. Interestingly, if the three models are combined, strong additive effects are observed (Juvani et al. 2018). Figure 3 displays the results of an updated *meta-analysis of prospective investigations on ERI and depression*, summarizing the results from 13 reports, with an elevated risk ratio of 1.81.

As was the case for coronary heart disease, depression is a multifactorial disease with a broad spectrum of risk factors and biomarkers indicating increased vulnerability. More information on associations of effort-reward imbalance with some of these risk factors and biomarkers is given in the next section “[Evidence from Experimental and Quasi-experimental Investigations.](#)” Taken together, the work stress model documents relatively consistent relationships with elevated risks of CHD and depression. Several other disease conditions were studied with regard to this model, but as evidence derived from cohort studies is still restricted, respective findings are not considered in this chapter (see, e.g., Siegrist and Wahrendorf 2016a).

### Evidence from Experimental and Quasi-Experimental Investigations

*Experimental investigations* provide a strong case for confirming or rejecting a research hypothesis. Yet, their external validity is often quite limited. Therefore, findings resulting from experimental studies complement rather than replace the

knowledge obtained from research based on other study designs. Only a few studies transformed the model's basic assumptions into an experimental procedure of unjust exchange. In one such study using a simple principal agent experiment, unfair pay was associated with reduced heart rate variability in a dose-response relationship (Falk et al. 2018). More often, *quasi-experimental or "naturalistic" study designs* were applied to test associations of stressful work with one or several indicators of psychobiological processes that are assumed to link exposure experience with the development of a stress-related disorder. A wide variety of *psychobiological indicators* has been studied with regard to effort-reward imbalance, most often in the context of everyday work environments (e.g., using ambulatory monitoring techniques). These indicators include systolic and diastolic blood pressure, heart rate and heart rate variability, stress hormones (e.g., saliva cortisol), and markers of inflammation and immune competence (e.g., C-reactive protein, interleukin, counts of natural killer cells).

It is not possible to give a detailed account of the available evidence on this line of research, and readers are referred to a recent synthesis of findings (Siegrist and Li 2017). One way of summarizing relevant findings is to focus on the number of independent studies dealing with one specific biomarker. Among the cardiovascular markers, heart rate variability (HRV) was most often analyzed. This is a relevant marker as decreased vagal tone is considered an early sign of functional impairment of the cardiovascular system. In nine out of ten studies, a significant association with components of the effort-reward imbalance model was reported: the higher the level of work stress, the lower the values of HRV. However, in two investigations the relations were restricted to women, and some studies were restricted to male samples (Siegrist and Li 2017). Cortisol is the stress hormone that has been analyzed most frequently in this context. Findings are difficult to compare because different measurements and study designs were applied. In earlier studies, the cortisol awakening response or diurnal salivary cortisol profiles were applied, whereas hair cortisol was introduced more recently as a marker of accumulated cortisol secretion. Despite an inconsistent state of research, reduced rather than increased cortisol secretion under stress seems to occur. This finding can be interpreted in the frame of a time-course model of cortisol excretion, suggesting increased levels of cortisol in an early stage of chronic stress exposure, followed by decreased levels, as a result of functional adaptation to long-term stress exposure. For several markers of cellular and humoral immunity, associations with effort-reward imbalance were investigated, and the same was true for C-reactive protein as a marker of endogenous inflammation. Although more studies are needed, the available data are generally in line with the notion that work stress in terms of this model impairs immune function and increases the vulnerability to inflammation (Siegrist and Li 2017).

Taken together, there is supportive evidence that *failed reciprocity at work* in terms of ERI is associated with altered functions of cardiovascular, hormonal, immune, and inflammatory markers that may contribute to allostatic load and the development of stress-related disorders. These biomarkers are hypothesized to act as mediators of the relationships between chronic work stress and incident coronary heart disease or depression. As the demonstration of biological pathways is an

important criterion of causality in epidemiological studies, this knowledge complements the findings reported in section “[Evidence from Epidemiologic Investigations](#),” summarized in two meta-analyses of associations of effort-reward imbalance with incident CHD and depression.

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## Interventions

In this chapter, we argue that adverse psychosocial working conditions contribute to a considerable burden of stress-related disorders, specifically so in times of economic globalization and rapid transformation of work and employment by technological advances. These conditions are mainly experienced by working people as an increase of work pressure and a decrease of job security and continuous employment. With the help of theoretical models, the health-adverse characteristics of these conditions can be identified. ERI is one such model. It has been widely used in research on occupational health during the last few decades, and with its focus on the contractual aspects of employment, it is of particular interest in times of increased nonstandard employment. *Research based on this model* has several functions. *First*, it enables the *identification of occupational groups with high levels of stressful work*, e.g., in different countries or occupational sectors, in different types of organizations and businesses, across occupational status groups, and under varying conditions of labor market development or labor market policies. This identification provides crucial information with relevance to policy, such as prioritization of need in case of investment into improvements of the quality of working life. *Second*, theoretical models, if measured by standardized assessment tools, are implemented in scientific *research on occupational determinants of workers' health*. Here, prospective cohort studies define a gold standard. Additionally, experimental and quasi-experimental investigations are instrumental that link the experience of stressful work with indicators of biological or behavioral pathways of the development of disorders. In case of stress-related disorders, a set of established psychobiological markers has been applied. Both lines of research were followed in a variety of international studies examining the *contribution of the ERI model toward explaining elevated risks of incident coronary heart disease and depression* and to supplement these statistical associations with information on underlying psychobiological pathways. A *third* function of theoretical models is to *instruct stakeholders in their efforts to design interventions and to develop policies that aim at improved work and employment conditions*. The next part of this chapter deals with this third function. Intervention measures are designed at *different levels*. Here we distinguish the three levels of individual (or interpersonal) measures, organizational measures, and national measures of policy development.

## The Individual Level of Stress Management

A large number of individual-level *stress management interventions* in the workplace have been conducted and evaluated during the past decades. In most cases,

positive effects on psychosocial characteristics and mental well-being were well documented. While psychotherapeutic techniques (especially cognitive-behavioral therapy) and relaxation were more frequently used, mindfulness-based interventions and recovery programs have drawn attention in recent years (Richardson and Rothstein 2008; Tetrack and Winslow 2015). So far, reports on five studies based on the ERI model are available (Aust et al. 1997; Mino et al. 2006; Unterbrink et al. 2012; Limm et al. 2011; Li et al. 2017; Heckenberg et al. 2019). Mino et al. (2006) conducted a 3-month randomized controlled trial among office workers in Japan, where a significant effect on depression was found. Two *randomized controlled trials* from Germany demonstrated that effects of stress management on ERI and burnout lasted for 6 months in bus drivers (Aust et al. 1997) and for 1 year in school teachers (Unterbrink et al. 2012), respectively. Notably, a randomized wait-list controlled trial in German male managers demonstrated that an ERI-guided individual-level stress management intervention in the workplace produced long-term effects over a 9-year period, with respect to improvements of ERI and depression (Li et al. 2017). It should be noted that these earlier studies used traditional approach to perform stress management, i.e., face-to-face group training/counseling. A recent study based on online mindfulness stress reduction from Australia indicated that, after completion of an 8-week online program, direct-care workers' overcommitment levels were significantly reduced (Heckenberg et al. 2019). In two studies, questionnaire-based outcomes were supplemented by biological data, showing a decrease in  $\alpha$ -amylase (Limm et al. 2011) and an increase in secretory immunoglobulin A (Heckenberg et al. 2019), respectively. Despite these *promising results*, one should be aware that, in general, individual-level stress management interventions do not target the extrinsic sources of stress at work. According to recent literature reviews (Richardson and Rothstein 2008; Tetrack and Winslow 2015), individual stress management programs need to be combined with organizational-level interventions in the workplace to produce more sustainable effects (see next section).

## The Organizational Level of Worksite Health Promotion

Individual-level interventions that improve workers' coping with chronic stress are an important approach toward reducing work-related ill health. Within the frame of this theoretical model, this becomes obvious if cognitions and motivations among overcommitted working people are addressed. Yet, the model's extrinsic components point to structural stressors that need to be tackled by measures of organizational and personnel development. It is generally difficult to implement such measures within the constraints of competitive everyday business life, and this holds equally true for attempts toward performing scientifically valid intervention studies in terms of randomized controlled trials or other well-designed investigations. Given these difficulties, there is no surprise that few such theory-based intervention studies were conducted up to now, and this holds particularly true for interventions based on the ERI model. Here, we briefly discuss three such intervention studies to illustrate their promises for improving health-conducive working conditions. All three studies were conducted in Canada, where white-collar employees and

professionals rather than blue-collar workers were the target populations, thus pointing to a restricted generalization of their findings. A detailed description and interpretation of the first two studies was given in an important book chapter written by the research team that developed these interventions (Brisson et al. 2016). The following *brief review* relies on this chapter. Both studies were conducted as *quasi-experimental before-after designs*, with pre- and post-intervention measurements, contrasting the effects in the intervention group with those in a control group of similar socioeconomic composition. It was their common aim to *implement organizational changes* to improve the psychosocial work environment according to the ERI and the demand-control models. Accordingly, these models were assessed with standardized methods before and after the intervention, and the implementation was directed either by managers or by an intervention team composed of employees and managers' representatives.

In the first study, the *acute-care hospital study*, healthcare providers (mainly nurses) in two hospitals in Québec were included, with 492 participants in the intervention setting and 618 participants in the control setting. The organizational changes were developed in an intervention team, instructed by the results of the baseline assessment of psychosocial stress at work. Several dozens of solutions to improve control, social support, and reward and to reduce demands at work were proposed, and many, but not all, of them were implemented subsequently, either at the level of work organization within units (e.g., regular work team meetings; improved replacement procedures) or at the hospital level (task enrichment, better training). After 12 months and 36 months, changes of work stress scores according to the models and changes of health measures (mainly client-related and work-related burnout) were analyzed, evaluating the differences between the two groups. In the intervention group, the levels of ERI and psychological demands were clearly reduced after 36 months, whereas in the control group, no major changes were observed. Importantly, work-related burnout was significantly reduced after 36 months in the intervention group, but not in the control group, with a decrease of prevalence from 48.2% to 43.2%.

The second intervention was conducted among three semipublic organizations (the *white-collar insurance services study*). The intervention group was composed of 1093 workers within the first organization, and a control group of similar size was mainly recruited from two remaining organizations. Based on the screening results of psychosocial working conditions and elaborated by focus groups, distinct organizational changes were identified in a logbook and were implemented subsequently. Social support and reward were the most often targeted psychosocial work factors. After 12 months, low respect and esteem, low support from superiors, and high psychological demands were significantly reduced in the intervention group. Except a decrease in reward, no changes were obvious in the control group. With regard to health, a substantial reduction of psychological distress occurred exclusively in the intervention group. Moreover, in the intervention group, mean levels of systolic and diastolic blood pressure were slightly but significantly reduced (Brisson et al. 2016).

The results of this second study led to a guide of organizational practices to improve the quality of psychosocial work. It is worth noting that this research

contributed to the declaration of a voluntary standard, the “Quebec Healthy Enterprise Standard” aiming to promote healthy organizational practices, with a special focus on management practices. The third intervention study (Letellier et al. 2018) was in fact part of an evaluation of the impact of this standard on the quality of work and the well-being of workers, with close reference to the ERI model. To this end, five organizations that implemented the standard were compared with five organizations without implementation. A total of 2,560 employees were included in a longitudinal survey between 2011 and 2015. Findings revealed that the prevalence of employees with low reward decreased by 8.6% in the intervention group, while it increased by 6% in the control group. A similar change was observed for the effort/reward ratio as well as for psychological distress, the main indicator of participants’ mental health. In all three instances, an interaction test “group x time” documented significantly reduced prevalence ratios in the intervention vs. control group. This latter test was used to document the net effect of the implementation (Letellier et al. 2018).

*These examples illustrate the potential benefit of organization-level primary prevention through theory-based interventions aiming at a reduction of health-adverse psychosocial work environments. ERI and demand-control model are two such theoretical models that can guide preventive activities with demonstrated impact on mental and cardiovascular health. Although the size of observed health effects is small, these differences are meaningful at the level of population health. Clearly, given the voluntary character of these standards, and given the resistance of many employers to implement these interventions, the preventive success may be limited. Against this background, it is important to intensify intervention research and to adhere strictly to the quality criteria of developing and implementing organization-level interventions (Brisson et al. 2016). Finally, in view of the challenge of strengthening the quality of work and employment and of reducing the work-related burden of disease, it is not sufficient to limit preventive efforts to single companies and organizations. Rather, these efforts need to be strengthened and extended by tailored policy programs at national and supranational levels.*

## **The Role of National Social and Labor Policies**

Since the late nineteenth century, pioneering countries established laws and protective measures against the threats imposed to the workforce by an unregulated capitalist market. Occupational health and safety measures, work time control, and regulation of risks of unemployment, sickness, and old-age poverty were implemented, supported by strong trade union activity. After the Second World War, Scandinavian countries developed the most comprehensive social and labor policies, serving universally as models of good practice. Yet, with the rise of economic globalization and the challenges of neoliberal policies, these developments increasingly came under pressure. At the same time, distinct occupational risks associated with increased work pressure, job instability, and rapid technological change emerged that called for additional social and labor policies, with a focus on

quality of work and employment. While a main burden is put on national regulations, supranational efforts are needed as well. As a remarkable activity, the ILO's "Social Protection Floor Initiative" must be mentioned (ILO 2013). Moreover, the WHO has fostered a global movement to promote health equity, including work-related health (WHO 2008), and, more recently, the United Nations adopted the declaration on Sustainable Development Goals, where goal number 8 explicitly focuses on the global promotion of decent work (UN 2015).

Important as these efforts are, they require a sustained reinforcement at national level. As mentioned, European countries, together with Canada and Japan, are at the forefront of this development. Improving the quality of material and psychosocial adversity at work, including job insecurity, lack of career advancement, and unfair pay, has been a priority target, with the implementation of mandatory regulations and their systematic monitoring as key elements. With the availability of research findings from *cross-country investigations*, it has become possible to *study associations of distinct social and labor policies with the quality of work and employment* according to variations of national policies. The Survey of Health, Ageing and Retirement in Europe (SHARE) is one such cross-country study that was conceptualized in close collaboration with the English Longitudinal Study of Ageing (ELSA).

Two reports using data from these studies illustrate the importance of national policies for the quality of work and employment. They both integrate data on ERI and low control at work. In the first study, an *index of national policies of labor market integration* was included, reflecting investments in continued education and in return-to-work of disabled or unemployed people. This index, developed by OECD, contained expert evaluations of the availability and quality of ten respective policy programs, providing scores ranging from 0 (poorest quality) to 50 (best policy). Countries like Denmark, Sweden, the Netherlands, and Germany ranged at the top, whereas countries from Southern and Eastern Europe ranged at the end. When these scores were related to mean levels of stressful work, as measured by the two models, an almost linear association became apparent, *where pronounced integration policies went along with lower mean scores of stressful work* ( $R^2 = 66.5$ ) (Wahrendorf and Siegrist 2014). These results were based on survey data from 11,181 older employed men and women from 13 European countries.

A further study explored the role of integration policies and protective policies in shaping social gradients of work-related stress. Here, *protective policies* are defined as measures offering financial compensation to those excluded from the labor market, while *integration policies* refer to investments into active labor market programs and educational or vocational training opportunities at older age. Given an unequal distribution of stressful work along socioeconomic indicators, such as education and occupational position, this *investigation set out to analyze whether, and to what extent, the implementation of respective policies was associated with a reduction of social gradients of stressful work, such that socioeconomically deprived groups were exposed to lower levels of stressful work*. In this analysis of data from 13,695 older employed persons participating in SHARE and ELSA, national variations of these policies were assessed in 16 countries. Multilevel analyses showed that the strength of associations varied according to the extent of implementation of the

two types of policy indicators. In countries with poor implementation, educational gradients of work stress were pronounced, whereas they were almost absent in countries with comprehensive implementation. The results may suggest that participants with low education benefit from such policy measures more than was the case for participants with higher education (Lunau et al. 2015). Thus, efforts to qualify older employees and to support their integration into the labor market not only seem to reduce the burden of stressful work, but they also reduce the negative effect of low educational attainment.

In conclusion, *distinct national, social and labor policies*, and specifically those strengthening active labor market programs, must be considered *promising entry points for efforts to reduce the burden of stressful work and its adverse effects on workers' health*. These entry points complement those defined at the level of organizations and companies, where employers and other stakeholders are expected to promote decent and healthy work. It is important to notice that the ERI model has produced new explanations both at the level of organizations and at the level of national policies.

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## Extensions Beyond Paid Work

“Effort-reward imbalance” has been proposed as a theoretical model that explains and predicts elevated risks of work-related poor health and disease, thus offering evidence for targeted intervention. Despite its wide empirical support, the model’s explanatory power is limited, due to its analytical focus. As mentioned, by combining the model with complementary theoretical approaches, the amount of variance explained is improved (e.g., Juvani et al. 2018). Yet, defining an analytically selective model has an important advantage as its degree of generalization can be extended beyond its original focus, i.e., paid work. In fact, *this model* has already been *generalized to include a range of other types of costly social transactions where the principle of social reciprocity matters*. Establishing a general model is required to meet a relevant quality criterion of scientific theory development, i.e., parsimony. *Parsimony* refers to the degree of abstraction inherent in a model’s core hypotheses. Applying these hypotheses to types of costly social transactions other than paid work increases the model’s explanatory power by heightening the degree of abstraction of its statements. In other words, the smaller a set of predictors and the wider the range of its explanations, the higher is the usefulness of a theoretical model. Therefore, *high effort in combination with low reward is expected to increase the risk of poor health* not only in case of paid work but equally so *in socially productive unpaid activities conferring some utility*, such as voluntary work, care of a family member, informal help, and homemaking. This notion was extended even to the exchange within close social relationships as well as to contexts of effortful learning (school, university). In all these instances, *failed reciprocity* between “give” and “take” *elicits strong negative emotions* of disappointment, anger, and frustration. If experienced recurrently, negative emotions and associated stress-physiological responses adversely affect people’s health and well-being. Conversely, experiencing



a *balanced exchange* between efforts spent and rewards received in turn *reinforces positive emotions*, including feelings of self-esteem, appreciation, and satisfaction, thus acting as a potential health-protective resource (Siegrist and Wahrendorf 2016b).

A *first extension* of the model concerned gainful transactions in *close social relationships*, such as dyadic exchange in partnership or in parent-child relationship. Although altruism acts as a strong motivation in these relationships, role obligations are often unequally distributed between partners, triggering experiences of unfair exchange and disappointment. In severe cases, they can include broken promise, deception, or unfaithful behavior. In a large cross-sectional study in France, between 18% and 26% of participants reported relevant experiences of nonsymmetric exchange in partnership and in other trusting relationships, respectively, and these experiences were associated with reduced mental health functioning and poorer self-rated health (Wahrendorf et al. 2010). It is important to notice that the prevalence was particularly high among people with low socioeconomic status. Similar findings from four other investigations were summarized in a recent review (Siegrist and Wahrendorf 2016b).

A *second extension* of the model was applied to different types of socially productive, unpaid activities, such as *voluntary work, caregiving, and informal help*. As a common trait, such activities generate goods or services that are socially valued by the recipients, without involving a reimbursement of providers. In these cases, experiencing social reward deficiency in terms of lack of recognition and esteem is expected to generate negative emotions and stress reactions among providers. In fact, several studies corroborated this assumption, with the strongest negative effects in case of caregiving (Zaninotto et al. 2013; for review, Siegrist and Wahrendorf 2016b).

*Third*, effort-reward imbalance in unpaid role-based activities was studied in case of *household and family work*, mainly among mothers. To this end, a specific questionnaire was developed and tested, and several studies revealed negative effects on mental and physical health associated with this specific burden (Sperlich and Geyer 2016). In addition, some evidence of a social gradient was observed in these associations, where mothers with lower educational degree and single mothers were more strongly affected.

A *fourth extension* concerned *educational work*, where the mismatch between efforts spent and rewards received at school was of special interest. Adolescents in Chinese schools are considered a risk group, as China turned out to be one of the countries with highest levels of pressure and competition with regard to academic success (Li et al. 2010). Findings summarized elsewhere (Siegrist and Wahrendorf 2016b) demonstrated strong associations of this mismatch with depressive symptoms and suicidal ideation. In one study, a strong interaction of school-related stress and family socioeconomic status on depressive symptoms was observed. These relationships were also studied in other countries, and more recently, the model was further specified to analyze health-adverse effects among university students (Wege et al. 2017; Hodge et al. 2019).

In summary, despite some unique features of the social role of paid work, *core notions of the ERI model* were successfully applied to other types of socially

*productive activities* as well as to costly transactions in close social relationships and in educational contexts. A *wider generalization* of the model's assumptions resulted in *new explanations* of elevated risks of mental health and well-being. This evidence supports the notion that *social reciprocity in costly exchange acts as a fundamental principle* whose violation threatens social relationships and generates stressful experience with adverse effects on health and well-being. At the same time, this evidence calls for distinct policy interventions to improve a balanced exchange in socially productive activities.

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## Concluding Remarks

Research on *ERI* as a theoretical model of a health-adverse psychosocial work environment has been conducted for almost 25 years. By now, the model is established as *one of the leading approaches in this field*, as manifest by hundreds of related scientific publications. Perhaps most surprising is the fact that *three lines of generalizations* became apparent during this time. *First*, the model was applied to a *broad range of health outcomes*. At the individual level, these data include several measures of self-rated health, symptom load, disability, and well-being, distinct diagnosed mental and physical diseases and their somatic or behavioral risk factors, sickness absence and disability-related pension, general morbidity, and total or disease-specific mortality. Health-related outcomes with relevance to the organization were also explored, such as exhaustion and burnout, presentism, and absenteeism. As an important extension, biological markers of disease vulnerability were analyzed in experimental and quasi-experimental investigations, often using biological monitoring techniques in natural settings. Release of stress hormones, markers of immune competence and inflammation, and cardiovascular parameters were studied most often.

A *second* line of generalization concerns the model's application to *different socioeconomic, occupational, and sociocultural contexts*. While originally designed for employed populations in Western Europe exposed to industrial and postindustrial working conditions in the second half of the twentieth century, it was introduced to the study of working populations in different cultures, such as Japan, South Korea, Mongolia, or Saudi Arabia, and in rapidly developing countries, such as China or Brazil. With the advent of economic globalization and rapid technological change, effort-reward imbalance turned out to be relevant to precarious jobs, disrupted employment trajectories, and new forms of self-employment. In policy terms, a *crucial result of research* confirmed the model's significance for *describing and explaining health inequalities of working populations*, specifically with regard to its reward components.

*Third*, as described above, the hypotheses of the model were applied to *types of costly interpersonal transactions other than paid work* where social reciprocity matters. These types include household and family work, volunteering, caring and informal help, and close social relationships. Moreover, educational work in school and university settings was investigated. In these instances, it turned out that failed

reciprocity was associated with reduced mental health, while a balanced exchange was considered a resource of well-being.

Despite these achievements, *additional research is required*, both at the theoretical and methodological level. *Conceptually*, in response to increased flexibility and rapid change of modern work and employment conditions, this static model needs to be transformed *to identify dynamic aspects of nonreciprocal exchange*, applying a life course perspective. At the *methodological* level, optimal ways of analyzing the interaction of the model's components require *further statistical testing*. Moreover, the identification of clinically meaningful *threshold of scores*, including their standardization for different population groups, deserves further exploration although the analysis of *continuous data* allowing the study of dose-response relationships is often more appropriate. Yet, the *most pressing aspect* concerns *the model's application to practice*, as a screening and evaluation tool for occupational health and safety monitoring and reporting purposes and as a guide instructing the transformation of disadvantageous working and employment conditions into a health-conducive world of work. As was demonstrated, this transformation can occur at the individual, organizational, and national policy levels. Concerted efforts of scientists and responsible stakeholders are warranted to this end.

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## Cross-References

- ▶ [From National Labor and Social Policies to Individual Work Stressors](#)
- ▶ [Organizational Justice and Health](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress, Immune, and Inflammatory Markers](#)

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# Organizational Justice and Health

# 20

## Make Decisions Fairly and Treat People with Dignity

Marko Elovainio and Marianna Virtanen

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### Abstract

Group-level and organizational decision-making and interaction has long roots in social and organizational psychology. One of the leading theoretical constructs on the issue during the last three decades has been procedural or organizational justice, defining the decision-making rules that people perceive being fair and acceptable in a group or an organization. Only relatively recently organizational injustice has been studied as an occupational health risk, but the idea has inspired already a large body of research. In this chapter, some of the historical roots and more current research on the associations between injustice, health outcomes, and the potential mechanisms and limitations will be reviewed. Also some ideas

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© Springer Nature Switzerland AG 2020

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,

Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_15](https://doi.org/10.1007/978-3-030-31438-5_15)



will be provided for future studies on organizational justice as a part of larger system of psychosocial work environment.

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**Keywords**

Justice · Motivation · Stress · Mechanisms · Health

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## Introduction

The organization injustice model of work stress is based on a long tradition of research on social interaction and decision-making in groups. Originally ideas of fair decision-making and interaction were applied to managerial decision-making and employee satisfaction. However, during the past two decades, these ideas were also understood as psychosocial health risks.

In the work life context, as in any other context of social interaction, one crucial phenomenon is the distribution of positions, roles, and obligations. That means, on the one hand, distribution of tasks and responsibilities and distributions of resources and wealth, on the other. These are group-level phenomena which have been on the focus of social psychology research for decades, but in organizational health psychology, they are relatively new. Of the theoretical models of work stress, the “effort-reward imbalance” model was among the first models that was based on the idea of interaction of responsibilities and benefits or obligation and gratitude (Siegrist 1996), corresponding to the distributive justice theory. Effort-reward imbalance model defines the imbalance of efforts spent and rewards gained as the fundamental source of occupational stress. Effort-reward imbalance model is described elsewhere in this book, so it is not more fully presented here, but according to a large number of evidence, a perception of imbalance may lead to health problems and reduced well-being (Dragano et al. 2017; Peter et al. 1998; Siegrist et al. 1990).

Why is it important to determine justice at the workplace, how do people determine it, and why justice violations seem to be unhealthy? There are several other models in this research field, one of them *the organizational justice model of occupational strain* (Elovainio et al. 2001) which helps in understanding organizational dynamics and gives some answers to these questions. The model is based on the idea that it is not only a question of distributing resources and obligations but also the procedures and rules that guide the decision-making in the organization that matter. Studies of these rules and procedures have provided the basis for a new line of research that evaluates decision-making and social relationships in working communities, i.e., distributive, procedural, and relational justice that are the basic dimension of organizational justice. This review presents the development of research on organizational justice from the social and motivational psychological theories to a major line of research in modern work and organizational psychology. A summary of the research evidence is provided showing that adverse consequences of injustice not only include poor social atmosphere, reduced productivity, and well-

being but also more severe health outcomes. In the end some ideas will also be given how organizational justice and other work-related models should be evolved and analysed in the future.

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## Theories of Motivation and Social Interaction as Exchange

Why should anybody care about how decisions are made, how decisions are justified, and how people are treated in work organizations? Just like many other occupational health psychology theories and models, the model of organizational justice is based on the long line of theories of social and motivational psychology focused on the exchange and social interaction and group-level decision-making and how these processes affect the involved people. These basic theories include the frustration-aggression hypothesis (Dollard et al. 1939), balance theory (Heider 1946, 1958), the theory of relative deprivation (Stouffer et al. 1949), and the general theory of social exchange (Homans 1958).

According to the theories of social exchange, social interaction between human beings may be conceptualized as a form of social exchange or a series of exchanges, by which different types of expectations and rules are developed in all groups and communities. The expectations include reciprocity, understanding of modesty and equity, and the relationships between inputs and outputs. The stronger the formation of these rules in human communities, the more important they become, and they may even characterize the basic nature of groups and communities. The more recent theories of *social capital* (Kawachi et al. 2013) are strongly based on these concepts. It has been suggested that humans are highly sensitive to inequalities and other violations of rules in social exchange. When the rules are violated, people experience an imbalance between their input and the outputs, and this imbalance is affected by multiple and complicated sets of social rules and expectations. If people feel they do not get what they deserve and interpret situation as unfair, they are eager and motivated to restore the balance. The theories also suggest that employees' satisfaction with rewards such as salary or status is dependent not only on their absolute level of rewards but also on how employees compare their rewards with those of others in similar positions.

Adams' theory (Adams 1965) had a major impact on organizational psychology by emphasizing the exchange balance: when rewards are greater than investments, an employee feels guilty and, as a consequence, increases his/her investments. Alternatively, the investments can be revalued as more highly valuable than previously, which is another way of reaching the balance between inputs and outputs. When rewards, in turn, are lower than investments, the consequence is dissatisfaction and a reduction of investments, that is, work efforts or, if possible, seeking a new job where the balance is secured. Thus, the focus had shifted from a simple, individual-based imbalance approach to *rules and context*. People define their own balance to a large degree by comparing their rewards and investments to those of certain reference people, i.e., to those who are in a similar position in the occupational hierarchy. These ideas were, as it is easy to see, strongly based on

the idea that the motivating power behind human behavior is striving toward balance in all areas of life. Imbalance means psychological strain that in the long run may cause experienced stress and overload, and thus people are motivated to resolve the imbalance somehow as soon as possible. Although the focus in balance theory was on behavior, it also offered an explanation for the association between justice at work and health of employees, by defining psychological stress as a central mechanism associated with long-term imbalance. Later, the concept of *allostatic load* was introduced, referring to a state of psychological stress which is opposite to homeostasis (i.e., balance). It has been suggested that allostatic load is a major mechanism explaining the effect of psychological stress on both physical and psychological health (Brotman et al. 2007; McEwen 1998).

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## Organizational Justice: A New Psychosocial Predictor of Health

Following the long tradition of research on group-level decision-making in social psychology, theories of organizational justice have been based on two core concepts: (1) *distributive justice*, i.e., employees' perception of justice in rewards and benefits at work, largely according to Adams' work (Adams 1965), and (2) *procedural justice*, i.e., employees' perception of fairness in the principles and processes of decision-making leading to the distribution of rewards and benefits (Greenberg 1990; Leventhal 1976; Lind and Tyler 1988; Thibaut and Walker 1975). The core focus of organizational justice is, of course, in work life and organizational behavior.

There were several observation studies showing that people do not only react to the amount of reward but also to separate aspects of the decision-making process itself, for example, the relationship between different benefits, the question of whether all parties are equally treated during the decision-making process, whether rules are consistent, whether all parties are informed, and whether assessment is unbiased (Leventhal 1980; Moorman 1991).

Bies and Moag (1986) presented a new dimension of justice, *relational (or interactional) justice*, which is a separate aspect from distributive and procedural justice. They claimed that people are sensitive not only to the actual decisions or the procedures leading to decisions but also how their managers treat them during the decision-making process. People expect courteous, friendly, and respectful treatment from their managers irrespective of the nature of the outcome in the decision-making process. In sum, the modern concept of *organizational justice* includes three core components: distributive, procedural, and relational justice; the latter may further be divided into two (Colquitt 2001): *informative justice*, the extent to which information processes are fair in the organization, especially when implementing big decisions, and *interpersonal justice*, which also reflects whether employees perceive their treatment as respectful and appropriate.

The most recent literature of organizational justice research includes the research on motivational factors behind justice processes, perception and cognitive processes behind justice perceptions, and the consequences of injustice. Here, we focus on the health consequences; however, for those interested in other research lines, there are

very good presentations in the classic articles of Thibaut and Walker (Thibaut and Walker 1975) and Leventhal (Leventhal 1980)) and the first broader review book, *The Social Psychology of Procedural Justice*, which was written by Allan E. Lind and Tom R Tyler (1988) (1988). Justice as a psychosocial concept in work life fully emerged in the beginning of the 2000s when a number of reviews were published (Colquitt et al. 2001; Cropanzano et al. 2001). The topic was emerged for the first time in the *Annual Review of Psychology* in 2001 (Miller 2001), and the first *Handbook of Organizational Justice* (Greenberg and Colquitt 2005) was published in 2005. Organizational justice has become established as an important research area, with several more recent reviews published (see, e.g., Colquitt et al. 2013; Elovainio et al. 2010b; Sara et al. 2018; Whitman et al. 2012).

Most of the research on the consequences of injustice at work has focused on the relationship between justice and organizational behavior (Colquitt et al. 2005a, 2012) which has usually been defined as work performance, proactive *citizenship behavior* and retaliation, or unjustified absence. Distributive justice, procedural justice, and relational justice have all been associated with such outcomes (Colquitt et al. 2001, 2012). Associations have also been shown in relation to work and organizational commitment and turnover (Colquitt et al. 2001, 2013; Posthuma et al. 2007), job dissatisfaction (Colquitt et al. 2001), and perceived stress (Elovainio et al. 2001).

The theoretical justification to examine employee health as an outcome was strongly based on stress theories and especially those defining stress as imbalance between demands and resources (e.g., McEwen 1998) and control over important things in ones' life (Elovainio et al. 2001), suggesting a relationship between injustice perceptions and health outcomes. As in all epidemiological research, there are certain steps to be taken to provide and support a new hypothesis: to show (a) that the association exists, (b) that the association is not explained by third factors, and (c) that there are plausible mechanisms explaining the association. Next, the research evidence according to these steps will be shown.

## **Association Between Organizational Justice and Health Outcomes**

The first epidemiological study showing the association between justice perceptions and employee health was published in 2001 (Elovainio et al. 2001). This study was followed by another, with the title *Organizational Justice: a New Psychosocial Predictor of Health*, which for the first time focused on multiple health outcomes such as mental health and sickness absence (Elovainio et al. 2002). Organizational injustice perceptions were related to psychological distress through reduced control experiences, supporting the theoretical background. The results of the latter showed that the risk of medically certified sickness absence was 15–35% lower among employees who reported high organizational justice. Later studies have shown associations with sickness absence due to anxiety and depressive disorders (Elovainio et al. 2013a). A systematic review supported the hypothesized association of perceived injustice at work with mental ill health (Ndjaboue et al. 2012).

However, studies on mental health have mostly examined procedural and relational justice and, to a lesser extent, distributive justice. Some studies have focused on cardiovascular outcomes which were summarized in a review of review papers (Fishta and Backe 2015). One review included studies of organizational justice and cardiovascular diseases (Eller et al. 2009) and suggested that there was an association between perceived injustice and the incidence of cardiovascular disease based on two studies (Elovainio et al. 2006b; Kivimaki et al. 2005). Since then, a new review (Theorell et al. 2016) had found three new studies which had analyzed the association between organizational justice and cardiometabolic factors. A Swedish study examined the quality of leadership, including components of justice, and found an association between poor leadership and coronary heart disease (Nyberg et al. 2009).

The association between justice and health has been found repeatedly during the past two decades; however, large-scale studies are still lacking, such as individual-participant meta-analyses summing up and quantifying the research evidence. Moreover, interventions studies analyzing whether improving justice would lead to better health are needed.

## Plausible Mechanisms and Potential Confounders

When seeking answers to the question of why justice matters for health, we need to return to the theory of social exchange (Colquitt et al. 2013). The core concept of social exchange, *trust*, has been suggested to act as a mediating mechanism between justice and its effects; trust reduces insecurity and maintains reciprocity (Blau 1964; Colquitt et al. 2012; Van den Bos and Lind 2002). However, in their recent meta-analysis, Colquitt and his group (Colquitt et al. 2013) found more consistent support for *emotions* as mediating mechanisms. According to this viewpoint, perceived justice evokes strong positive emotions, such as enthusiasm and pride, whereas experiences of injustice evoke strong negative emotions, such as anger, anxiety, and guilt. In a classic work by Skarlicki and Folger (Skarlicki and Folger 1997), perceived injustice at the workplace was associated with increased retaliation, which was manifested as damaging of tools or work processes, verbal assaults on managers, stealing from the workplace, unjustified absence, doing private businesses during working hours, and smearing employer's reputation. To date, there is consensus that a combination of the social exchange theory and emotion viewpoint may be the most appropriate approach when aiming to proceed in organizational justice research and theory (Colquitt et al. 2013).

However, even strong emotions do not inevitably lead to health problems – they must get “under the skin”; thus, plausible mechanisms are needed. Researchers have sought answers from risky health behaviors, such as smoking, alcohol consumption, sedentary life style, unhealthy diet leading to weight gain, and poor sleep, as potential mechanisms. Indeed, a relatively large body of evidence shows that perceived injustice is associated with poor lifestyle such as risky alcohol use (Kouvonen et al. 2008), smoking intensity (Kouvonen et al. 2007), as well as

sleeping problems (Elovainio et al. 2009, 2003; Lallukka et al. 2017). A “non-randomized pseudo-trial” approach has been used to obtain more reliable evidence on direction of causality between organizational justice and insomnia symptoms (Lallukka et al. 2017). One study suggested an association between perceived organizational injustice and poorer cognitive function (Elovainio et al. 2012).

Another link may be related to physiological changes, which means that injustice-triggered psychological stress and strong negative emotions have a direct physiological link which, in turn, leads to adverse health outcomes (there are more detailed presentations about the potential physiological changes including metabolic and hormonal processes, so we do not go through them here). For example, perceived injustice has been associated with vascular dysfunction (Elovainio et al. 2006a), metabolic syndrome (Gimeno et al. 2010), and inflammatory markers (Elovainio et al. 2010a).

A shared etiology with stress and mental disorders suggests that mental ill health, such as depressive symptoms, may also be a mediating mechanism between organizational injustice and somatic health (Elovainio et al. 2011; Ferrie et al. 2006) (Inoue et al. 2013), although some studies have found that these associations may be bidirectional (Lang et al. 2011; Ybema and van den Bos 2010).

Residual confounding is always possible in observational studies, as those reviewed here. Therefore, the role of some plausible confounders has been assessed, such as individual perception styles and personality (Colquitt et al. 2005b). Some studies have aggregated the survey responses to work unit level. In those studies, work unit level procedural justice was associated with a lower prevalence of depression and anxiety among employees (Elovainio et al. 2013a; Kivimaki et al. 2003), supporting the idea that the justice perceptions are not biased by individual differences in personality or response style.

Justice as a shared perception was assessed in two studies focusing on Finnish secondary schools (Elovainio et al. 2011; Virtanen et al. 2009a). School personnel perceptions of procedural and relational justice were merged with a health and well-being survey carried out among students. The results suggested a shared experience of justice; when the school personnel rated high their possibility to be heard at school, the students responded in a similar manner in their independent survey (Virtanen et al. 2009a). Low procedural justice among the personnel, in turn, was associated with students’ dissatisfaction with school, and low relational justice was associated with students’ poorer school grades, as well as psychosomatic and depressive symptoms. Each form of injustice was associated with students’ truancy (Elovainio et al. 2011).

Hospital-acquired infections among patients in Finnish hospitals were a topic in another study using aggregated work unit scores of justice (Virtanen et al. 2009b). Personnel-reported poor trust at the hospital ward and injustice in the distribution of work tasks was associated with a twofold higher prevalence of hospital infections among patients. Poor leadership and trust may lay behind work stress which, in turn, leads to indifference among staff. Stress and lack of time probably reduce commitment to the most important principles of infection control, such as hand hygiene.

In another Finnish study, high procedural justice in primary health care centers was associated with better glucose balance among patients with diabetes (Virtanen et al. 2012), and in a UK study, procedural justice was associated with better commitment to treatment guidelines among personnel and better treatment in health centers. This was seen in more frequent blood pressure and glucose measurements, as well as counselling for weight control and self-treatment (Elovainio et al. 2013b).

This evidence suggests that organizational decision-making and processes are targeted at groups and the experience of justice is socially constructed. Indeed, recent advances in the research field investigate organizational justice as a collective, shared experience in work communities (Whitman et al. 2012). These studies are based on several theoretical frameworks, such as the *attraction-selection-attrition* theory (Schneider 1987), which postulates that the members of work communities metamorphose into a uniform group in their perceptions and understanding of justice over time. This is a consequence of a process in which deviating people leave the group. *Social information processing* and *fairness heuristic* theories suggest that employees in working groups seek signs of justice, especially in insecure and unclear situations, and discuss and share information in order to finally form a uniform interpretation (Degoey 2000; Lind 2001; Salanick and Pfeffer 1978). Whitman et al.'s systematic review summarized the evidence in 2012 (Whitman et al. 2012) and suggested that of the shared organizational justice climate perceptions, distributive justice was most strongly associated with work unit performance (e.g., productivity and customer satisfaction). Relational justice, in turn, was most strongly related to working unit processes, such as commitment to the workplace and cohesion in the working unit.

The reviewed evidence suggests that organizational justice may have large impacts beyond the employees and working units. These impacts might relate to the quality of work, and customers, students, or patients. Even though the analyses of working units seem promising, Whitman and his colleagues (Whitman et al. 2012) provide a new viewpoint in which a shared perception is based on a bilateral relationship between employees and their managers. This research line seeks to understand how, for example, the employee personality characteristics (conscientiousness and agreeableness) are associated with supervisor's behavior in the justice context (Huang et al. 2017). Supervisors' behavior is dependent on both cognitive appraisal and affective responses, both of which have been suggested to be affected by employees' personality characteristics. Therefore, there is no need to make a value judgement of research that separates individual and group experiences of justice; instead they can be seen as research lines that complement each other.

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## Next Steps in the Research of Organizational Justice and Health

Changing decision-making procedures toward increased justice may lead to many positive outcomes. Because people are sensitive in registering violations of justice in rules that direct social interaction and because these violations may have various adverse effects, fair procedures, information sharing, and treatment at the

workplaces are worth considering. As justice in decision-making is particularly important in organizational changes and times of insecurity (Brockner et al. 2007; Van den Bos and Lind 2002), justice is particularly relevant in contemporary work life with increasing speed of changes. However, relatively few intervention studies have been carried out to test whether improvement of justice leads to improvement in employee well-being and health. Many interventions have been targeted to justice perceptions, such as an RCT conducted in Japan, in which improvement in justice perceptions after management training was found among those employees who had the lowest ratings of justice (Nakamura et al. 2016).

The dimensions of organizational justice are not the only important psychosocial factors at work. So far, work-related psychosocial factors have been formulated and tested as relatively separate and clearly defined models that have been understood as complementary models concentrating on different aspects of work environment. All models are presented elsewhere in this book, and they will not be described in detail, but, for instance, the job strain model may be understood as focusing on physical and situational factors of work settings and arrangements, the ERI model on division of esteem and rewards, the Team Climate model on the quality of co-operation and social interaction at work, and the organizational justice model on decision-making procedures and managerial practices. In the future, it may be more useful to analyze psychosocial work environment not based on one or few core dimensions or latent structures but on a system of interconnected physical, social, organizational, cultural, affective, cognitive, and behavioral components. More specifically, every individual psychosocial factor may act as a potential component of psychosocial work environment, and those factors could be analyzed as a network of interconnected factors or as a unique “causal system,” the pattern of causes and effects that the component exhibits in relation to other components. Such components cannot change independently of one another, and, therefore, all factors form a network of mutual dependencies that may alternatively be causal, homeostatic, or logical. Thus, psychosocial factors at work could be conceptualized as a network of mutually associated characteristics and that the key feature of a given environment is the density and the architecture of the connections between individual factors forming systemic states. For example, work load affects the ability to control one’s work that, in turn, associates with the perception of the decision-making in the background of that situation and that sense of unfairness may not only affect the perception of control but also trust and uncertainty. It can also be expected that in those organizations where the connections between individual characteristics are strong, the potential adverse effects spread more quickly and easily (risky or vulnerable environments) than in those organizations where these associations are weak (resilient environments). These novel ideas require new statistical tools that have lately been rapidly evolved and applied to clinical and health psychology (Borsboom and Cramer 2013; Boschloo et al. 2016; Frewen et al. 2013; Fried et al. 2017; Kendler 2012; van Borkulo et al. 2015). Thus, it may be time to give up on developing separate models and begin a new era where work organizations are seen as systems of interrelated individual factors and their architecture.



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## Conclusions

In this chapter, we will review the current evidence regarding this idea and present some ideas for how to develop the theoretical ideas further. Although there is a large body of evidence supporting organizational injustice as potential health risk with plausible mechanisms including behavioral and biological factors, a more comprehensive frame that combines ideas from multiple other models would be useful in the growingly complex working life.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Sexual Harassment and Bullying at Work](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress and Adverse Health Behaviors](#)
- ▶ [Work Stress and Autonomic Nervous System Activity](#)
- ▶ [Work Stress, Immune, and Inflammatory Markers](#)

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# Psychosocial Safety Climate and Occupational Health

# 21

What We Know So Far

May Young Loh, Amy Zadow, and Maureen Dollard

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© Springer Nature Switzerland AG 2020

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*, Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_17](https://doi.org/10.1007/978-3-030-31438-5_17)

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## Abstract

Psychosocial safety climate (PSC) is a facet-specific organizational climate that relates to employee psychological safety and health. Since the proposal of PSC over 10 years ago, PSC has received significant attention from researchers interested in the effect of the meso-level organizational context and its relationship with occupational health and safety. The theory of PSC is an emergent phenomenon which proposes that organizations differ in terms of their prioritization of psychological aspects of individual's well-being over productivity imperatives. Empirical evidence relating to PSC theory has largely supported the notion that PSC is a lead indicator of workplace psychological health and safety, largely through its influence on the job design and socio-relational aspects of the work environment. To date, more than 62 research outputs, including books, journal articles, book chapters, and industry reports, have been published in relation to PSC theory and its negative relationship with occupational health issues using qualitative, quantitative, and meta-analytic research designs. However despite substantial evidence outlining the preeminent role of PSC as a predictor of psychosocial workplace factors, several questions remain to be answered. This chapter summarizes the propositions of PSC theory and empirical evidence relating to PSC to date. It provides an overview about what is known in the PSC literature and suggests further areas for exploration to expand on our understanding of the influence of meso-level PSC measured at the organizational and group level as a cause of the workplace conditions that affect workplace psychological health.

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## Keywords

Psychosocial safety climate · Occupational health · Psychological health · Organizational intervention · Employee well-being · Work stress

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## Introduction

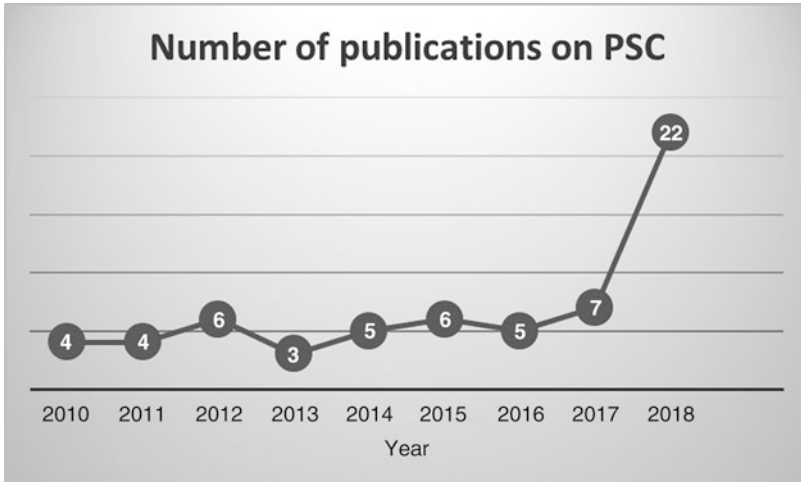
The Global Commission on the Future of Work 2019 proposes a **human-centered agenda for the future of work** by “placing people and the work they do at the centre of economic and social policy and business practice” (International Labour Organization 2019). In line with this, psychosocial safety climate (PSC) theory is proposed as an organizational value and structural framework that promotes decent work and prevents the development of the adverse work conditions that impact employee psychological health and well-being within workplaces. PSC is a domain-specific aspect of organizational climate related to the organizational priorities articulated and demonstrated in relation to employees' psychological health and safety at work

(Dollard and Bakker 2010). Identifying, measuring, and cultivating domain-specific organizational climates are important because evidence demonstrates that they influence behavior and health within organizations (Schneider et al. 2017). In short, employers who exhibit high concern about employees' psychological health are expected to develop and implement rules and regulations that balance the imperatives between productivity and employees' well-being. Hence, PSC is a fundamental element preceding the design of a psychologically safe workplace.

In comparison with traditional ideas about work stress that emphasize personal responsibility and individual coping strategies, PSC is derived from a notion that occupational health and safety is a product of the multilevel nature of organizations (Zadow and Dollard 2016; Hofmann et al. 2017). PSC researchers argue that the hierarchical nature of team, departments, and organizations influence the occurrence of stress through the way top management decide, assign, and set goals and job tasks. These decisions directly affect the level of workplace psychosocial hazards affecting workers such as work overload, job insecurity, tight working deadlines, extensive learning demands, and long working hours, in turn leading to poor psychological health. Aligned with the aim of the current handbook in exploring the multilevel influences on occupational health, the focus of discussion in this chapter will be on the meso-level influence of PSC, at the organization and team level, and this level of influence on individual occupational health outcomes. Although several papers measuring PSC at the individual level have found that high individual PSC is related to better individual health and more engaged working lives (Bailey et al. 2015a; Dollard et al. 2017), this chapter focuses on how PSC is conceptualized as a multilevel phenomenon, playing a role at the sociopolitical (macro-), organizational, and team (meso-)level, as a predictor of worker health and productivity outcomes. This chapter aims to outline PSC as a multilevel work stress theory and review the evidence supporting the PSC theoretical framework that has been established in the literature to date. At the end of this chapter, several suggestions and recommendations for the future investigation of PSC are canvassed.

While research investigating the PSC framework has specifically focused on PSC as a lead indicator that predicts workplace psychological health, engagement, and productivity, through the promotion of healthy psychosocial job design, the specific focus of PSC studies varies. A systematic review completed by Yulita et al. (2016) identified that 70% of PSC studies between 2010 and 2016 investigated the relationship between PSC and psychological health outcomes, focusing on emotional exhaustion (i.e., a core component of burnout), psychological distress, or depression. Physical health outcomes have also been investigated in PSC research including musculoskeletal pain, work injuries, and workers' compensation claims for physical complaints. Nonetheless, the development of PSC theory has received substantial amount of attention since then. In March 2019, 22 studies on PSC were identified using Google Scholar specifying a 2018 publication date using the keyword of "psychosocial safety climate." It is clear that PSC publications are growing since its introduction of PSC in year 2007 (see Fig. 1). Recent studies have extended PSC theory to individual needs, interventions, and cardiovascular disease.





**Fig. 1** Number of publications on PSC between year 2010 and 2018

## Why “Psychosocial” Safety Climate?

An important issue identified in the work health and safety literature is the articulation and measurement of the root cause of adverse employee safety outcomes. The occupational health literature initially focused on the individual causes of poor safety outcomes (e.g., individual safety behavior, motivation, and knowledge). Then several scholars suggested that safety within an organization is closely associated with its context, such as the climate of the organization. Organizational climate reflects on what employees perceive is valued and rewarded in an organization or team (Cox and Flin 1998; Zohar 1980). The notion of safety climate as a root cause evolved following incidents such as the Chernobyl nuclear explosion in 1986 that was attributed to the perceptions of employees that safety was not prioritized, leading to a range of emerging problems such as insufficient training and staffing to maintain the safety of the plant. The lesson learned from these events was that individual safety rules and regulations are not enough to ensure occupational safety, when there is a competing perception that safety is not a priority. Hence, the idea of safety climate was developed and has been proposed as a critical predictor for workplace safety (Hofmann et al. 2017). Undeniably, safety climate research has successfully helped improve employees’ health and safety for years, with research evidence demonstrating that a strong safety climate reduces the occurrence of workplace accidents and injuries and promotes safety behaviors (Jiang et al. 2019). However, coming into the new millennium, the nature of work has changed with the advent of technology, increasing pressure for productivity, profits, and growth, creating different demands (Korunka and Kubicek 2017), and leading to higher rates of workplace stress.

At the turn of the century, the leading theories of work stress were largely limited to proximal predictors of workplace stress such as job design (e.g., the job characteristics theory [JCT; Hackman and Oldham 1976], the job demands-control model [JDC; Karasek 1979], etc.). These established theoretical models have led the literature in work stress and other psychological health issues. Their main tenet is that the working conditions, which consist of both positive and negative job design, affect psychological health. On one hand, positive job design reduces the likelihood of psychological strains; on the other hand, negative job design would lead to the onset of psychological health problems (Bakker and Demerouti 2016; Lesener et al. 2019). Although this provides some initial understanding on how working conditions affect individuals, the design of a job is arguably driven from a higher level of influence, such as the organizational context (Parker et al. 2017), leading to a need for further investigation upstream.

One of most important concepts in the occupational safety literature is the role of the safety climate as a higher level influence affecting individual conditions in the workplace that impact safety outcomes (Hofmann et al. 2017). However, before the new century, studies of the safety climate in relation to occupational health were mainly focused on the physical safety features but neglected what has been called the psychological perspective. As noted by Zadow and Dollard (2016), there are two streams of inquiries in relation to occupational safety and health: (1) the work stress literature focusing on proximal and individual factors and (2) the occupational safety studies focusing on organizational climate and physical safety issues. The lack of convergence between these two areas inspired the development of a new work stress theory, that is, the psychosocial safety climate (PSC).

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## PSC Definitions and Domain

By definition, PSC is the shared perception of employees toward the organizational “policies, practices and procedures for the protection of worker psychological health and safety” (Dollard and Bakker 2010). This definition is derived from the traditional concept of organizational climate which have been proposed for nearly half of a century (Schneider et al. 2017; Schneider and Reichers 1983). Scholars argued that the early work on organizational climate focusing on the molar idea of organizational climate as a precipitator of a wide range of employee outcomes lacked specificity. They argued that it would be more effective to measure and promote specific climates for specific outcomes of interest, for example, safety climate to prevent occupational injuries. It was proposed that aspects of an organizational climate would have specific relationships that are directly aligned with the outcomes of interest and that these aspects should be measured specifically to ascertain their direct influence. For example, an organization may have a strong climate for the protection of physical safety but at the same time have a very weak climate for the protection of psychological safety. Aligned with the call for a “climate for something” (Schneider and Reichers 1983), PSC refers to a climate specifically for employees’ psychological health.

Organizations, or work units, with high PSC, are anticipated to have top management and leaders who give a higher priority to employees' psychological health compared to productivity imperatives. By exhibiting such a concern about protecting workers from psychological risks, management in high PSC organizations commits to implementing certain policies, practices, and procedures in relation to the protection of workers' psychological health, along with better communication and a clear demonstration of upholding the value of protecting psychological health. The policies, practices, and procedures of a high PSC organization are reflected in four main domains, namely, (a) management priority for psychological health, (b) management commitment and support for stress prevention, (c) organizational communication encouraging the voice of employees about psychological health concerns, and (d) organizational member, manager, and employees or their representatives, participation, and involvement in dealing with psychological health issues (Hall et al. 2010).

Management priority about psychological health entails the perception by employees that the management will always prioritize their psychological health as a more important concern than productivity. This indicates that during the completion of their work, employees perceive that they will not be expected to prioritize productivity imperatives that may place their psychological health at risk, such as taking on an excessively cognitively demanding workload without training and support to complete the tasks. Next, management commitment and support reflects the willingness of management to make decisions and undertake prompt action to correct threats to psychological health. An example would be the development of policies and procedures in the workplace to identify, intervene, and prevent bullying. Organizational communication is perceived by how much the organization promotes an exchange between the employees and senior management in terms of how psychological health issues affect them, via communication tools or reporting systems. Lastly, the organizational participation and involvement includes the participation or collaboration process by involving different parties including the employees, worker unions, and occupational health and safety representatives, in relation to issues that impact psychological health.

These four domains were initially summed up following an extensive review on the stress intervention process and safety climate literature by Dollard and Bakker (2010). They incorporate the main ingredients of what an organization should focus on when the development of high PSC is required. These theoretical domains were supported by qualitative interviews among Australian and Malaysian employees across different settings. Although some details of how PSC is being perceived and understood by the employees might be different, semi-structured interviews revealed that the high PSC context is characterized by these four elements. For example, McLinton et al. (2018a) conducted a qualitative study among South Australian frontline healthcare workers and found support for the four PSC domains. The researchers identified that there were six elements denoting a high-risk workplace with potentially low levels of PSC. These six elements included group expectations, exposure level, immediate manager leadership style, top level management involvement, communication, and conflicting pressures. Another study by Potter et al. (2019) again examined the four PSC domains

through semi-structured interviews among the managers in high PSC workgroups from university setting. Within these domains three major themes emerged from the interviews revealing that a high PSC group possesses (a) shared sense of meaningful work and social support, (b) high level of employee job crafting, and (c) middle management support for employee psychological health. The authors argue that these three themes reflect an enactment of all four PSC domains in the work setting. Using a sample from a different continent, Loh et al. (2019) in their study among 18 Malaysian healthcare workers supported the PSC domains of management priority, management support, and organizational communication with common themes within healthcare workplaces involving safety procedures, communication, and management involvement.

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### Measuring PSC: The PSC-12 Scale

PSC is measured by assessing employees' perception toward the organizations' policies and regulations in relation to employee psychological health. The most commonly used measurement of PSC was developed by Hall et al. (2010) consisting of all four subscales based on PSC theoretical principles. The scale was tested using three different samples of Australian employees (PSC was included in the broader psychosocial risk assessment tool – the Australian Workplace Barometer). Using a pilot study among 78 participants, Hall and colleagues shortened the original 26 items of PSC scale (Dollard and Kang 2007) into 12 items and further validated the scale by conducting the confirmatory factor analysis using the data from 398 Australian workers. The convergent and divergent validity of the scale was confirmed by using both the second and the third sample ( $n = 106$  Australian healthcare workers residing from 16 teams). The results showed that both individual and team-level PSC were related to job design (i.e., skill discretion, control, social support, and job demands) and employees' psychological health outcomes (i.e., emotional exhaustion, psychological distress, and depression). So far, the PSC-12 scale has been well-validated and widely used in most studies on PSC. This scale has since been translated into different languages including Chinese, French, Malay, German, Iranian, and Vietnamese.

Since the perceptions of work and individual response styles might be influenced by culture (Erez 2010; Iwata 2014), to further test the appropriateness of the PSC-12, researchers from Germany conducted a qualitative study to understand the appropriateness of using PSC-12 in a German context (Ertel and Formazin 2019). By using a cognitive evaluation approach, Ertel and Formazin (2019) interviewed the participants taking the PSC-12 and analyzed their cognitive appraisal during the process. According to the results, the researchers reworded some of the items to improve the clarity and increase comprehensibility within the German context. In addition to the revision of PSC-12 on German version, Ertel and Formazin (2019) noted some overlapping items from the PSC scale, suggesting a shortened version of the scale. In line with this, and in consideration of the practical utility of a shorter scale, Dollard et al. (2019) have proposed a new short PSC tool by reducing the

**Table 1** PSC domains and items in the PSC-12 scale

PSC domain	Items
Management commitment and support	1. In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health
	2. Senior management acts decisively when a concern of an employees' psychological status is raised
	3. Senior management shows support for stress prevention through involvement and commitment <sup>a</sup>
Management priority	4. Psychological well-being of staff is a priority for this organization
	5. Senior management clearly considers the psychological health of employees to be of great importance
	6. Senior management considers employee psychological health to be as important as productivity <sup>a</sup>
Organizational communication	7. There is good communication here about psychological safety issues which affect me <sup>a</sup>
	8. Information about workplace psychological well-being is always brought to my attention by my manager/supervisor
	9. My contributions to resolving occupational health and safety concerns in the organization are listened to
Organizational participation	10. Participation and consultation in psychological health and safety occur with employees' unions and health and safety representatives in my workplace
	11. Employees are encouraged to become involved in psychological safety and health matters
	12. In my organization, the prevention of stress involves all levels of the organization <sup>a</sup>

<sup>a</sup>Items included in the short PSC-4 scale (with permission, Hall et al. 2010)

PSC-12 to four items. Based on theoretical considerations, Dollard (2019) suggested four items, one from each domain, which could be used as an ultrashort PSC scale, and supported the veracity of the new scale with sound predictive validity and reliability using three time-lagged Australian samples. However, both the revised and the ultrashort PSC scales lack extensive empirical testing suggesting that more studies are required. In addition, while the German version of PSC scales might be useful within the German context, the idea of using cognitive appraisal approach could be considered by other researchers while undertaking PSC-12 in a different context or cultural background. Table 1 shows the PSC-12 domain and its items.

## PSC Versus Other Related Constructs

Ever since the proposal of PSC, debate continues about how PSC differs from other safety-related constructs such as the Zohar's safety climate, organizational support, and team psychological safety. Although early research on PSC established the discriminant validity of PSC with the abovementioned constructs (Idris et al. 2012), confusion

remains among the researchers. This can be seen from a constant need to explain and compare how PSC is distinct and even precedes some of the psychological safety-related concepts for nearly a decade (Mansour and Tremblay 2018; Huyghebaert et al. 2018a). Although these constructs, safety climate, organizational support, and team psychological safety are very similar to PSC, even sharing some characteristics, they are theoretically and empirically distinct from each other.

## **PSC Is Not Safety Climate**

Among these, safety climate is a traditional organizational climate that has been long introduced to the academic field. Zohar first introduced safety climate as shared perceptions that employees develop regarding the safety aspects of their working environment (Zohar 1980). Safety climate and PSC are distinct in at least three ways. Firstly, safety climate and PSC have different target outcomes. Different from PSC, safety climate has been always linked to the physical safety aspects and outcomes of the organization. Safety climate entails how employees perceive that their organization rewards, expects, and highlights safety-related behaviors over and above the productivity performance of an organization (Griffin and Curcuruto 2016). However, most of these “safety” features refer to the physical aspects of injuries, accidents, workarounds, etc. Secondly, the mechanism of how safety climate relates to safety outcomes is also very much different from PSC. While PSC is suggested as a lead indicator of job design (will be discussed shortly), safety climate is linked with individual behaviors, attitudes, and knowledge on safety (Griffin and Curcuruto 2016). The common tested link between safety climate and safety outcomes is through individual behavior such as safety engagement, safety compliance, safety knowledge, and safety motivation (Griffin and Curcuruto 2016). Thirdly, unlike PSC, the domain of safety climate is yet to reach a consensus (Alruqi et al. 2018). Many different domains have been studied in the safety climate literature and hence leading to an extent that safety climate researchers have difficulties on integrating these domains into a comprehensive, mutually agreed framework. Comparatively, PSC has a rather consensually theoretical framework with the proposed four main domains as discussed above.

Aside from the differences in theoretical viewpoints, several empirical studies have tested both PSC and physical safety climate simultaneously and concluded that PSC is the stronger predictor for job design and psychological-related health problems, while safety climate focuses more on the physical injuries and accidents, as well as physical safety behaviors. Recently Bronkhorst and Vermeeren (2016) conducted a multilevel cross-sectional study among a large sample of 8761 healthcare workers from 177 healthcare organizations in the Netherlands finding that PSC, but not safety climate, is associated with employees’ emotional exhaustion and other health outcomes. In addition, the researchers found no significant effect between safety climate and MSDs. They hence argue that PSC is more related to health outcomes, because safety-related outcomes such as injuries have mostly happened within a short timeframe and can be prevented through physical environment (e.g., good safety climate), but health outcomes might be due to long-term exposure to, for example, a low PSC context. In line

with this argument, PSC seems to be superior to safety climate in ensuring the sustainability of an organization and protecting employees' well-being in the future. In a similar vein, another study by Bronkhorst (2015) compared the difference between safety climate and PSC in terms of the moderation of the relationship between psychosocial job conditions and safety behaviors. Again, PSC showed a stronger moderation impact in influencing the effect of job conditions on safety behaviors compared to safety climate.

### **PSC Is Not Perceived Organizational Support**

PSC is also related to another concept called perceived organizational support (POS). Proposed by Eisenberger and colleagues in 1986, POS is defined as employees' "global beliefs concerning the extent to which the organisation values their contributions and cares about their well-being" (Eisenberger et al. 1986). PSC focuses on psychological health as a value in and of itself, alongside well-being. An additional difference between POS and PSC lies in the emphasis in PSC about the prioritization of employees' psychological health over productivity. Although PSC also contains the element of support from the organizational level, it captures a more comprehensive picture of "what" is being designed and provided by the organization in the effort to protect the workers' psychological health and well-being. The distinctiveness between POS and PSC is also presented in their assumptions. Underlying the theory of POS is the social exchange principle that emphasizes the expectations of mutual commitment between the employers and employees. Employees who receive adequate POS likely feel obligated to "return" the good deed of the organization by performing well in achieving organizational objectives or goals. Apart from the social exchange principle, PSC, as well as POS, is also more likely working as a resource that motivates the employees to strive within their workplace. In contrast to safety climate, the concept of POS is not often tested together with PSC. One example is Nguyen et al. (2017) who found that PSC is related to POS. Theoretically they argued, and were supported by their results, that PSC is a lead indicator of POS. Notably this study was conducted within a cross-sectional design, so the causal relationship between PSC and POS remain unconfirmed. Also PSC was more strongly related to engagement and well-being than POS. Another study is Idris et al. (2012) that have shown the empirical evidence on the differences between POS and PSC using a confirmatory factor analysis. Moreover, by using hierarchical linear modelling (HLM), organizational PSC was a better predictor of individual reports of psychological distress and emotional exhaustion than POS.

### **PSC Is Not Team Psychological Safety**

Another similar concept that is related to PSC is the construct, team psychological safety. This concept originally proposed by Edmondson (1999) shares similar properties with PSC in relation to its focus on the psychological well-being of the employees. Team psychological safety is defined as a shared perception of the employees toward psychological security in their workplaces. The central tenet of

team psychological safety is that an employee who is experiencing a high psychological safety in the work team will be able to perform effectively because they are free from the threat of psychological harm and are therefore able to engage in better learning processes (Edmondson 1999). There is a wide range of research linking team psychological safety with the performance of employees, innovation, and creativity (Edmondson and Lei 2014). The concepts of team psychological safety and PSC differ in significant ways. PSC is an upper-level phenomenon that focuses on employee-shared perceptions of the organizational or team context, an upstream multilevel influence. PSC is built upon the idea of organizational climate that highlights policies, practices, and procedures about the protection of psychological health within organizations. Team psychological safety, however, reflects a comfortable working environment characterized with interpersonal respect and trust that allows freedom to speak up and encourage positive behaviors (Walumbwa and Schaubroeck 2009). Nonetheless, some of the team psychological safety literature have used the term “psychological safety climate” to refer to the construct measuring at team level (Deng et al. 2019; Koopmann et al. 2016), creating more confusion with PSC. Note that in the PSC vernacular, psychological PSC refers to PSC that is observed by individual workers, whereas organizational or team PSC refers to PSC that is observed by a collective usually by aggregating individual scores to the organizational or team level. In fact, one of the articles with the title of “psychological safety climate” was actually operationalizing PSC in their study (Nguyen et al. 2017). However, little research has been conducted in comparing both psychological safety and PSC, with only one exceptional study that investigated the distinctiveness of PSC with all three constructs (Idris et al. 2012). Again organizational PSC was a better predictor of psychological distress and emotional exhaustion than team psychological safety (and POS).

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## The Propositions of PSC and Its Evidence

Since the first publication of PSC in 2010, the theory of PSC has been extended and revised. Several theoretical assumptions or propositions of PSC have been modified and integrated into the framework. In addition to the first book of PSC, published in 2019, PSC theory is now an established work stress theory that incorporates organizational climate within a multilevel work stress theoretical framework offering practical implications for the management of work stress within occupational health interventions. Table 2 summarizes the propositions of PSC theory, and Fig. 2 depicts the theoretical framework of PSC implied by the most recent PSC publications.

### **Proposition 1: PSC Is the Lead Indicator of Job Conditions and Social Relational Aspects at Work**

The first proposition of PSC theory is that PSC is the cause of the causes for work stress, particularly through job design (Dollard and Bakker 2010) and socio-relational aspects of work (Law et al. 2011). Job design can be further categorized into



**Table 2** Propositions of psychosocial safety climate

Proposition 1	PSC is the lead indicator of job conditions and social relational aspects at work
Proposition 2	PSC is an upper-level resource moderating the effects of job demands and/or negative social-relational aspects at work
Proposition 3	PSC is a safety signal encouraging the use of resources
Proposition 4	PSC is a pro-social ecology complementing job resources
Proposition 5	PSC influences individuals' well-being through needs fulfilling
Proposition 6	PSC is salient when there is a congruence between espoused and enacted PSC
Proposition 7	The influence of PSC is affected by its climate strength

two general but appositional aspects, i.e., job demands and job resources (Bakker and Demerouti 2016). On one hand, job demands refer to the job aspects that require continuous effort from the employees in dealing with them with certain costs to their physiological, psychological, and mental condition. On the other hand, job resources are those aspects of work that will help (1) deal with the demands of the job, (2) boost personal growth, and (3) accomplish organizational and job-related goals and tasks (Bakker and Demerouti 2016). Socio-relational aspects at work include the interaction between persons, such as social support and the experience of bullying. The central tenet of PSC theory indicates that if an organization is concerned about the psychological health of the workers, then certain actions are expected to be included during their decision-making process in assigning job scopes, tasks of the workers, and the expectations of the organizations, such as providing appropriate resources and reducing demands.

By extending the popular job design model, the job demands-resources (JDR) model (Bakker and Demerouti 2016), Dollard and Bakker (2010) argued that PSC influences employees' psychological health and well-being through two pathways, namely, the health erosion and the motivational pathways. The health erosion pathway suggests that negative job conditions will lead to negative consequences such as burnout, while the motivational pathway highlights the influence of positive job conditions on work engagement. PSC is proposed as the lead indicator of job conditions which increase job resources and reduce job demands. Several papers on PSC have examined this notion using multilevel modelling. An earlier study of PSC by Law et al. (2011) supported the notion of PSC as the predictor of job resources and job demands. Law and colleagues using a sample of 220 Australian employees from 33 organizations conducted a multilevel modelling analysis revealing the cross-level effect of PSC on employees' emotional exhaustion through a reduction on workplace bullying and harassment (social relational aspects). Later, Dollard et al. (2012a) further confirm the cross-level link between PSC, job characteristics, and psychological health by a two-wave longitudinal study design among remote area nurses ( $n = 202$ , Time 1;  $n = 163$ , Time 2) from 48 work teams. They found that PSC could predict psychological strain of the nurses after 2 years through its influence on workload, job control, emotional demands, and supervisor support. In a similar vein, Owen et al. (2016) with a sample of 850 employees from 119 Australian organizations found that organizational PSC showed a positive impact

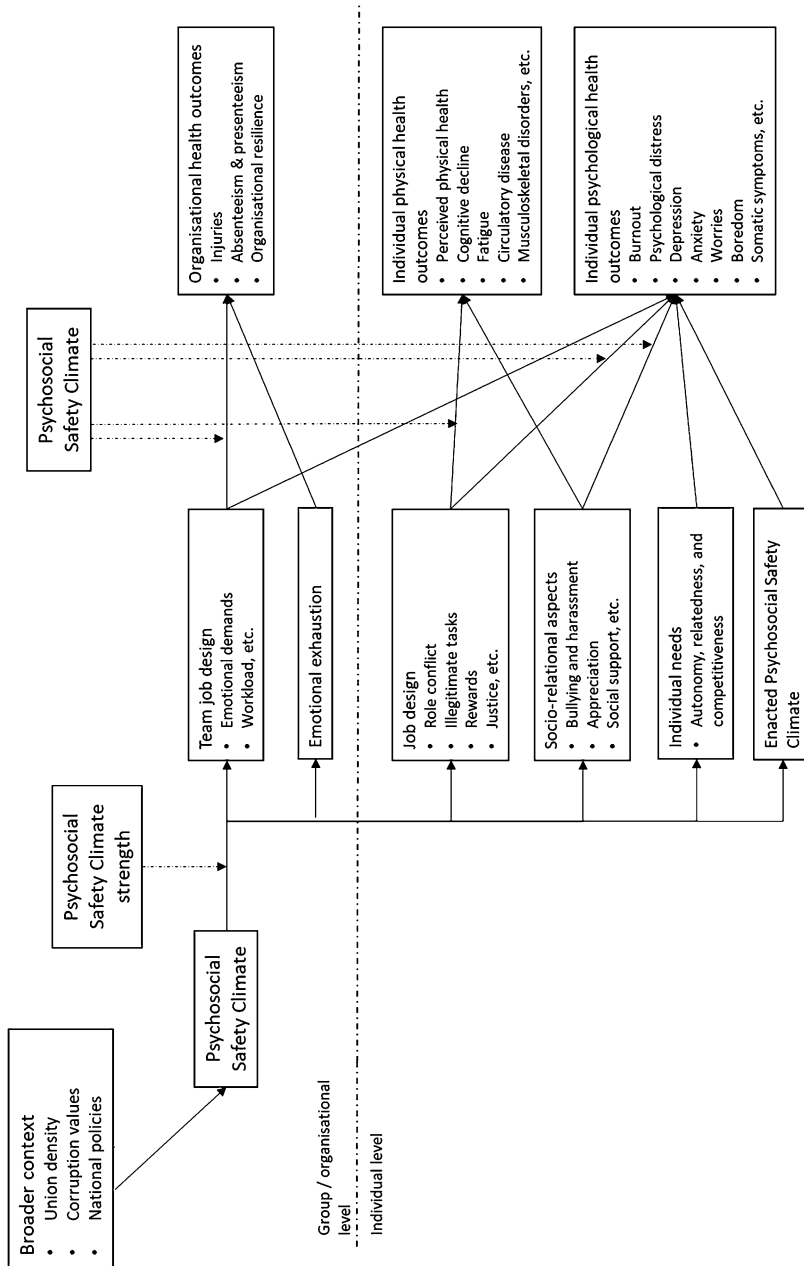


Fig. 2 PSC theoretical framework

on organizational rewards and negative impacts on organizational demands, consequently improving workers' satisfaction and physical and psychological health, respectively.

From a different cultural perspective, Idris et al. (2014) conducted a study among Malaysian employees and examined the mediational pathways between PSC, job characteristics, and change in employees' psychological health (i.e., emotional exhaustion, anxiety, and depression) after 4 months. They revealed the indirect effect of PSC toward employees' emotional exhaustion, but not depression, through emotional demands among 117 employees in 27 private organizations in Malaysia. By using boredom as the outcomes, Krasniqi et al. (2019) in their study among Malaysian employees tested the impact of PSC and job characteristics (i.e., emotional demands and supervisor support) at both individual and organizational level. The results showed that PSC was related to employee boredom via both individual and organizational emotional demands. Notably, only individual-level supervisor support, but not organizational-level supervisor support, mediated the relationship between PSC and job boredom. This indicates that supervisor support only explained the within-group variance of job boredom. Nonetheless, these studies have provided evidence about process and mechanism that PSC as a lead indicator related to psychological health (i.e., through job characteristics).

Some other research on PSC extended this by examining the impact of PSC on physical injuries. For example, Yulita et al. (2014) sought to understand how PSC is linked to two distinctive types of job demands (i.e., challenging and hindrance demands). Theoretically, PSC as a lead indicator of favorable job design should be able to increase challenging demands and reduce hindrance demands. In their empirical results, the researchers found that PSC as an upper-level phenomenon led to a reduction in hindrance demands, but did not increase challenging demands, among 909 Malaysian policemen, which in turn influenced the development of physical health issues. This study has also extended the link of PSC to its effect on the physical aspects of occupational health. Some other evidence on the role of PSC on the development of physical injuries is seen from Zadow et al. (2017). In their three-wave longitudinal study ( $n = 214$ , 18 teams), they found that PSC was related to registered sickness absence via job conditions and emotional exhaustion. In a similar vein, McLinton et al. (2018a) found some empirical support on the role of PSC in the development of work injuries through violence exposure and musculoskeletal disorders (MSDs) among 288 healthcare workers from 26 teams.

### **Proposition 2: PSC Is an Upper-Level Resource that Moderates the Effects of Job Demands and/or Negative Social-Relational Aspects at Work**

Different from the predictive function of PSC, far less attention has been given to the secondary function of PSC and its moderating effects. In the JDR model, job resources possess the functions of reducing the harmful effect of job demands. Likewise, in PSC theory, PSC may be referred as a job resource located at an

upstream level, since it may buffer demanding working conditions. The reason is PSC reflecting the organizational view on what are the desirable behaviors, attitudes, and outcomes. High PSC organizations are expected to be an environment characterized with high resources in assisting the employees to complete their daily job tasks and achieve the organizational goals. Some studies on PSC as a moderator have yielded interesting and significant results. Of the moderating effects of PSC, scholars so far have investigated three types of moderating functions: (1) PSC as the moderator of the relationship between job demands/socio-relational aspects and psychological health outcomes; (2) PSC as the moderator of the buffering effect of job resources on the relationship between job demands/socio-relational aspects and psychological health outcomes; and (3) PSC as a resource passageway that begets job resources and creates a resource caravan (Hobfoll et al. 2018). In other words, PSC works as a moderator boosting effect of job resources on protecting and improving employees' health outcomes.

The first moderating function of PSC is where PSC acts as a job resource itself. Explained by the conservation of resources (COR) theory, individuals feel stress when there is a loss of resources – a demanding working environment would be a likely cause. This situation could be avoided by having adequate resources to compensate the loss situation. PSC could help to reduce the impact of demands by acting as an upper-level resource that allows the employees to cope with the situations. Employees work under a high PSC environment experiencing a psychological security due to the emphasis of psychological health of the organization. The sense of security hence helps the employees to tackle with the challenges and hindrances at work. Bronkhorst (2015) conducted research among healthcare workers in the Netherlands ( $n = 6230$  from 52 organizations) revealing that PSC moderated the relationship between job insecurity and safety behaviors. She argued that when there is high PSC, employees tend to behave safely even under the pressure of high job insecurity. In addition, the study also found that PSC could improve the functions of job resources by encouraging safety behaviors.

### **Proposition 3: PSC as a Safety Signal Encouraging the Use of Job Resources**

While job resources have been well established as an effective moderator of job demands (Bakker and Demerouti 2016), scholars are interested to know what might enhance or hinder the function of job resources. This idea was tested by proposing PSC as the “moderator of the moderators” of the relationship between job demands and its outcomes (Loh et al. 2018) – a three-way interaction between PSC, job resources, and job demands. Two mechanisms could be used to explain how PSC serves as an important boundary condition for job resources, namely, the safety signal theory or the resource passageway. Firstly, PSC as a safety signal (Loh et al. 2018) provides cues about the psychological safety in a workplace to approach, utilize, and request more resources. As a working environment that exhibits concern about psychological health, resources are often available and may be easily assessed

in a high PSC context. If a supervisor cares about their subordinates, they would be willing to help or provide constructive feedbacks to the employees. As such, the employees would be able to obtain the necessary resources to deal with their job demands. Conducting research among Australian policemen from 23 police stations, Dollard et al. (2012b) suggested that a contingent environment is the key for the robust effect of job resources in reducing the detrimental effect of job demands. Using a two-wave longitudinal multilevel design, they revealed that emotional resources are able to moderate the relationship between emotional demands and emotional exhaustion under the conditions of high PSC only. Even if resource levels were high, they could not be used functionally to reduce emotional demands if PSC was low. The result was again tested with a split sample and confirmed the notion of PSC as a safety signal.

#### **Proposition 4: PSC as the Pro-Social Ecology Complementing Job Resources**

Apart to be a safety signal, PSC is aligned with theory of COR on resource passageway because it could help to develop more resources in workplaces. In the central tenet of COR, resources tend to tie to each other to create a resource caravan (Hobfoll et al. 2018). Resource caravan passageway is a concept where the social ecology of an organization is useful for resources accumulation, utilization, and bolstering the effect of resources. Under this assumption, Loh et al. (2018) found that PSC acts as a resource caravan passageway which may bolster, compensate, and complement the effect of other resources in the workplaces. In a sample of 429 Malaysian healthcare workers from 53 workgroups, Loh and colleagues conducted hierarchical linear modelling using two-wave longitudinal data. The three-way interaction between team-level PSC x rewards x emotional demands was found to predict employees' somatic complaints, but not emotional exhaustion. Results showed that somatic complaints were at worst when there were both low PSC and low rewards and least reported when both PSC and rewards were high. This reflected the role of PSC in compensating the effect of rewards. PSC did not act as a safety signal in this instance. Rather PSC provides a condition that facilitates the formation of other resources by encouraging more resources to connect and link with each other. The positive ecological condition of PSC allows resources, such as rewards, to achieve their optimal function. For example, when rewards are provided to the employees, under a high PSC environment, it would, more likely, bind with other resources such as fair rewards and positive respect from co-workers and supervisors rather than contempt. So high PSC creates a resource caravan. Hence, in this case, authors found rewards show greatest effect toward individuals' health outcomes, while PSC was reported as high within the team. Notably, the authors only found the interactive relationship between rewards and emotional demands happen at the same time point (cross-sectionally rather than time-lagged). They have provided arguments as to why this might happen. They also found that PSC was the best moderator of emotional demands, compared to decision authority and rewards.

### **Proposition 5: PSC Influences Individuals' Well-Being Through Needs Fulfilling**

Apart from the working condition pathways as explained above, researchers have started to explore how PSC as a work context could affect individual's psychological condition by exploring the relationship of PSC to individual needs. Based on self-determination theory (SDT), Huyghebaert and colleagues conducted several studies in relation to PSC and how it might link to needs thwarting or needs fulfilling among employees, in turn affecting their psychological health (Huyghebaert et al. 2018a, b). SDT posits that individuals possess innate psychological needs, including the need for autonomy, relatedness, and competences. Failing to fulfil these needs will lead to a negative consequence in one's motivation and psychological well-being. In their study among French healthcare nurses, they found that PSC is a factor leading to need fulfilment and reducing need thwarting. Using the idea of SDT, PSC provides an environment that helps to protect individuals via fulfilling their needs. Although these studies that attempts to uncover the psychological mechanism of how PSC leads to positive well-being relied on individual-level data, but suggests a possible mechanism regarding how and why PSC relates to worker psychological health (i.e., through need fulfilment/reduced need thwarting). These individual needs can be viewed as personal valuable resources, which are explained by COR theory. According to the principles of COR theory, individuals strive to protect and invest resources, and hence by fulfilling individual needs, this allows resources gain and reduces need thwarting and protects individuals from the circumstances of resource loss and to be more resilient.

### **Proposition 6: PSC Is Salient When There Is a Congruence Between Espoused and Enacted PSC**

The issue of enacted (i.e., what had been done) and espoused (i.e., what have been said) theory was raised by researchers who underscored the need of alignment between the two (Zohar 2010). Aligning with the concept of value enactment, scholars suggest that by aligning the talk and the action, one could experience positive outcomes. Taking the exemplar of PSC, espoused PSC reflects the policies and procedures that have been introduced and implemented in the organization largely by senior management and enacted PSC means the organizational policies and procedures that have been put into practice by middle managers and supervisors. In their diary study among 109 Malaysians across five consecutive workdays, Yulita et al. (2017) studied the link between team-perceived PSC (i.e., espoused PSC), enacted PSC, and workers' psychological health (i.e., emotional exhaustion). They operationalized daily supervisor support as the enactment of PSC and argued that when working under a high espoused PSC context and high supervisory support on a daily basis, the perception of concern toward employee psychological health is amplified. In their study, the interaction between espoused and enacted PSC had a negative impact on emotional exhaustion. Levels of emotional exhaustion were

lowest when there was high PSC and high supervisor support, in other words, congruence between the espoused and enacted climate. This indicates that when tangible action is taken to practice espoused policies and procedures for workers psychological protection, the influence of PSC may be optimized.

### **Proposition 7: The Influence of PSC Is Affected by Its Climate Strength**

Another interesting construct in the organizational climate research is climate strength. Climate strength reflects within-group variability in climate perceptions. It is conceptualized as the degree of agreement among the employees on the climate of an organization. The operationalization of this construct could be measured by the standard deviation of employee perception or by using some indexes such as the  $r_{WG}$ . In their initial study attempt on PSC climate strength, Afsharian et al. (2018) argued that the level of climate strength is important to predict or understand the employees' behaviors in the organization. High climate strength reflects a high homogenous perception among the employees on the working environment. Stronger climate strength would enable one to improve the understanding of the context and hence gain a better understanding or encouragement in engaging on the expected behaviors, in turn leading to positive outcomes. Aligned with the proposition of PSC as the safety signal, high PSC climate strength is expected to strengthen the influence of PSC toward individuals. By using the standard deviation (SD) of PSC, Afsharian and colleague examined whether that climate strength would moderate the influence of PSC on working conditions, emotional exhaustion, and work engagement. However, as opposed to their expectations, they found that PSC climate strength only moderated the relationship between PSC and working conditions on work outcomes (i.e., work engagement) but not emotional exhaustion. They suggested that PSC level itself might be salient for the prediction on working conditions and psychological health. Nonetheless, there are limitations of using SD as the indicator for dispersion model; hence, more empirical studies are needed to test this proposition.

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### **Research on PSC Across Different Cultures**

Throughout the development of PSC theory, studies have been conducted across different nations and cultures. While the earlier studies of PSC have mostly originated from Australia and Malaysia, some studies emerged from other countries. The majority of these studies have focused on PSC within a healthcare setting. For example, Bronkhorst and Vermeeren (2016) studied PSC among 8761 healthcare workers from 177 organizations in the Netherlands. Through a test of multilevel structural equation modelling, the authors found that PSC predicts the organizational absenteeism and presenteeism (i.e., going to work despite feeling unwell) via collective emotional exhaustion and MSDs within the organization. Notably Bronkhorst and Vermeeren (2016) also tested physical safety climate in their study

yet were unable to find any statistically significant relationship between physical safety climate and MSDs. They therefore suggested that physical safety climate might be more relevant to safety outcomes compared to health outcomes (i.e., MSDs). In another cross-national study, McLinton et al. (2018b) have reported the mean scores of PSC in the Australian and Malaysian healthcare settings. In comparison, both Australian and Malaysian healthcare workers have reported a lower PSC level than those from other industries suggesting the importance of paying attention to the psychological well-being of healthcare workers. In another continent, Afsharian et al. (2018) investigated PSC levels in hospitals in Iran. From their study, they suggested that the level of PSC is lower in Iranian hospitals compared to those in Australia. Yet their study confirmed that the theory of PSC could be applied to the Middle East context supporting the cross-cultural implication of PSC. Again, in a different cultural background, Pien et al. (2019) revealed that there is a relationship between PSC and perceived health of 1690 Taiwanese nurses from 73 hospitals. Again, they have found the overall mean score of PSC in the healthcare setting in Taiwan (PSC = 34.1) was lower than the established benchmark of PSC (PSC = 41). They noted that the differences between the score of PSC might due to the societal values and the different cultural backgrounds which will be discussed in the following section.

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## PSC from a Broader Context

Risk management within an organization is influenced by the macro factors such as the labor market policies, societal values, and norms. The current public values on the societal issues are expected to affect the leadership of an organization as well as the implementation on the organizational policies. The formation of organization cultures and norms is largely influenced by the external societal system (i.e., social, cultural, and economic factors are all related to this system) due to the constant interaction and connection with the policies of the government or other national agencies. For example, union density was found to be a national-level predictor of workers' health (Dollard and Nesar 2013). Workers' unions are expected to represent the workers and protect workers' welfare and likely influence pro-social workplace policies; hence union density was related to PSC levels across 31 European countries (Dollard and Nesar 2013).

Another study extended the investigation of the link between national factors and PSC in organizations by focusing on a social issue, corruption. By using secondary data, Dollard and Jain (2019) retrieved information about corrupt values in society, PSC, and workers' health of 31 European countries. From a multilevel analysis, they have found a negative link between corrupt values and the level of PSC at a national level, in turn leading to workers health and well-being. Studies also found a link between government policy and PSC level across Australian states and territories. Potter et al. (2019) conducted a comprehensive review on the current psychosocial risks-related policy documents in eight jurisdictions in Australia. They noted that Victoria has the most established and detailed policies on handling psychosocial



risks factors at work. Linking this to their earlier work in 2017, Potter et al. (2017) have investigated the data of Australian workers on their PSC level. Victoria has reported the second highest in their overall PSC level. The phenomenon provided new insights on the relationship between national policies and PSC.

## Practical Implications of PSC

### PSC Benchmarks

It is often a challenge to translate theory into practice. For the purpose of on-site practice, PSC researchers conducted several tests and suggested PSC risk benchmarks for the workplace to avoid job strain (future high demands, low control) and depression. Bailey et al. (2015b) determined that an organization with the total score of PSC  $\geq 41$  could be categorized as a low-risk group for job strain and depressive symptoms, while PSC  $< 37$  is considered as high-risk, and some interventions might be required. From their study, the researchers also suggested that by increasing the PSC level beyond 37, the population attribution risks (PAR) of job strain and depressive symptoms could be reduce as much as 14% and 16%, respectively. A few years later, Dormann et al. (2017) added on a critical value to the benchmarks of PSC. By using a continuous time structural equation modelling, Dormann and colleagues reported that PSC  $\leq 26$  would predict a doubled risk on clinical depression. Taken both studies into account, several benchmarks may be used to identify the status of an organization as very high risk, high risk, medium risk, or low risk of job strain (see Table 3).

### Stress Intervention

Work stress intervention has been a challenge to the occupational health experts and practitioners. The target of the interventions has usually focused on either the

**Table 3** PSC range score, risk level of organization, and prognosis

Risk level	PSC range	Prognosis
Low risk	PSC $\geq 41$	<i>Performing well, improvements in PSC levels might be noted; increased leader performance in PSC</i>
Medium risk	41 < PSC > 37	<i>Steady state, need more enacting of PSC principles</i>
High risk	37 $\leq$ PSC > 26	<i>Increasing PSC levels from low could reduce depression by 16% and job strain by 14%</i>
Very high risk	PSC $\leq 26$	<i>Urgent action required to prevent further dramatic increases in depressive periods, worsening conditions (e.g., increased bullying)</i>

Note: © Bailey and Dollard (2019)

individual or organizational structures. Individual-focused interventions target on improving the personal coping strategies of the employees and helping them adapt to the working environment. Yet, recent researchers challenge this approach and have moved toward the organizational intervention (Nielsen and Miraglia 2017). Different to the individual intervention, organizational stress interventions aim to address occupational issues at the primary level by tackling the root cause of the work stress, which generally refers to the working condition. Given that PSC is the lead indicator of working condition, it is expected that by incorporating PSC framework will help for an effective intervention (Dollard 2012).

Several attempts have been made to improve PSC in workplaces (Haar 2018; Rasdi et al. 2018). Dollard and Karasek (2010), for example, described how PSC could be nurtured from the actions, process, and progress of a participatory action approach. In line with these initial findings, Rickard et al. (2012) reported that PSC was increased after an intervention of improving communication, reducing workload, and increasing resources was implemented. However, this result was limited to one out of two participatory hospitals in the study. Adding to this is the unexpected results reported by Dollard and Zadow (2018). In their study, Dollard and Zadow (2018) described and reported the preparatory phase of an intervention. The preparatory phase included the educational workshops in identifying stress and coping strategies. These educational workshops did not improve the organizational PSC at the post-test assessment which was not surprising given no changes were yet made to policies, practices, or procedures. Another intervention study among nurses at Australian remote area showed similar findings (Lenthall et al. 2018). These contradictory results would guarantee a further exploration on what could help to improve PSC in the future.

Researchers have also suggested the best practice of how an organizational management could design and implement an intervention in managing the psychosocial risks at work. Bailey and colleagues published the PSC hierarchy of control (PSC-HOC) that provides a guideline on how to integrate PSC theory into real practice (Bailey and Dollard 2014). The PSC-HOC has been suggested as a practical tool to help practitioners develop interventions that would be helpful in tackling psychosocial risks factors at work. Starting from the values of senior management to job design to individual factors, PSC-HOC consists of several stages that required the attention from top management to manage stress issues at workplace. Strategies can be developed according to each level, and PSC could be a useful measure in assessing the effectiveness of the intervention.

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## Summary and Where We Should Move from Here

In summary, research on PSC to date has revealed the theoretical pathways of how PSC influences employees' health through job design and other mediators. The latest research on PSC has also uncovered new mechanisms involved in the link between PSC and employee health. Different research methodologies have been applied (e.g., cross-sectional and longitudinal design, diary studies, analytical review,

multinational study, and mixed methods) to justify the notion of PSC as a lead indicator and boundary condition of a favorable working condition and psychologically safe environment. Several reviews on PSC studies have further provided an extensive summary on the PSC research (Yulita et al. 2016; Zadow et al. 2019). The first book of PSC has also been published, establishing additional evidence on the roles and importance of PSC in different work settings and nations, expanding the theory beyond the JD-R framework (Dollard 2019). Despite that, some unanswered questions still remain, in relation to the antecedents of PSC and the time it takes for the emergence of PSC and so on. In their final chapter of the PSC book, Dormann et al. (2019) raised six issues that require further research attention:

First, they called for more “shortitudinal research” by incorporating shorter time interval between the multi-waves of data collection.

Second, aligning with the hierarchical influence within an organization, they suggest researchers to examine PSC at different levels.

Third, expanding the variables used in PSC research beyond the JD-R model.

Fourth, studying PSC across different cultures, context, and nations.

Fifth, integrating PSC with other objective measurements, such as blood flow and registered data such as the medication history.

Sixth, investigating the complementing organizational characteristics such as the ethical climate.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [The Demand Control Support Work Stress Model](#)

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I am indebted to John M. Levine for his helpful comments on an earlier version of this chapter.

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_18](https://doi.org/10.1007/978-3-030-31438-5_18)



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**Abstract**

In addition to having a positive view of oneself (personal self-esteem), being valued by significant others (social self-esteem) is a central human concern that corresponds to the need to belong. Violating the need to belong, encountering relational devaluation by being derogated, excluded, attacked, etc. implies a threat to self. This chapter argues that offense to self through relational devaluation constitutes a major element of many conflicts, and this offense goes beyond the individual and includes social identities. Triggers of relational devaluation are mainly investigated in research on aggression (in a broad sense, i.e., including incivility). Relational devaluation typically induces anger, which, in turn, induces a desire for retaliation. Targets of anger and retaliation, again, often go beyond individuals and include their social groups. To the extent that retaliation is enacted, spirals of mutual relational devaluation can develop. Escalation processes are characterized by such aspects as polarization, conflict enlargement, shifting goals, and increasingly automated appraisals. Issues of self-defense become progressively dominant as compared to substantive issues, and communication increasingly contains “added messages” of devaluation. More and more, conciliatory behavior entails the risk of losing face. Conflict management therefore should focus on core issues and avoid added messages, employ a flexible repertoire of behaviors regarding styles of conflict management, and aim at cycles of tension and tension release to mitigate offense to self. The chapter ends with a consideration of circumstances in which potentially offending others may be unavoidable and with emphasizing the role of a culture of respect for adequate conflict management.

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**Keywords**

Conflict · Offense to self · Relational devaluation · Entitlement · Retaliation · Added messages · Cycles of tension and tension release · Culture of respect

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**Introduction**

Protecting and enhancing a positive self-view is one of the most fundamental human concerns, and it implies a need for being treated with respect and dignity by significant others (Alicke and Sedikides 2009; Leary et al. 2006). Conflicts are likely to threaten self-worth, particularly if they elicit strong emotions, notably emotions related to being offended, and if they include behaviors that contain messages of relational devaluation (Leary and Allen 2011). The approach presented in this chapter contends that perceiving threat to the self is a major element in the development of conflict, which also needs to be taken into account in conflict management.

This chapter will draw not only on the conflict literature “proper” but also on literature on aggressive behavior and on negotiation, as both deal with processes important for our topic and conflict escalation involves behaviors investigated in the context of aggressive behavior (Raver 2013). Furthermore, research and theorizing

about the importance of offenses to the self in the context of stress at work are pertinent for our purpose (Semmer et al. 2019). This chapter does not attempt to give a systematic account of the literature on conflict. Rather, it limits itself to highlighting those aspects that are related to offenses to the self.

The chapter is structured as follows. The first part offers a definition of conflict and shows that affect is an important part of many, if not most conflicts. The chapter then emphasizes the importance of protecting and enhancing a positive self in general and the central role of threats to the self by behaviors that convey a message of relational devaluation, a core concept in this chapter. Threats to the self constitute an attack on people's identity, which includes social identity that is based on belonging to groups one identifies with. There are many ways that relational devaluation can be expressed, the impact it has, and the ways people try to ward off the offense to self associated with it. Based on these considerations, mechanisms of escalation are described, followed by suggestions of how considering potential offenses to the self can help manage conflict.

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## Conflict

Conflict “begins when a Party (..) feels that others did or will do something that negatively affects the Party's interest, opinions and beliefs, or norms and values” (De Dreu 2014, p. 1). A frequent classification of conflicts postulates a dichotomy between *task* conflict (i.e., disagreement about the best way to accomplish a task) and *relationship* conflict (interpersonal tensions and animosities; Jehn 1997). Extensions of this dichotomy include *process* conflict as disagreements on how to do things and who is responsible for what (Jehn 1997) and *non-task organizational conflict*, which refers to such issues as company policy, benefits, hiring decisions, or power (Bruk-Lee et al. 2013).

Other classifications also see conflicts evolving around different issues, in terms of *interests* (i.e., involving scarce resources, such as money, status); *intellectual* problems (agreeing on the correct solution for a problem for which such a solution, at least approximatively, exists); and *evaluative* problems, which involve agreeing on what is morally adequate or just (Harinck et al. 2000; Van Kleef and Côté 2018).

The various classifications of conflicts (for an overview see Jehn 2014) show quite some overlap, and the different types of conflict tend to be interrelated. Thus, task and relationship conflicts often co-occur (De Dreu and Weingart 2003), and the effects of one of them may depend on the intensity of the other (Meier et al. 2013a). Furthermore, conflicts referring to “correct” solutions (intellectual, task-related, cognitive) often develop into relationship conflicts (Friedman et al. 2000; van de Vliert 1998; Yang and Mossholder 2004).

An important characteristic of the different types of conflict is often seen in a differential likelihood for strong emotions to develop. Conflicts referring to “correct solutions” (e.g., task conflict) are expected to be less likely to involve strong emotions (and more likely to foster problem-solving and compromising)

than relationship conflicts (Weingart et al. 2015) and conflicts involving value-laden issues (Bazerman et al. 2008; Stöckli and Tanner 2014).

This issue of emotions is of central importance for this chapter, as it contends that the emotions involved typically are related to offenses to the self. It therefore is important to note that including emotional intensity in the conceptualization of conflict issues likely represents an unjustified confound. Although some conflict types are more prone to involve strong affect than others, any conflict can involve emotions but none has to (Jehn and Bendersky 2003; Weingart et al. 2015). At one extreme, a party may deal with a conflict of interest in a strategic, unemotional way (“cold” conflict). At the other extreme, a conflict may be “hot” and involve strong negative and aggressive feelings, such as anger and even hatred, against the other party (Allen and Anderson 2017; Neuman and Baron 2005), and these are not limited to relationship conflicts. Disagreements about tasks (or “correct solutions”) may involve strong emotions because people may be offended if their position is being challenged, implying a threat to their self-image as being competent (Maltarich et al. 2018; Meier et al. 2013a). Seeing one’s own view prevail may well be regarded as “winning” (Levine and Thompson 1996, p. 746), implying self-affirmation; not surprisingly, therefore, affirming one’s position without proper scrutiny of disconfirming evidence is especially likely under self-threatening conditions (Butera et al. 2018).

The focus of this chapter is on “hot” conflicts that clearly involve emotional reactions. It is contended that the type and intensity of emotional expression in conflict behavior and the intensity of emotions felt may often be even more important than the specific issue around which the conflict evolves (Weingart et al. 2015). And it will be argued that a (perceived) threat to the self induced by derogatory messages, referred to as “relational devaluation” by Leary and Allen (2011), is a major element for the development of strong emotions and the development of conflicts. As noted above, this approach requires the consideration of research on aggressive behavior and retaliation, as well as negation research, because this literature deals with the communicative acts that signal offenses to the self in a more specific way than much of the conflict literature (Raver 2013).

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## **The Concern for High Self-Esteem and Relational Devaluation as Offense to Self**

The importance of offense to self in conflicts is based on the fact that protecting and enhancing the self and the concern for high self-esteem is one of the most fundamental concerns humans have (Alicke and Sedikides 2009; Leary et al. 2006). On the one hand, people strive to build and maintain a positive self-image in terms of their personal self-evaluation; the personal self is threatened by personal failures or wrongdoing. On the other hand, a positive social self is maintained if one is acknowledged, accepted, and respected by significant others (Semmer et al. 2019). The terms used with regard to social self-esteem differ widely, referring to concepts such as “relational value” (Leary and Allen 2011), “face” (Ting-Toomey

and Kurogi 1998), appreciation (Semmer et al. 2019; Stocker et al. 2014), or respect (Grover 2014; Miller 2001; Rogers and Ashforth 2017; van Quaquebeke and Eckloff 2010); there is widespread agreement, however, about their importance. Threats to the social self stem from relational devaluation and therefore violate the need to belong (Leary and Allen 2011); they are in the focus of this chapter.

A core facet of being accepted and respected is to be treated in a just (or fair) way. Justice has a distributive, a procedural, and an interactional aspect (Cropanzano et al. 2001; Deutsch 2014b). Distributive justice refers to outcomes (do I get what I deserve?), procedural justice refers to the way outcomes are determined (are decisions made in a way that is fair and unbiased?), and interactional justice refers directly to how one is treated and thus emphasizes respect and dignity. People tend to feel they are generally entitled to respectful and fair treatment (Miller 2001), and how fairly one is treated is an indicator of one's worth and dignity (Bies 2015; De Cremer and Tyler 2005; Miller 2001; Rogers and Ashforth 2017). In conflicts, the self often is offended by a lack of respectful or fair treatment, which signifies "relational devaluation" (Leary and Allen 2011). Because fair treatment is seen as the normative default, it follows that relational devaluation, that is, feeling put down, abused, disrespected, treated unfairly, or excluded, constitutes an offense to self and therefore is stressful (Leary et al. 2006; Semmer et al. 2019).

## **Offense to Self Through Relational Devaluation: Forms, Impact, and Reactions**

This part discusses the many different forms relational devaluation can take; this draws from literature on aggressive behavior (in a broad sense, i.e., including low-intensity behaviors such as incivility; Hershcovis 2011) and on justice and retaliation (Tripp and Bies 2009). Describing the impact of relational devaluation and ways of dealing with it, this part prepares the discussion of the importance of relational devaluation in conflicts.

### **Forms of Relational Devaluation**

Relational devaluation comes in many forms (Hershcovis 2011); among them are discrimination on the basis of one's characteristics, such as age, race, or sex (Dipboye and Colella 2005; Jones et al. 2016); being ignored and excluded (ostracism; Pereira et al. 2013; Williams and Nida 2011); receiving inappropriate feedback (Baron 1988; Krings et al. 2015); not being granted privileges that one feels entitled to (Mikula and Wenzel 2000); and being exposed to aggressive behavior (Neuman and Baron 2005; Nielsen et al. 2016). Aggressive behavior ranges from comparatively mild, mostly verbal and nonverbal "uncivil" behavior (Andersson and Pearson 1999; Cortina et al. 2017) to strong forms of aggression, such as mobbing/bullying (Zapf and Einarsen 2005), and outright physical aggression (Neuman and Baron 2005). Note that relational devaluation often goes beyond simply being disliked; effects on aggressive tendencies are stronger if they also involve rejection, which implies a stronger offense to self (DeBono and Muraven 2014).

In addition to the wide range of forms of relational devaluation, offending messages of devaluation can be expressed in different ways. They do not necessarily have to be expressed directly and explicitly, as in insults. Rather, relational devaluation may be conveyed indirectly. For instance, one can signal exclusion and devaluation by not passing on an important information, by assigning illegitimate tasks, by not mentioning someone's contribution to a successful project, or by leaving a mess that others have to clean up (Pearson et al. 2000; Semmer et al. 2016). In fact, signs of devaluation may be conveyed in a great variety of behaviors, events, and circumstances. Given that the concern for a positive self-view is so pervasive, people are likely to continuously scan the environment for cues related to self-worth. It is likely that signs of (potential) relational devaluation are detected even at rather mild intensities, as the scanning "should operate continuously (or almost continuously) at an unconscious or preattentive level" (Leary and Baumeister 2000, p. 14). Semmer et al. (2019) therefore speak of a kind of "fire alarm" that detects information related to the self among competing stimuli even if it is rather subtle. Note that such monitoring processes are characteristic not only for individuals but also for groups, which often are highly sensitive to indications that the group's social identity may be threatened (Levine and Kerr 2007).

Given that self-threatening messages come in so many intensities and forms, it is difficult to develop a specific catalogue of behaviors as a criterion for specifying relational devaluation; rather, it is the social meaning of behaviors in a specific context that counts. In this chapter, a violation of entitlements is regarded as the core characteristic of self-related offenses; this aspect will be developed below.

In the tradition of the psychological literature on aggression, such triggering events represent hindrances to attaining valued goals, and thus frustration, which is associated with negative affect, notably anger (Berkowitz 1989; Fox and Spector 1999). Although frustration does not simply induce aggression, as originally postulated (Dollard et al. 1939), it does tend to induce negative feelings, notably anger, which often result in a *tendency* to react in an offensive way, even though a number of conditions have to be present for this tendency to actually be translated into offensive behavior (Averill 1997; Berkowitz 1989, 2003; Fox and Spector 1999).

### **Relational Devaluation and Social Identity**

Relational devaluation refers not only to individual characteristics (Levine and Kerr 2007). If people are part of a social group they value, they tend to develop a social identity. Being part of this group shapes their sense of who they are and fosters self-esteem (Haslam 2004). Categories that are sources of social identity are, for example, one's profession, one's organization, national or regional background, minority status, or gender. Such social identities often are cherished and a source of self-worth; if the group providing the social identity is derogated, individuals identifying with that group likely experience an offense to self. A salient social identity may even take priority over individual identity; this can go along with deindividuation, which implies that the individuals see themselves more as group members than as individuals.

A strong social identity is based on the perception of “us” and “them” and contributes to ingroup conformity and (perceived) ingroup homogeneity, to polarization regarding outgroups (“we are very different from them”), and to a positive evaluation of the ingroup as compared to outgroups (Haslam 2004). A strong social identity also contributes to viewing actions of the ingroup, and of ingroup members, as justified, and to blame outgroups, and outgroup members, for negative occurrences. Therefore, social identity plays an important role in conflicts. For instance, social identity processes may lead to “vicarious retaliation” (or “vicarious retribution”; Lickel et al. 2006), in which members of an outgroup are punished for alleged misdeeds of members of that outgroup, even if those who are punished have not been involved in the perceived provocation and the individuals who are punishing are not personally among the victims (who, however, are members of their ingroup).

Under threat to their social identity, group processes may develop into “groupthink,” a condition in which group members strongly enforce conformity and discourage disagreement and doubt while derogating the outgroup and believing in the moral superiority of the ingroup. Such groupthink typically results in a lack of careful evaluation of actions of the ingroup, whose success is taken for granted, and of the outgroup, which is seen as so incompetent and weak that it is believed to be incapable of defending itself effectively (Janis 1982; Turner and Pratkanis 1998).

### **Impact of Relational Devaluation**

Obviously, how people feel when experiencing offense to self through relational devaluation, as well as their reactions, can vary considerably. Intense, long-lasting, and regularly occurring harassment such as mobbing/bullying directed specifically against the focal person can have far-reaching consequences akin to post-traumatic stress disorder (Zapf and Einarsen 2005). On the other hand, singular and less intense experiences of devaluation may not leave long-term consequences – although they may well induce strong negative feelings, notably anger and sadness, in the immediate situation (Williams and Nida 2011). If one’s (work) environment is characterized by frequent and chronic relational devaluation, the risk of many kinds of negative effects increases; among them are depression, distress and low satisfaction, counterproductive work behavior, work withdrawal, and turnover intentions, but also lower task performance and creativity as well as helpfulness (Cortina et al. 2017). Furthermore, effects of relational devaluation may spill over into private life and increase work-to-family conflict, decrease marital satisfaction, and impair recovery after work (Cortina et al. 2017; Schilpzand et al. 2016). Also, effects are not limited to those who are direct targets; rather, witnessing others being exposed to relational devaluation may have negative effects, even if the person itself is not targeted (Meier et al. 2013b).

In sum, offenses to the self induced by relational devaluation can have a strong impact, both on the individual and the collective level. Such impacts have implications for the development of conflict, mainly because they entail strong negative affect. Most importantly, they can elicit anger and related reactions such as irritation, annoyance, or even hatred. Anger arguably is the most important single affective

reaction that may trigger retaliation, an important aspect of conflict escalation (Tripp and Bies 2009).

## Dealing with Relational Devaluation

Dealing with the negative affective consequences of relational devaluation also comes in many different forms; they typically aim at protecting and restoring one's self-esteem. Restoring self-esteem can be accomplished by processes such as focusing attention on positive aspects of the self (Steele 1988), by engaging in self-serving attributions, that is, attributing negative events or outcomes to external forces (Alicke and Sedikides 2009), but also by derogating others (Fein and Spencer 1997).

Attempts to restore self-esteem also can involve verbal or behavioral acts of revenge or retaliation, such as petty theft, reducing performance and attendance. Insulting, ridiculing, and derogating others and talking about them in a negative way are frequent manifestations as well (Cortina et al. 2017), and so are other forms of aggressive behavior (Schulte-Braucks et al. 2019; Spector and Fox 2005; Tripp and Bies 2009). Some of these behaviors may be quite indirect, sometimes even not recognized by the target. An example is a secretary who learns that her supervisor may run into problems but does not warn her because she is offended by the way her supervisor treats her. Such indirect forms of revenge tend to be chosen when dealing with "offenders" who are more powerful (Pearson and Porath 2005; Tripp and Bies 2009), whereas the more powerful usually can express their anger with less restraint (Pearson and Porath 2005).

Dysfunctional behaviors are often reactions to experienced relational devaluation, but they also constitute relational devaluation themselves. It is important to note that people tend not to see themselves as instigators of incivility or other forms of relational devaluation; rather, they regard themselves as those who *react* to others' improper behavior (Helmond et al. 2015; Rosen et al. 2016; Tripp and Bies 2009; Vahle-Hinz et al. 2019). These tendencies are important for conflict spirals and conflict escalation; they imply justification for one's own behavior but not for that of opponents, and that may go along with an erosion of "attention to standards of conduct" (Pruitt 2008, p. 250).

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## Relational Devaluation as a Core Element of Conflict

The approach presented in this chapter does not imply that all kinds of aggressive behavior involved in conflicts are triggered by relational devaluation and thus an offense to self. People may enact such behaviors because they are frustrated for reasons that have nothing to do with the target of their behavior (displaced aggression; Pedersen et al. 2017) or because they use aggressive behavior as a means to obtain valued goals (e.g., a promotion) in a "cold," unemotional way (Allen and Anderson 2017). Nor does feeling relationally devalued lead to revenge *necessarily*. People may ignore the offensive behavior; they may forgive it; they may

accept an explanation or an apology; and they may avoid the instigator; control their anger; leave the situation; or simply do nothing (Cortina et al. 2017; Domagalski and Steelman 2005; Leary and Allen 2011; Mikula and Wenzel 2000; Tripp and Bies 2009).

However, it is claimed that offenses to the self in the context of relational devaluation frequently are important triggers of behaviors that signify the existence of a conflict. In addition, they often fuel and contribute to conflict spirals.

Many authors in this field share this view. Tripp and Bies (2009, p. 24) propose a model according to which “the conflict begins when an offender somehow harms, mistreats, insults, or generally offends the victim. This offense is the *trigger* of revenge.” Andersson and Pearson (1999, p. 462) regard the point at which “at least one of the parties involved in an exchange of incivilities perceives an identity threat” as the tipping point, which prompts “a more intense behavioral response by the threatened party. . . .” Baumeister, Bushman, and Campbell (2000, p. 26) advance a “theory of threatened egotism, which depicts aggression as a means of defending a highly favorable view of self against someone who seeks to undermine or discredit that view.”

Thus, although it may constitute neither a necessary nor a sufficient condition, a threatened ego can be considered an important ingredient of many conflict situations, and efforts to defend one’s ego (e.g., by retaliating) can be an important element of conflict escalation.

## What Triggers Relational Devaluation for Whom?

In the following, perceiving relational devaluation is conceptualized in terms of not respecting entitlements (Mikula and Wenzel 2000). The discussion centers around the nature of entitlement, around the role of blame, and around individual differences.

### Entitlements

Obviously, the many forms of relational devaluation described above will not be perceived the same way by everyone. The question is: Who perceives what as relational devaluation? And this question must be asked on an individual as well as on a collective level. In our view, the most promising approach to this question is the issue of entitlement, which refers to something people “believe is rightfully theirs” (Miller 2001, p. 533). Being denied something one feels entitled to constitutes injustice, and thus an offense to self (Mikula and Wenzel 2000; Miller 2001).

Entitlement can refer to many different issues, including being treated in a civil and respectful way, respect for one’s occupational role, respect for a group or organization one belongs to, but also for one’s honor, status, property, privileges, and reputation. Entitlement beliefs can be based on shared standards but may also include “undeserved” privileges (Mikula and Wenzel 2000); for instance, one characteristic of narcissistic people is that they feel entitled for special treatment.



Thus, if people feel entitled to privileges, they will feel offended if these privileges are not granted; if they feel entitled to ownership (which may range from a parking space to land for cultivation), they may be offended by someone transgressing into “their” property (see Ayoko and Härtel 2003); if they feel they have the right to give orders that are followed without questioning, they are likely to feel offended if these expectations are not fulfilled, etc.

Cultural values determine to a large degree to what people feel entitled to. Thus, the idea that everybody deserves respect (Miller 2001) characterizes egalitarian cultures, and people in these cultures are likely to be sensitive to being treated respectfully (Leung and Cohen 2011). By contrast, in cultures with high power distance, defined as “the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally” (Hofstede 2011, p. 9), people in powerful positions are regarded as being entitled to privileges that are not granted to the less powerful. It also implies that the powerful need not justify their actions to the same extent as would be expected in cultures with less power distance and those lower in the hierarchy are more ready to accept behavior that would be considered unfair, and thus as implying relational devaluation, than in cultures with less power distance (Gudykunst and Ting-Toomey 1988).

Norms about status exist at various levels of culture, including subcultures, which may be organizational, professional, regional, etc. Status may be inherited, for instance, by noble descent or by belonging to the family of the owner of an enterprise, or acquired through membership in a highly respected group (e.g., medical doctors), by having a superior position in an organization, or by personal characteristics (e.g., being famous for one’s professional achievements, contributions to society, or special virtues). Status provides the entitlement to be treated in an appropriate way, and not receiving entitlements may induce an offense to self and trigger conflict.

Cultures also define which entitlement norms are especially important, and therefore especially offending if not respected. Cultures of “honor” as well as cultures of “face” tend to be very sensitive to insults, and even subtle signs of disrespect may trigger conflict. In “honor cultures” tolerating insult implies losing one’s honor; thus, people may retaliate in order to preserve their honor, and not retaliating would in itself constitute a threat to self (Leung and Cohen 2011).

Feeling offended by disrespect for one’s entitlements is considered appropriate if the entitlement corresponds to cultural norms, and frequently these norms also specify the reaction that would be appropriate (Averill 1997). If people feel overly entitled and display so-called entitlement behavior, their behavior itself becomes a source of relational devaluation, and thus an offense to self, for others (Hackney et al. 2018); obviously, such behavior may fuel conflict.

### **The Attribution of Blame**

An important aspect of perceiving a relational devaluation and being offended is the attribution of blame. Blame includes that someone is held responsible for inappropriate behavior, assuming that this person, or these persons, could, and should, have acted differently (Cropanzano et al. 2001). In some cases, such as

explicit insults, it is obvious who is to blame. In other cases, however, it is less clear who is to blame or even if anyone is to blame. For example, if a machine breaks down and those working with it suspect that the previous shift must have noticed there was a problem but left it for the next shift (an illegitimate stressor; Semmer et al. 2019), this suspicion, and the corresponding blame, may or may not be correct. Even if it is clear who is responsible, the intentions of this person, or these persons, may not be clear, which also influences blame. Thus, an offending remark may reflect an offensive intention, but also carelessness, or lack of social skills; this problem is reflected in research on incivility, which is defined as an offense with “ambiguous intent” (Pearson and Porath 2005).

The problem is that attribution processes, and this includes the attribution of blame, tend to be biased (Tripp and Bies 2009). Specifically, people are more likely to blame others for negative events, whereas they attribute negative events connected to their own actions to circumstances (self-serving attribution; see Harvey et al. 2014; Mezulis et al. 2004); this tendency is enhanced under self-threat (Campbell and Sedikides 1999). Such processes also operate at the collective level. Thus, positive attributions are more likely when judging ingroup, as compared to outgroup, members (Chatman and Von Hippel 2001), and the tendency to attribute negative events to negative intentions is greater when outgroup members are involved (Halabi et al. 2015; Haslam 2004). If tensions between the groups already exist, these attribution tendencies, as well as associated tendencies for strong retaliation, are likely to become even stronger (Rozmann and Walsh 2018). (Note, however, that deviant ingroup members who are perceived as threatening the social identity of the group may be evaluated in an especially negative way; Levine and Thompson 1996; Pinto et al. 2010.)

### **Individual Differences**

On the individual side, there are person characteristics that support blaming others, such as a hostile attribution bias, narcissism, and low agreeableness (Spector 2011). Furthermore, there are characteristics that support especially strong affective reactions to offenses, such as an exaggerated sense of entitlement, which is characteristic of people high in narcissism (Meier and Semmer 2012; Morf and Rhodewalt 2001), high values on trait anger (Spector 2011), or especially strong “justice sensitivity” (Schulte-Braucks et al. 2019). Finally, there are characteristics that support a rather unregulated expression of hostile impulses, as when people have low self-control in general (Morf and Rhodewalt 2001; Spector 2011) or when their self-control is momentarily diminished, for instance, under conditions of “ego-depletion” after stressful situations that already required high self-control (Barlett et al. 2016; Stucke and Baumeister 2006).

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### **Mechanisms of Conflict Escalation**

The preceding parts have introduced many ingredients of situations that may induce conflict due to an offense to people’s individual or social self. The initial situation may be characterized as a conflict *episode*. Many, if not most, of these episodes go by

without escalating into larger, and persisting, conflict, whereas other episodes trigger a conflict escalation. So, the question arises as to what are the mechanisms that foster, or prevent, conflict escalation. These mechanisms are likely to change over time if a conflict persists; the focus will first be on initial triggers of conflict and then on mechanisms involved in escalations when a conflict is established.

## Initial Triggers

The initial trigger of a conflict can be a frustrating event, which refers to an “interference with a person’s goals or ongoing activity” (Spector and Fox 2005, p. 156). The immediate reaction to frustration is likely to be anger. Anger is especially likely if this interference is attributed to inappropriate behavior of others. Furthermore, anger may also induce a tendency to search for someone to blame (Berkowitz 2003), and, like other emotions, it may act as an “amplifier of moral judgments” (Horberg et al. 2011).

Anger is an emotion that instigates a tendency to “get even,” to act in an aggressive way (Averill 1997; Berkowitz 2003), and this tendency may be directed against the people judged to be responsible but also against people who are part of those people’s social group; furthermore, it may lead to “displaced aggression,” which “refers to retaliatory aggression that is misdirected from an initial source of provocation and turned instead upon an innocent other” (Pedersen et al. 2017). Such reactions are likely to be the stronger the more the ego is involved (i.e., the more the self is offended), which, again, depends on entitlements not being respected. People often regard these aggressive impulses, and the offensive behavior they might induce, as constituting a *reaction* that is justified by the opponent party’s inappropriate behavior. But the same applies to opponents, implying that they might classify their offensive tendencies and behaviors as a *reaction* as well. This is the problem of “punctuation,” referring to the issue of what is believed to be the starting point of a sequence of events – which in conflict typically is the others’ behavior (Tripp and Bies 2009). Once such a sequence of accusations is established, there are strong forces toward escalation, because each party is continuously confronted with a “need” to retaliate.

As mentioned above, not all aggressive impulses result in aggressive behavior (Schumann and Ross 2010), as people may decide to ignore, or forgive, the offensive behavior, or opponents may display reconciliatory behavior; group members often find many ways to avoid conflict escalation (Levine and Thompson 1996). In other cases, anger and resentment (and the desire for retaliation) may persist, but there is no opportunity to strike back without a high risk for punishment and failure, for example, if the opponent party is more powerful. In such cases, people may delay their response but wait for an opportunity to strike back later, when an opportunity arises that is associated with less risk of being punished (Pearson and Porath 2005; Tripp and Bies 2009). If offenses occur repeatedly without an opportunity to get even, resentment may build up and eventually lead to an attempt to attack the power of the perceived instigators, for instance, by a joint protest, strike, or political

pressure (Berkowitz 2003). Another possibility is that the anger builds up to such an extent that it “eventually breaks through” inhibitions against aggression (Pruitt 1998, p. 488), which diminishes the tendency to calculate the consequences of one’s actions.

Keeping in mind that escalation into intense, or long-standing, conflict is not automatic, the following discussion will focus on the mechanisms that are typical elements of such escalations, with a special emphasis on offenses to self due to relational devaluation.

## Conflict Escalation

As conflicts escalate, an escalation spiral can develop into a “self-reinforcing, destructive process” (van de Vliert 1998, p. 369). Conflict escalation is typically characterized by an increasing intensity of a conflict that gets more and more difficult to stop. Pruitt (1998, pp. 486–487) characterizes conflict escalation by the use of “contentious tactics” with an increasing intensity, going from requests to demands, complaints, and angry statements to threats, harassment, and abuse. If groups are involved in conflicts, they have the tendency to escalate more strongly than individuals, as shown by research on interindividual-intergroup discontinuity (Cohen et al. 2010; Meier and Hinsz 2004).

However, there is more to this escalation process than increasing intensity. First, the longer such a cycle of “negative reciprocity” has been going on, the higher the risk of “conflict entrapment,” characterized by an escalation of “commitment to a failing course of action in order to justify prior investments in the conflict issues and in the previously chosen reactions” (van de Vliert 1998, p. 364). This commitment makes it more and more difficult to reverse the course of action, to make compromises, etc., as people run the risk of losing face if they do. Not enforcing one’s position therefore becomes ego-threatening, and protecting the self has been identified as “one of the most powerful drivers” of such conflict entrapment (Sleesman et al. 2012, p. 554), indicating the importance of continued perceived offense to self in driving conflict escalation. This process can be observed in conflict among individuals as well as groups. Conflict escalation and entrapment between groups is often reinforced by factors such as a strong connection of the identity of the organization or powerful leaders to the issue at hand (Sleesman et al. 2018). Social pressures, incentive structures, and constraints set by rules and procedures may further support conflict escalation (Thomas 1992). Such influences increase the threat of losing face by appearing weak because of being too conciliatory.

An ongoing escalation spiral often entails some qualitative changes in appraisals, convictions, behavior tendencies, and goals; many of them are again driven by offenses to the self. Glasl (1982) developed a model of conflict escalation involving nine stages during which such qualitative changes occur. It contains three “main phases” with three stages each. During phase I (Stages 1–3), “the parties are aware of the latent and manifest tensions and antagonisms but try to

treat them in a rational and controlled way.” (p. 124). In phase II (Stages 4–6), “stereotyped images are built up and confirmed by ‘self-fulfilling prophecies’... Distrust, lack of respect, and overt hostility evolve...” (p. 127). In phase III (Stages 6–9), “the other party no longer represents any kind of human dignity... How to hinder the other side becomes a goal in itself” (p. 130). The last phase constitutes rather extreme escalations that are not very likely to be found in organizations. The nine stages are described in more detail in Glasl (1982), Glasl (1999), and Jordan (2000).

To our knowledge, no empirical confirmation of Glasl’s model exists. Indeed, stage models are difficult to confirm empirically, as many of the processes described may happen not during the phase they are attributed to, but earlier or later. It therefore may be more informative to look at the processes involved, without declaring them as part of a given stage.

One can extract six mechanisms from descriptions of conflict escalation, including Glasl’s model; they refer to polarization and simplification, devaluation of opponents, restricting communication, enlarging the conflict, changing goals, and increasingly automatic responses (see also Pruitt 2008; Thomas 1992). In all these mechanisms, offenses to the self play an important role.

### **Polarization and simplification**

At the beginning, the parties may well see that the arguments of the opponent do have some merit, although they are convinced that their own arguments are better. As escalation develops, nuances are increasingly disregarded; advantages of the opposing view as well as disadvantages of one’s own view disappear; differences are magnified (Levine and Thompson 1996). What was more versus less appropriate becomes appropriate versus inappropriate; preferable becomes right, second best becomes worst, and imperfect becomes impossible. Note that such a process may be involved in the transition from task conflict to relationship conflict: As one’s position is increasingly depicted as simply wrong, and one’s arguments in favor of this position are increasingly discounted, one is likely to feel not taken seriously as a person, experiences relational devaluation, and accordingly an offense to self. Defending one’s position therefore increasingly becomes defending the self, making relational (as opposed to substantive) issues salient and fueling affective reactions such as anger.

### **Devaluation of opponents**

Another mechanism is the explicit or implicit devaluation of opponents. Increasingly, positive actions and successes of the opponents are attributed to external factors (“since they have so many more resources than we do, their ‘success’ is no surprise”); conversely, their negative actions and failures are attributed to stable internal factors, either in terms of competence (“given their inability to organize things well, this mistake was to be expected”) or in terms of their moral quality (“I don’t think they just ‘forgot’ to inform us; that looks more like a deliberate undermining”). To the extent this happens, relational devaluation as a driver of conflict escalation becomes obvious.

### **Restricting communication**

As interaction with the opponents increasingly entails offending communication and negative affect, it becomes more and more aversive and tends to be restricted, both in a quantitative and a qualitative sense. Quantitatively, interacting with the opponents is avoided and kept as short as possible if it cannot be avoided. Information that might be useful for the opponent may be withheld. If interaction with the opponents is unavoidable, it may be used as an opportunity to demonstrate their inferiority and one's own superiority ("I hear your last report was actually on time...") – which, in turn, may strengthen the tendency to restrict communication as much as possible.

### **Enlarging the conflict**

A conflict may start around a specific issue. As escalation develops, additional issues are likely to be included (Fisher 2016). Most people know constellations of long-standing conflicts implying that A will oppose any suggestion if comes from B – anything B proposes must be wrong from A's point of view. Such an attitude is supported by the tendency to question the opponents' competence and moral quality: These people are not able to come up with reasonable suggestions; even if they come up with something that looks good and has nothing to do with the conflict's core issues, there must be some sinister plan behind it. Thus, enlarging the issues is associated with increased personalization and devaluation.

In addition to including more and more issues, there is a tendency to include more and more people. One looks for supporters, and as escalation continues, their support is increasingly demanded. Pressure on ingroup conformity increases; nuanced positions are regarded as a lack of loyalty ("who is not for us, is against us"), as is "too much contact" with the opponents (I saw you talking to X and Y yesterday; don't you know they belong to A's department?). Newcomers are indoctrinated ("One of these days, X is likely to show up. He will be very friendly – but beware, you can't trust him"). Such processes can contribute to an almost infinite prolongation of conflicts, characterized by hostile relations between the groups, and a dominance of mistrust, suspicion, and mutual devaluation. As a result, conflict "often becomes independent of its initiating causes and is likely to continue after these have become irrelevant or have been forgotten" (Deutsch 1969, p. 11). There are examples of long-standing conflict between two departments that had been started many years ago by the two department heads. Neither of these – and, indeed, no one who was present when the conflict started – was still in the organization, but the conflict had been perpetuated by "socializing" newcomers into mistrust, interpreting any act as hostile, avoiding contact, and the self-fulfilling prophecies generated as a consequence.

### **Shifting goals**

Initially, goals may be focused on specific issues, such as obtaining a position, getting more resources, seeing one's strategy being accepted, obtaining (or keeping) certain privileges, and the like. As the number of issues grows, and "rebuttals" are increasingly combined with attacks on each other's competence and/or moral qualities (and, thus, on each other's identity as competent and valuable

people), goals shift to identity issues, and defending one's own self-image and reputation but increasingly also undermining the opponents' reputation become goals in and of themselves. In extreme cases, destroying the opponent becomes so dominant that even grave losses for one's own party become acceptable (e.g., insulting or undermining an opponent in such an obvious way that the organization punishes the offender).

### **Increasingly automatic appraisals**

Increasingly, elaborated cognitive strategies of analyzing the situation, trying to understand the motives and arguments of the opponents, and weighing the pros and cons of possible strategies give way to a mere activation of existing beliefs and stereotypes, and the certainty associated with these beliefs goes along with less systematic information processing (Douglas et al. 2008; Van Kleef and Côté 2018). Ambiguous actions of opponents are "immediately recognized" as being driven by bad motives; the inferiority of the opponents is regarded as a fact, and so are convictions such as "they will never change." Minor cues often are sufficient for activating such belief systems, including scripts about "the only way we can respond..." Furthermore, the strong emotions (notably anger) associated with "hot" conflicts induce perceptions and appraisals based on that anger and a tendency for information processing to be comparatively shallow (Van Kleef and Côté 2018) and based on stereotypes and heuristics (Douglas et al. 2008; Lerner et al. 2015). Defending one's own and attacking the opponents' identity are central parts of the stereotypes that are activated.

In sum, as escalation progresses, qualitative changes occur, characterized by increasing costs of constructive behavior in terms of losing face and thus entrapment. Six mechanisms are described that contribute to escalation. They all contribute to an increasing dominance of relational issues, whereas substantive issues recede or disappear. The relational topics often supplant substantive arguments; avoiding these relational topics in favor of focusing on substantive issues therefore is pivotal for conflict management, as will be discussed in the next section.

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## **Conflict Management**

Discussions of conflict management frequently focus on the dual-concern model (Rahim 2002; Thomas 1992). This model regards conflict behavior in terms of a combination of (a) concern for one's own interest and (b) concern for the others' interest. Typically, five "styles" are derived from this model (Pruitt 1998; Tjosvold et al. 2014; van de Vliert 1998). They entail *competing* or *dominating* (high concern for own, low concern for others' interests), *accommodating* or *obliging* (high concern for others', low concern for own interests), *avoiding* (both low), and *collaborating* or *integrating* (both high). The fifth style represents compromising. The five styles represent trait-like tendencies on the one hand and are influenced by situational characteristics, such as conflict history, the issues and the people

involved, and social pressures to appear “tough,” and momentary characteristics such as ego-depletion, on the other hand.

Traditionally, a collaborative or integrative approach is recommended, emphasizing “open-minded discussion” (Tjosvold et al. 2014) or “constructive controversy” (De Dreu 2014). Frequently this general recommendation is qualified by contingencies, as when Thomas (1992) recommends avoidance when the issue is trivial or when a cooling-off period is needed and compromising if goals are mutually exclusive, parties are equally powerful, and consensus cannot be reached. Other authors, notably van de Vliert (Euwema et al. 2003), emphasize using not one strategy but a “conglomerated” behavior that combines several strategies flexibly. Furthermore, it often is recommended to reduce affective conflict and to stimulate a moderate amount of cognitive (or task-related) conflict (Rahim 2002). Finally, time is taken into account in that short-term interventions may focus more on the process of conflict handling, whereas a long-term perspective implies structural changes.

The following discussion will try to highlight issues related to offense in terms of relational devaluation and how communication can be influenced to reduce such offense. The focus will therefore be more on process issues than on types of conflict (DeChurch et al. 2013), and it will be more on specific behaviors of conflict management than on the general styles or strategies entailed in the dual-concern model. The key message of this discussion is that any behavior that might imply a relational devaluation should be avoided unless there are specific and important reasons for accepting an offense to the self; and if such reasons exist, offense should be limited to an absolute minimum.

## **Avoiding Unnecessary Relational Devaluation Through “Added Messages”**

The processes of conflict escalation, such as polarizing, extending issues, proving one’s superiority, and damaging the opponents’ reputation, imply that many communicative acts are sending derogatory messages that go well beyond a message of disagreement that might be functional in solving a conflict. In other words, from the perspective of optimal conflict management, many communications entail *unnecessary* relational devaluation. For example, when giving (negative) feedback about someone’s behavior or performance, people often go beyond the issue to be criticized (e.g., “you often are late for meetings”) by combining it with nonverbal behavior (e.g., eye-rolling), by expressing it in an angry voice, by adding offending attributions regarding motivation (“you don’t seem to care about our meetings”) or competence (“you seem to have problems with time management”), or by overgeneralizing (using qualifications such as “always” or “never”). Furthermore, extreme classifications (e.g., “this is nonsense!”) may imply added messages, such as “you are a fool!” Such messages add relational devaluation that is not necessary for making a position clear. In Weingart et al. (2015) terms, such messages would be considered high in directness and in entrenchment (an indicator of high oppositional intensity). Such ways of expression turn the criticism regarding a specific type of



behavior (e.g., being late) into a criticism aimed at the person or group. Note that such “added messages” usually do not simply give more weight to the criticism; rather, they detract from the substantive message and direct attention to the offense to the self. As noted above, the threshold for perceiving such messages tends to be low, implying that even subtle “added messages” can make a difference. For instance, negotiators who immediately answer a proposal with a counterproposal, or who voice disagreement before, rather than after, an explanation, have been shown to be less effective (Rackham 1993). Immediate counterproposals and disagreements can be offensive to the self because they signal premature rejection of the opponent’s position without careful consideration and thus a lack of respect for the opponent’s competence or reasonableness. Retaliation is typically triggered by relational devaluation aspects of the communication. This implies that in many cases, conflict escalation is driven by messages that are not part of the substance of the conflict but rather constitute added messages that constitute an offense to the self.

Note that refraining from such added messages does not imply that one should not send clear messages of disapproving and being angered. However, there are constructive ways to express anger, such as telling the opponent that one is angry while staying calm or, at least, keeping the anger expression at a low intensity (Davidson and Mostofsky 2010; Gibson et al. 2009; Linden et al. 2003). Thus, leaving out the unnecessary added messages is not to be mistaken for a conflict avoidance strategy. Rather, the disagreement/disapproval is directed at the issue at hand, rather than the person, which is a frequent recommendation in the literature on conflict (e.g., Glasl 1999; van de Vliert 1998) and on feedback (Krings et al. 2015). “One of the most important skills is to be able to disagree with each other’s ideas while confirming each other’s personal competence. . .” (Johnson et al. 2014, p. 92).

In a similar vein, depicting impressions and attributions as facts, rather than interpretations, draws attention to the opponent’s self. “You have been late so often that it is now clear you don’t care about our progress” draws attention away from the substance (being late) and toward the person (does not care). Again, the substantive issue does not have to be avoided – even including possible interpretations. For instance, saying something like “Frankly, I am starting to wonder how much you care about our progress, given that you have been late so many times now” expresses quite some irritation and disapproval yet leaves open to what degree a personal interpretation is correct.

As an aside, these considerations support the conclusion that the type of conflict may often be less important than the way it is dealt with (DeChurch et al. 2013; Weingart et al. 2015). The “added messages” that derogate the opponent (and may trigger retaliation and escalation spirals) actually *detract* from the substantive issues, and they become more and more salient as escalation progresses (Fisher 2016).

## Trying to Understand the Opponents’ Perspective

Showing respect implies listening attentively to the others’ concerns and trying to understand their perspective (van Quaquebeke and Eckloff 2010; van Quaquebeke

and Felps 2018). In situations of conflict, however, arguments of opponents are easily dismissed and often poorly understood, due to a bias toward regarding one's own standpoint as more legitimate than that of the opponents, attributing actions by the opponents to weaknesses in terms of morality and/or competence, and regarding the other standpoint as not deserving close scrutiny. With escalation progressing, the interpretations are increasingly taken not as own interpretations but as "facts." It is not surprising, therefore, that many authors emphasize the crucial role of understanding the others' perspective (e.g., Cohen et al. 2010; Janssen and Van de Vliert 1996). This is partly a question of a basic concern for the interest of the other side, as described in the dual-concern model; it is, however, also a question of behavior. Thus, people often focus on preparing their reply while an opponent is speaking; as attentional capacity is limited, this elaboration of one's own reply detracts from what the opponents are saying and may make it difficult to fully comprehend their position (next-in-line effect; Bond et al. 1991). Arguments of the other side therefore are simply rejected rather than really challenged based on critical examination. This is important, as challenging the thoughts of people who vent, while not making them feel better, can foster problem-solving (Behfar et al. 2019).

Discussion rules that foster understanding (e.g., asking participants to summarize the opponents' position) may therefore be helpful for respectful communication, as might attempts by group leaders or mediators to question interpretations of the opponents' actions and motives. Furthermore, Douglas et al. (2008) recommend attribution training to counter tendencies of attributing negative and ambiguous acts and messages to malevolence and thus to be more open for alternative interpretations, including legitimate "underlying concerns" (DeChurch et al. 2013; van de Vliert 1998).

## Focusing on Core Issues

Conflict escalation is characterized by increasing the number of issues in a conflict (Fisher 2016). As escalation progresses, it becomes difficult to disentangle these issues. Many, even minor, events are being "incorporated" and give rise to reactions that are not focused on specific issues and events but on general issues such as the opponents' incompetence or malevolence (see the concept of "event-blurred reactions" by Douglas et al. 2008). "Carving out" the key issues therefore may help refocusing on substantive issues, rather than on the offense to the opponents' self, which is often contained in the added messages discussed above. If the core issues are very large, they may be broken up into a number of smaller ones (van de Vliert 1998). These resulting issues should be coined in rather specific terms (e.g., "do we want to focus on improving the current project, or do we need to develop a new one?"), because more abstract terms (e.g., "do we want to be innovative, or do we want to stick to what we have?") tend to be more confounded with issues of identity; specific definitions therefore make it easier to discount the many added messages that have become dominant in the course of conflict escalation and thus to reduce offenses to the self.

## **Conglomerated Behavior and Cycles of Tension and Tension Release**

Effective conflict management requires flexible and adaptive behavior (Deutsch 2014a; van de Vliert 1998). Such flexibility can be demonstrated in two ways; one refers to combining different strategies, rather than using one strategy only. The second refers to cycles of tension and tension release and thus incorporates the time aspect more explicitly.

### **Conglomerated Behavior**

Conflict styles and corresponding behaviors according to the dual-concern model are often described in terms of one dominant tendency. However, as emphasized by van de Vliert (1998), one should not stick to one strategy, such as dominating, only but rather combine several strategies (“conglomerated behavior”). Regarding relational devaluation, one of the most promising combinations is being firm (akin to a dominating style and thus potentially self-threatening) combined with showing interest in finding a solution and acknowledging the concerns of the other side. For instance, responding to an attack with a counterattack increases the risk of losing face for the opponents if they give in or offer a compromise. Clearly refuting the attack (“I cannot accept these accusations”) but combining it with a conciliatory gesture (“but we may well find a way out of this dilemma”) may be most promising, not least because it enables the other side to maintain face when being cooperative. Similarly, the description of an optimal combination of different behaviors in terms of four f’s, firm, fair, flexible, and friendly, as discussed by Deutsch (2014a, pp. 27–28), contains behaviors that signal respect and appreciation.

### **Temporal Issues: Cycles of Tension and Tension Release**

One way of specifying what “good handling” of conflicts could mean and of preventing tensions from building up to a high level might be seen in an aspect of time that has not received much attention in the conflict literature: cycles of tension and tension release. In occupational stress research, it is well established that “it is not primarily the acute stress reaction that is detrimental for an organism but rather the sustained activation. . .” (Sonnentag and Fritz 2015, p. S75); the term “effort-recovery cycle” (Meijman and Mulder 1998) has been used to describe this phenomenon (see also McEwen 1998). Regarding family conflict, Wilson and Gottman (2002, p. 251) describe the important role of repair: “We contend that it may not be conflict per se (i.e., nonphysical conflict) that leads to negative child outcomes, but a failure of repair mechanisms” (see also Jehn and Bendersky 2003). And Bales (1999, p. 167) describes processes of effective team decision-making as patterns of “increasing conflict, argument and tension, eventually interrupted by jokes and laughter, and then followed by signs of relaxation and friendly remarks. . . .” Other possibilities are apologies and explanations (Schumann 2018). These behavioral patterns may interrupt a beginning escalation spiral and mitigate the negative effects of relational devaluation. Signaling that offenses to the self that might have occurred were due to the heat of the moment and do not imply

a permanent derogation of opponents can compensate for or repair offenses to the self to a certain degree and signal intent to cooperate.

Such patterns have an additional advantage with regard to potential positive effects of conflict. It has often been contended that conflict, notably task conflict, may be stimulating for good outcomes without doing a lot of damage in terms of hurt feelings, provided that tensions are not too high (Weingart et al. 2015) and the conflict is handled well (De Dreu 2014); it therefore might be stimulated in moderate amounts (e.g., Rahim 2002). Cycles of tension and tension release could support such an approach by fostering an exchange of opposing positions, even at the cost of tension building up, but interrupting this process by tension release before tensions get too intensive and tendencies of warding off self-threats through relational devaluation become dominant.

### **When an Offense to Self May Have to be Accepted**

Avoidance typically is not a recommended strategy, unless the issue is trivial and not likely to be a persisting source of conflict (Thomas 1992). However, being involved in conflict is a stressful experience, and avoidance behavior may promise staying out of trouble, often including staying away from the risk of being offended oneself. Avoidance motivation is higher if influential people are involved in the conflict, such as people in high positions and/or those who have special expertise that is important for an organization. Targets of conflict behavior therefore often try to avoid the instigators of such behavior. Avoidance is especially likely if people see no promising way of getting even directly, due to the higher status or greater organizational support for the instigators (Porath and Pearson 2012).

However, people in leadership positions, who have a responsibility to deal with conflicts, also are inclined to turn a blind eye (Pearson et al. 2000); this tendency is well known with regard to giving honest performance feedback (Waung and Highhouse 1997). Shying away from dealing with conflicts or from provoking conflict by giving honest feedback may have very negative consequences in the long run. It can imply hindering learning processes, failing to support targets of aggressive behavior, failing to intervene at early phases of conflict development, and tolerating a culture of incivility. It therefore is sometimes necessary to accept confronting, and possibly offending, someone in order to protect others, to maintain quality standards, and to enforce a culture of civility (see Pruitt 2008).

These considerations are not meant to serve as an excuse for offending behavior. When considering whether to intervene in light of inappropriate behavior, for instance, because it involves relational devaluation, one has to consider carefully if this intervention might be offending and whether or not this offense can be accepted. It follows that such behavior should not be fueled by momentary anger, premature attributions, and activated stereotypes, as is often the case in ongoing conflicts. Rather, one has to decide strategically, based on carefully weighing pros and cons. Furthermore, one should think about ways to keep the offense to the absolute minimum necessary and to avoid any “added messages” (“minimally invasive

feedback”; Semmer and Jacobshagen 2010). This can be achieved, for instance, by a calm, rather than angry, tone of voice, by refraining from nonverbal intensifiers such as eye-rolling, by giving feedback in a dyadic situation rather than in front of others, by focusing on core issues rather than minor ones, or simply by not repeating criticism over and over again (Krings et al. 2015). Furthermore, by emphasizing not only negative aspects but positive aspects as well, one can offer messages that confirm the other’s self in addition to the negative messages that need to be communicated as well. Thus, avoiding negative “added messages,” and offering positive messages as well, can keep the offense to the self to a minimum.

## **Building a Culture of Trust and Respect**

Solving a “well-established” conflict may require external help by professional mediators or counsellors (Glasl 1999). However, long-lasting conflicts often start with quarrels about minor issues, and with uncivil behavior, before they escalate; in these early phases, conflict escalation may be prevented. Organizations and their representatives, that is, people in leadership positions, therefore have an important role in detecting early signs of conflict and preventing conflict escalation. From the perspective of this chapter, a central focus of early signs should be on behaviors that carry the potential for offending the self, notably the “added messages” discussed above. Leaders should develop a repertoire of behaviors that are promising for carving out the substantive issues, for identifying biased attributions and added messages, and for interrupting escalation spirals.

To be able to live up to these responsibilities requires social competences, and organizations should not leave employees and supervisors alone but offer training. Over and above training interventions, however, organizations should aim at establishing and supporting a culture of respect that includes a fair way of dealing with conflict. Such a culture must not only be proclaimed in “mission statements” but also enforced in everyday life. Pearson and Porath (2005) offer suggestions on strategies to implement a culture of respect, for example, a zero-tolerance expectation for incivility, reflecting about one’s own modeling behavior, weeding out trouble early, teaching civility, listening carefully, reacting quickly to instances of incivility, heeding warning signals, not excusing powerful instigators, and investing in exit interviews.

To support a culture of civility, rather comprehensive interventions akin to organizational development may be helpful (Coleman 2018; Rahim 2002; van de Vliert 1995). An example is the “Civility, Respect and Engagement at the Workplace (CREW)” program, which has successfully been applied and evaluated. Presupposing management commitment, this program entails facilitated discussions about respect, such as ways of expressing respect and disrespect, conflict management, camaraderie, etc., combined with exercises regarding, for instance, active listening and conflict behavior. Specific content is adapted to the organization where the intervention takes place and to specific units within this organization.

Based on surveys before and after the program, intervention sites have shown improvements as compared to control sites, and these changes were maintained well beyond initial effects (Leiter et al. 2012; Osatuke et al. 2013).

It should be added that respect and appreciation are not only shown in social interactions. The way work is organized also sends social messages that can signal respect and appreciation – or offenses to the self (Semmer et al. 2019). Thus, allocating tasks that are not part of one’s core role or are considered unnecessary (“illegitimate tasks”) signal a lack of respect for people’s occupational roles; they can be described as “identity-relevant stressors” (Thoits 1991). By contrast, granting autonomy signals that employees are trusted to use this autonomy in a responsible and competent way; dealing quickly with problems that impede performance, such as malfunctions of machines or material (i.e., organizational constraints or performance constraints; Pindek and Spector 2016), signals respect and caring (Semmer et al. 2016).

A culture of respect also can foster positive contact and a common superordinate identity among organizational members, which may prevent conflict escalation. However, it is often important not to emphasize such a common social identity at the *expense of subgroup identities* but rather to support the expression of both (Dovidio et al. 2007) and to pursue “a carefully managed strategy of ‘cultural’ pluralism within an overarching entity” (Hogg et al. 2017, p. 575).

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## Final Thoughts

Conflicts are part of everyday (working) life. They range from minor encounters of incivility to full-fledged and escalated conflict, and they may involve only two people, different groups, or whole departments. The focus of this chapter is on an aspect that runs through all forms, stages, and contexts of conflict: offenses to the self by messages that signal relational devaluation. Such offenses are never totally avoidable and sometimes even have to be accepted deliberately. Yet, in many cases, these offenses are unnecessary “added messages” that may momentarily boost the self-esteem of (at least one of) the parties involved but are detrimental over time and actually detract from the substantive issues that may be worthwhile to “fight” about. Avoiding, repairing, and sanctioning such unnecessary offenses – in everyday social interactions, in the design of jobs and working conditions, and in organizational cultures – can support a culture of respect and civility that profits both organizations and their employees. In such a culture, the conflicts that keep occurring even under the best circumstances may be bearable and not leave longtime resentments. Furthermore, such a culture also increases the chances that the often claimed positive and stimulating effects of conflicts may be promoted by supporting a focus on substantive issues; on avoiding offenses, notably unnecessary added messages; on repairing offenses that do occur; and on embedding such developments in a context of support and respect.

## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Interactions of Work and Health: An Economic Perspective](#)
- ▶ [Organizational Justice and Health](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [Psychosocial Safety Climate and Occupational Health](#)
- ▶ [Sexual Harassment and Bullying at Work](#)
- ▶ [The Associationalist Demand–Control \(ADC\) Theory](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress and Autonomic Nervous System Activity](#)

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# Sexual Harassment and Bullying at Work

# 23

## Prevalence, Health, and Social Outcomes

Åse Marie Hansen, Anne Helene Garde, and Roger Persson

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### Abstract

In this chapter, research on health and social effects attributed to two forms of potentially harmful maltreatment at work: sexual harassment and workplace bullying are summarized. The text in the chapter covers literature on how sexual harassment and workplace bullying may act as determinants for poor health (e.g., depression, cardiovascular diseases, and diabetes) and negative social outcomes (e.g., long-term sickness absence (LTSA), job turnover, unemployment, drop-out

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_19](https://doi.org/10.1007/978-3-030-31438-5_19)

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from a trade, early retirement/disability retirement). The chapter will also bring in recent research on the impact of workplace bullying on the non-bullied colleagues.

Further, in the chapter, possible pathways that describe how sexual harassment and bullying at work may influence health and/or social outcomes are described. Presumably, exposure to sexual harassment and/or bullying at work (or similar misbehaviors) may cause stress reactions, triggered by the unpredictability and lack of control that follows these exposures. Feelings of control and predictability are two outcomes that results from the individual's appraisal processes and may as such explain how workplace bullying "gets under the skin." The chapter briefly presents theoretical models that may explain how discrimination behavior "gets under the skin."

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**Keywords**

Workplace bullying · Sexual harassment · Health · Long-term sickness absence · Individual level · Workplace level

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**Introduction**

For most people work represents a source of income, identity, structure, and belongingness and constitutes such an important resource in life. On occasion, however, work can also be a source of harm that negatively tax health and social life. In this chapter research on health and social effects attributed to two forms of potentially harmful maltreatment at work: sexual harassment and workplace bullying are summarized. The text in the chapter focus on how sexual harassment and workplace bullying may act as determinants for poor health (e.g., depression, cardiovascular diseases, and diabetes) and negative social outcomes (e.g., LTSA, job turnover, unemployment, drop-out from a trade, early retirement/disability retirement). An important difference between workplace bullying and sexual harassment is that bullying, per definition, refers to a persistent pattern of mistreatment from others in the workplace that causes either physical or emotional harm (Rayner and Keashly 2005). Workplace sexual harassment does not need to occur more than once to be classified as such (Nabe-Nielsen et al. 2016).

**Sexual Harassment at Work**

Sexual harassment comprises improper behavior that has a sexual dimension (O'Hare and O'Donohue 1998). Research on sexual harassment has increased in scope since the 1970s when it gained recognition as a legal and social concern (McDonald 2012). Definitions of sexual harassment may both be legal and/or sociopsychological. One example of a sociopsychological definition is Fitzgerald and colleagues definition of sexual harassment as "unwanted sex-related behaviour

at work that is appraised by the recipient as offensive, exceeding her resources, or threatening her well-being” (Fitzgerald et al. 1997). This definition highlights the individual emotional outcomes from sex-related behaviors. It could encompass a broad range of physical, verbal, and nonverbal behaviors. While this definition is rather broad, the chapter also refers to the term inappropriate sexual behaviors, which include all types of unwanted sex-related behaviors (regardless of their emotional impact).

A survey among randomly selected employed people in 31 European countries in 2005 found that 1% of men and 3% of women were exposed to sexual harassment (Niedhammer et al. 2012). The study investigated working conditions and was conducted as face-to-face interviews among 29,680 employees. National statistics from Sweden, covering the period of 2009 to 2017, shows that the prevalence of sexual harassment from leaders and/or colleagues at work has been stable for men, but slightly increased for women (Arbetsmiljöverket 2017). Specifically, approximately 1% of the men reported being sexually harassed between 2009 and 2017, whereas approximately 2% of the women reported being sexually harassed between 2009 and 2013, a figure that increased to approximately 4% in 2015 and 2017. In contrast, the percentage of men and women that reported to be exposed to sexual harassment at work from other individuals than leaders and/or work colleagues (e.g., customers, clients, etc.) is higher. Yet, while approximately 2% of the men reported being sexually harassed from other people in the period of 2009 to 2017, there has been an increase for women from approximately 7% in 2009 to 11% in 2017. In 2017, approximately one of ten employed individuals had during the last 12 months been subjected to sexual harassment from managers/colleagues and/or other people. Particularly women between 16 and 29 years of age are the most subjected to sexual harassment. In this group, in 2017, approximately 30% of women reported being subjected to sexual harassment from managers/colleagues and/or other people. However, the assessment of sexual harassment varies, and this may influence the estimated point prevalence. For example, in some studies sexual harassment has been assessed with one item that read: “Have you been subjected to unwanted sexual attention at work within the past 6 months?” (Nabe-Nielsen et al. 2016) or “Have you been exposed to sexual harassment at your workplace during the last 12 months?”. The response options were “yes, daily,” “yes, weekly,” “yes, monthly,” “yes, rarely,” or “never.” In other studies, sexual harassment has been preceded by a definition, and respondents have been asked to respond to a number of items concerning experiences and behavior. For example, in a study among Gulf War veterans (1990–1991) (Vogt et al. 2005), sexual harassment was defined as unwanted sexual contact or verbal conduct of a sexual nature by other unit members, commanding officers, or civilians in the war zone that contributed to a hostile working environment. Respondents rated their experiences of sexual harassment on seven items; each had a 4-point response format with anchors from 1 (never) to 4 (many times) (Vogt et al. 2005). In addition, a recent study investigated the association of history of sexual harassment and sexual assault with blood pressure, mood, anxiety, and sleep among midlife women. Among 304 middle-aged women reported a history of workplace sexual harassment (19%) and sexual assault (22%). The way



the item is phrased may have an influence on the prevalence of sexual harassment (Thurston et al. 2019).

## Workplace Bullying

Bullying at work, according to most definitions, takes place when someone, repeatedly and over a long period of time (usually 6 months), is exposed to negative acts from one or several others, in a situation where defensive actions against the negative acts for some reasons are difficult to perform. Definitions of workplace bullying are typically described by three main characteristics. First, an employee becomes the target of systematic negative and unwanted social behaviors in the workplace. The behaviors may affect the target directly (e.g., teasing, scolding, spreading rumors, and threats) or indirectly (e.g., social isolation and/or withholding information) (Nielsen et al. 2010). In addition, they may obstruct the target possibility to perform his or her work or be of a more personal nature (e.g., offending teasing, rumors, slander, or sexual harassment). A second main characteristic is that workplace bullying occurs over long time period. Thus, occasional and/or brief clashes and conflicts between individuals are not considered bullying unless they are part of a long-term pattern of events (Nielsen et al. 2010). The third main characteristic is that the target experiences that he or she cannot easily escape the situation nor stop the unwanted treatment (for review see (Nielsen and Einarsen 2018)). Closely related to this characteristic are power differences that may be caused by the formal division of labor at work and/or be a consequence of other individual, situational, or societal characteristics (Cleveland and Kerst 1993). Power imbalances may evolve over time, and the bullying process in itself may give rise to further increasing power imbalances. In some cases subordinates, especially if acting in a group, may muster enough power to bully a supervisor.

Similar to sexual harassment, the assessment of bullying at work varies with the measurement method. A number of approaches and instruments of varying complexity have been used to measure the bullying (Nielsen et al. 2010). Bullying takes place when employees are exposed to negative or offensive acts repeatedly over a longer period of time, which it is difficult to defend oneself against (Nielsen et al. 2010). One approach, denoted the self-labeling method, assesses workplace bullying by presenting the respondents for a definition of bullying, i.e., “Bullying takes place when employees are exposed to negative or offensive acts repeatedly over a longer period of time, which it is difficult to defend oneself against,” followed by an item that read: “Have you been subjected to bullying at work within the past 6 months?” (Nielsen et al. 2010). Another instrument designed to measure exposure to bullying in the workplace is the negative acts questionnaire (NAQ). In NAQ the respondent is supposed to rate the occurrence of 22 negative acts in three dimensions (i.e., work-related acts, person-oriented, and acts of social isolation) (Einarsen et al. 2009). Using the self-labeling method, a rate of 11.3% was found for studies if a definition of bullying was given, whereas a rate of 14.8% was found for behavioral experience method (using NAQ) studies, and 18.1% for self-labeling method without a given

definition (Nielsen et al. 2010). In Denmark, it was estimated that 10 to 12% of the working population was subjected to bullying in the period of 2012 to 2018 (The National Work and Health Survey in Denmark 2018). Among these, approximately 1.5% reported frequent bullying, that is, weekly or daily workplace bullying. National statistics from Sweden showed that, during 2009 to 2017, approximately 10% of the working population reported being subjected to personal harassment through negative words and acts from leaders and/or colleagues (Arbetsmiljöverket 2017). In the survey one item was used (Have you been exposed to negative acts from managers or colleagues?), and response categories were from daily to not at all during the past 12 months (Arbetsmiljöverket 2017). While the operational definitions vary, the results from Denmark and Sweden are consistent with results reported in Finland, Norway, and France (Einarsen et al. 2009; Lallukka et al. 2011; Niedhammer et al. 2009).

## Health

The understanding of health and disease may vary widely across cultures and individuals. In mainstream biomedical research, however, a central concept for understanding human health is “physiological balance” (also denoted as homeostasis or allostasis) (Sterling and Eyer 1988). If the physiological balance is compromised by, for example, physiological insults (e.g., not receiving food or water, bacteria, viruses, pathogens, etc.) and/or by expectations and beliefs (e.g., excessive worrying) poor health may develop. However, according to the biopsychosocial (BPS) model of health (Engel 1992), suffering, disease, and illness may depend on the complex interaction of diverse causal factors, including those at the molecular, individual, and social levels (Borrell-Carrio et al. 2004; Engel 1992). Importantly, the BPS model emphasizes the individual’s subjective experience as a contributor to accurate diagnosis, health outcomes, and human care (Borrell-Carrio et al. 2004). Thus, subjective reports are to be taken seriously even if they do not correspond with detectable changes in physiology, and it may be worthwhile to search for associated expressions on different levels of organization (e.g., individual, group, organization, and societal levels).

When applying the BPS model to understand how health in part may be determined by workplace bullying and sexual harassment, it is acknowledged that health builds on physiological, psychological, and social functioning and their interactions (Engel 1992). From the perspective of the individual, however, stressors (e.g., sexual harassment and workplace bullying) constantly challenge a complex dynamic equilibrium in the body (homeostasis). This equilibrium needs to be reestablished by various physiological and behavioral adaptive responses that sometimes are loosely referred to as the “stress system” (Chrousos 2009). The adaptive response also entails sleep. Sleep is vital for our mental and physical health, including the maintenance of memory and other cognitive and/or neuroendocrine functions (Cohen et al. 2009; McEwen 2006). For example, sleep duration has been associated with an increased risk of diabetes (Nilsson et al. 2004), CVD and all-cause mortality

(Cappuccio et al. 2010), and the common cold (Cohen et al. 2009). Hence, sexual harassment and bullying at work may in theory both contribute to poor health and disease by inducing unfavorable physiological changes and/or inadequate behavioral responses in various configurations.

## **Theoretical Considerations on the Links Between Sexual Harassment, Bullying, Health, and Social Outcomes**

How social stressors, via psychological mechanisms, can trigger unfavorable activations of the stress response and transmute into physiological effects and subsequent health problems is currently best explained by psychobiological theories such as allostasis (McEwen 2006; Sterling and Eyer 1988) and the cognitive activation theory of stress (CATS) (Ursin and Eriksen 2004). In these theories, the stress response is essentially a life-promoting general, nonspecific alarm response that causes a general increase in wakefulness and brain arousal, and specific responses to deal with the reasons for the alarm (Ursin and Eriksen 2004). The stress response is primarily mediated by the sympathetic-adrenal-medullary axis (SAM axis) and the hypothalamus-pituitary-adrenal axis (HPA axis) (Ursin and Eriksen 2004). If the stress response is inadequate, too frequent, or too long, negative effects will occur (McEwen 2006). Unfortunately, there exist no definite answers as how to define too frequent or too long, and the large intra- and interindividual difference in how people respond to various stressors has since long been acknowledged (Appley and Trumbull 1986).

As part of the stress response, individuals may also display certain rudimentary behavioral reactions, e.g., fight, flee, freeze, and/or seek out peers and build social alliances (Selye 1956). However, in real life these rudimentary responses may not be obvious and easily identified and labeled as stress responses. Excessive and prolonged stress reactions may be maintained and fuelled by mental processing (e.g., anxiety, worry) or a constant exposure to adverse environments involving interpersonal conflicts. This may induce changes in lifestyle and health-related behaviors and affect basic processes of importance of maintaining physiological balance such as eating (nutrition) and sleeping (McEwen 2006). Because the neuroendocrine regulation of sleep and wakefulness is intertwined with the physiological stress response, the activation of the hypothalamus-pituitary-adrenal (HPA) axis may cause disturbed and less refreshing sleep and vice versa (Eek et al. 2012; Partinen 1994; Rodriguez et al. 2011). Lack of sleep has also been associated with an increased risk of disease (McEwen 2006), and even mild insomnia has been associated with impaired quality of life (Léger et al. 2001). It should be acknowledged that sleep is not only the simple absence of wakefulness; sleep is an active, regulated, and metabolically distinct state, essential for health and well-being (Carley and Farabi 2016). Initiation and maintenance of sleep require suppression of activity in the ascending arousal systems (Carley and Farabi 2016). Thus, poor sleep may provide a link between social stressors such as sexual harassment and work-related bullying and poor health.

## **Sexual Harassment, Bullying, Health, and Social Outcomes**

Brodsky, who pioneered research on workplace bullying, described severe behavioral and mental stress reactions among employees exposed to harassment or bullying at work (Brodsky 1976). The bullied employees reported symptoms such as nervousness, irritability, chronic fatigue, insomnia, tension, memory problems, physical pains, aggression, depression, and self-hatred (Brodsky 1976). Since then the field of research has expanded greatly as have the number of studies documenting the detrimental effects of workplace bullying on targets' mental health problems and somatic symptoms (Hogh et al. 2016b; Kivimaki et al. 2003). Both cross-sectional and prospective studies have consistently reported strong associations between self-reported bullying at the workplace and a number of health-related outcomes such as sickness absence (Bonde et al. 2016). There are several ways to depict how social stressors at work may contribute to poor health or social effects. A simplified conceptual model, which depicts our relationships of interest in this chapter between social stressors, stress reactions, disease, and social outcomes, is presented.

### **Sexual Harassment and Workplace Bullying as Work-Related Stressors**

Both workplace sexual harassment and bullying may be regarded as potent social stressors (Hauge et al. 2010). Part of the potency reflects that workplace bullying, and sexual harassment are unwanted behaviors and considered unethical (thus they break social norms and sometimes the law). Another reason is that both sexual harassment and bullying can be seen as facets of two core activities that engages the human species, that is, cooperation and reproduction. (Nabe-Nielsen et al. 2016).

Being social stressors, that is, stressors that are primarily dependent on the dynamic and symbolic laden transactions between individuals (e.g., verbal and written communication, literature, movies, arts, etc.) sexual harassment and bullying primarily operates on the target via the cognitive system and psychological mechanisms (c.f., allostasis and CATS). A complicating factor for research is that both sexual harassment and bullying at work are phenomenon's that have a fairly low point prevalence and are, for ethical reasons, difficult to study experimentally (c.f., Persson et al. 2018). Accordingly, the study of these social stressors is very much limited to nonexperimental study designs. However, and similar to other stressors encountered within organizations such as heavy workloads, time pressure, overtime work, etc., one can assume that many individuals risk being exposed to bullying and unwanted sexual attention at some point in time during their career. Contrary to many other stressors at work, workplace bullying and sexual harassment are primarily phenomenon's that are directed toward a very restricted range of individuals at the workplace (c.f., Hauge et al. 2010). Thus, both sexual harassment and bullying may result in severe stress reactions for the targeted individuals, while their colleagues and other employees at the workplace may not be affected at all or only to a

very limited extent (Einarsen and Mikkelsen 2003). While less research is available on sexual harassment, similar mechanisms are judged relevant (De Haas et al. 2009; Quick and McFadyen 2017).

## Diseases

The psychological and physiological stress reactions associated with bullying and/or sexual harassment may be part of a pathway leading to disease.

### Psychological Stress Reactions

A few longitudinal studies have also found workplace bullying to be prospectively associated with psychological stress reactions (Hogh et al. 2012; Nielsen and Einarsen 2012; Taniguchi et al. 2016). Hogh et al. showed that some negative acts, especially person-related acts such as direct harassment and intimidating behavior, appeared to be more detrimental than other negative acts, i.e., direct harassment was associated with avoidance, and being intimidated was associated with intrusive thoughts and hyperarousal (Hogh et al. 2012). Onset of sexual harassment were associated with psychological stress reactions 2 years later with an OR of 1.73 [95% CI: 0.98, 3.08] and an OR of 2.31 [95% CI: 1.34, 3.99] for physical stress reactions, such as pain in the lower back (Taniguchi et al. 2016). Among midlife women, workplace sexual harassment was associated with higher blood pressure and poorer sleep, and sexual assault with depressed mood, anxiety, and poorer sleep (Thurston et al. 2019). A study entailing Gulf War veterans (1990–1991) suggested that sexual harassment have had a stronger negative impact on men's than on women's mental health (Vogt et al. 2005).

### Physiological Stress Response

During the past decade, a few studies have addressed the association between workplace bullying and salivary cortisol among occupationally active targets (Hansen et al. 2006, 2011; Hogh et al. 2012; Kudielka and Kern 2004; Lac et al. 2012). The inquiries cover two clinical studies (Kudielka and Kern 2004; Lac et al. 2012), one cohort study, and three cross-sectional studies (Gullander et al. 2015; Hansen et al. 2006, 2011; Hogh et al. 2012). Kudielka and Kern studied differences in terms of both morning cortisol increase and cortisol day profile between a workday and a day off among 12 women and 4 men that were bullied at the workplace (average age 45 years, age range 33–60 years). They found that on a workday, the difference between the peak cortisol level in the morning and the lowest level in the evening showed a lesser decrease at the workday compared with a day off (Kudielka and Kern 2004). Lac et al. did not find a significant difference in the area under the curve in the morning (difference between concentration at awakening and 60 min after awakening) and slope from 120 min after awakening and 16 h after awakening (Lac et al. 2012). Further, recent studies have entailed larger study samples and been designed to counter some of the methodological weaknesses that were inherent in previous studies involving salivary cortisol

(Hansen et al. 2011; Høgh et al. 2012). Accordingly, the frequency of workplace bullying has been included (Hansen et al. 2011) and bullying operationally defined in a more fine-grained way by using the negative acts questionnaire (Høgh et al. 2012). The incidence of workplace bullying and its discontinuance was examined in relation to subsequent change in morning and evening saliva cortisol concentrations (Gullander et al. 2015). The assessment schedule applied were only two daily measurements (morning and evening), which differed from previous studies. However, the applied assessment schedule was considered sufficient to capture and account for the diurnal variation in salivary cortisol concentrations (Gullander et al. 2015). In any event, the results showed no indication of differences in saliva cortisol concentrations when participants changed from being non-bullied at baseline to being bullied at follow-up, nor were there any differences when they, at follow-up 2 years later, reported discontinuance of bullying (Gullander et al. 2015). In summary, four of the six studies found that salivary cortisol were lower among bullied respondents compared to no-bullied respondents. According to McEwen a failure to activate the physiological stress response in a stressful situation will cause an extra burden on health as the physiological imbalance will be maintained, and there is a risk of cascade effects when other physiological systems need to compensate for the failure (McEwen 2004). Hence, the association between workplace bullying and salivary cortisol could be a chronic stress reaction, as proposed in the allostatic load model (McEwen 2004).

### **Sleep and Health**

So far five longitudinal studies on workplace bullying and sleep problems seem to have been conducted (Hansen et al. 2014, 2016; Kostev et al. 2014; Lallukka et al. 2011; Rodriguez et al. 2011). Lallukka et al. performed a 5-year follow-up study and found workplace bullying to be associated with sleep problems, but associations attenuated after factors related to the social environment, work, and health were taken into account (Lallukka et al. 2011). Whereas Hansen et al. had a 2-year follow-up and adjusted for baseline sleep problems (Hansen et al. 2014, 2016) and found a two times higher risk of sleep problems. A recent study supported this finding in first-time workplace bullied persons (Kostev et al. 2014). Hence, it seems plausible that sleep difficulties may provide a link between work-related bullying and poor health. The bidirectional relationship between workplace bullying and psychological distress may indicate a vicious circle, where bullying and distress reinforce the negative effects of each other, i.e., bullying leads to mental health problems, which may act to worsen the target's situation or at least his or her perception of the situation (Einarsen and Nielsen 2015). Nielsen et al. concluded that the mechanisms to explain this relationship between workplace bullying as a risk factor for sickness absence are not sufficiently described (Nielsen et al. 2016). Nielsen et al. also suggest possible bidirectional relationships between workplace bullying and sickness absence. Self-reported measures of workplace bullying and sexual harassment were found to be prospectively associated with register-based LTSA using  $\geq 30$  consecutive days as outcome (Nabe-Nielsen et al. 2016). The authors also found that disturbed sleep and difficulties awakening were associated with increased odds of

sickness absence. Nabe-Nielsen et al. found that poor sleep, mainly in terms of disturbed sleep, partly mediated some of the association between workplace discrimination and LTSA (Nabe-Nielsen et al. 2016).

### Cardiovascular Disease and Diabetes

Two studies showed an increased risk of workplace bullying and CVD. A longitudinal Finnish hospital study of primarily female employees (Kivimäki et al. 2006) showed a much higher risk of cardiovascular disease for targets of prolonged bullying compared to nontargets (odds ratio (OR) = 2.31 [95% CI: 1.15–4.63]). Adjustment for overweight at baseline attenuated the OR to 1.62 [95% CI: 0.75–3.50]. A recent large multi-cohort study covering approximately 80,000 employed men and women from Denmark and Sweden showed similar findings that workplace bullying was associated with a higher risk of new-onset CVD, with a HR of 1.59 [95% CI: 1.28–1.98] (Xu et al. 2019). The authors also observed a dose-response relationship. The association between workplace bullying and diabetes was investigated recently (Xu et al. 2018). One study on workplace bullying and diabetes found a 1.46 (95% CI: 1.23, 1.74) times higher risk of developing diabetes among bullied compared with non-bullied participants. Xu et al. included 45,905 men and women (40–65 years of age and free of diabetes at baseline) from 4 studies in Sweden, Denmark, and Finland. No studies on workplace sexual harassment and risk of heart disease and diabetes have to our knowledge been published.

### Depression

Several studies showed that workplace bullying increased the risk of depression (for review see (Hansen 2017)) in cohort studies. Two of the Danish studies (Gullander et al. 2014; Rugulies et al. 2012) differentiated into the frequency of bullying and depression. Gullander et al. found a dose-response relationship with ORs for depression 2 years later of 2.17 [95% CI: 1.11; 4.23] and 9.63 [95% CI: 3.42; 27.1] for frequently bullied and occasionally bullied, respectively (Gullander et al. 2014). Rugulies et al. reported ORs of 2.22 [95% CI: 1.31–3.76] for occasionally bullied and 8.45 [95% CI: 4.04–17.70] for frequently bullied (Rugulies et al. 2012). Kivimäki et al. studied incident cases of depression, i.e., if the respondent reported that a medical doctor had diagnosed him or her as having depression baseline, but not in 2 years later (Kivimäki et al. 2003). Overall the studies report similar ORs even though the studies used different methods to measure workplace bullying, different follow-up times, target populations, and measurement of depression. The majority of the studies used the self-labeling item to assess workplace bullying. Three studies used bullying behavior (Einarsen et al. 2009) to measure the association between workplace bullying and depression while using a 1-year follow-up (Reknes et al. 2014), a 2-year follow-up (Hogh et al. 2016b), and a 5-year follow-up period (Einarsen and Nielsen 2015). Interestingly a recent study showed that adjusting for sense of coherence and depressive symptoms at baseline cancelled the association between workplace bullying and depression (Hogh et al. 2016b). In addition, two recent studies found some evidence for the possibility of reverse causality, i.e., depression or depressive symptoms at baseline increased the risk of

subsequent workplace bullying (Hogh et al. 2016b; Loerbroks et al. 2014). In summary, all the longitudinal studies showed that workplace bullying was associated with the risk of subsequent depression independently of assessment of workplace bullying and follow-up time. To what extent depression or depressive symptoms are antecedents to workplace bullying is less clear, but definitely a possibility.

A meta-analysis of 41 studies of the antecedents and consequences of workplace sexual harassment found evidence for the association of sexual harassment with general poor mental health (Willness et al. 2007). Although anxiety and depression were the most prevalent conditions, the strongest evidence of effect was found for post-traumatic stress disorder (Willness et al. 2007). These symptoms may be worsened for minorities through an interactive effect of sexual and racial/ethnic harassment (Buchanan and Fitzgerald 2008).

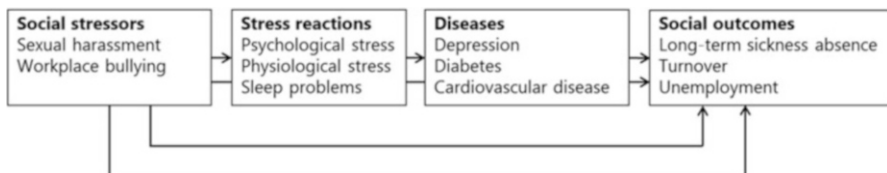
## Social Outcomes

### Long-Term Sickness Absence (LTSA)

The chapter only covers LTSA as short-term sickness absence which often is related to cold, flu, or shorter infections and often based on self-reported measures from 3–8 days of sickness absence. Whereas longer spells of sickness absence (more than 7 consecutive days) is proposed to be used as an integrated measure of physical, psychological, and social functioning in working populations (Marmot et al. 1995).

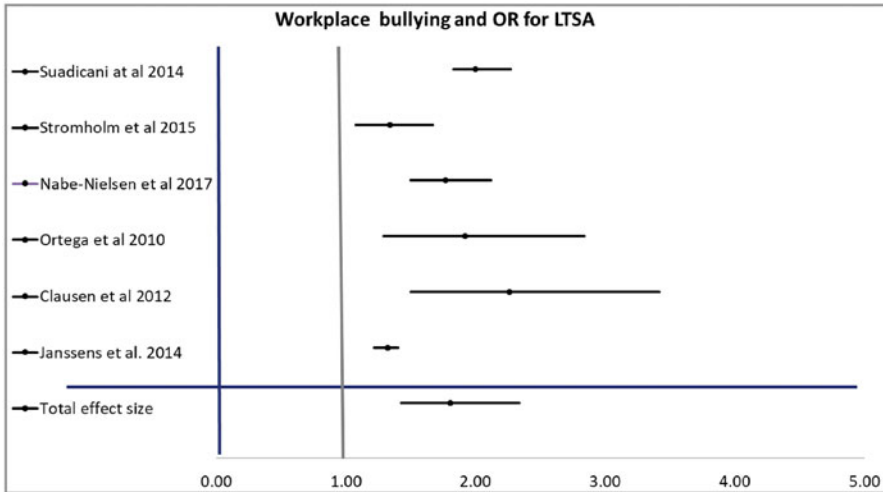
Workplace bullying has been associated with LTSA (>14 consecutive days, >15 consecutive days, and >28 days) in studies based on registers. A meta-analysis workplace bullying and LTSA showed an overall OR of 1.81 [95% CI: 1.43–2.34] more LTSA among the bullied employees compared to non-bullied employees (Fig. 1) (for review see (Hansen 2017)) (Fig. 2).

The association between sexual harassment and LTSA is less studied. One study found that unwanted sexual attention was associated with increased LTSA with an OR of 1.55 [95% CI: 1.06–2.29] (Nabe-Nielsen et al. 2016). The second study found that unwanted sexual attention from colleagues, managers, and/or subordinates predicted LTSA among men (HR 2.66; [95% CI: 1.42–5.00]) (Hogh et al. 2016a). Among women, Hogh et al. found an elevated but non-statistically significant risk of LTSA (HR 1.18; 95% CI: 0.65–2.14). Hence, the association between sexual



**Fig. 1** The overall OR sexual harassment, bullying, health, and social outcomes. A conceptual model of how social stressors (e.g., sexual harassment and bullying at work) could lead to disease and social outcomes. The figure presents three stress reactions (psychological and physiological stress and sleep problems) and three possible diseases related to stress reactions





**Fig. 2** A meta-analysis of seven studies on workplace bullying and LTSA. OR and 95% CI for workplace bullying and risk of being on LTSA (>14 days, >15 days, >28 days, and >30 days) among a total of 67,466 individuals. The gray line shows no risk, i.e., OR = 1.00

harassment and LTSA appears to be in the same order as for workplace bullying and LTSA.

Only one study investigated if the association between workplace bullying and subsequent LTSA was mediated by salivary cortisol (Grynderup et al. 2017). The study population consisted of 5,418 eligible participants contributed with 7,451 observations across the 3 waves with 2 years in between. The authors found no indication that concentrations of cortisol mediated the association between workplace bullying and sickness absence.

### Sickness Presenteeism and Labor-Marked Affiliation

Sickness presenteeism, a concept often perceived as the opposite of absenteeism, has been studied recently, and various definitions have been created. Kivimäki et al. defined presenteeism as feeling sick but attending work (Kivimäki et al. 2005). Another definition of presenteeism is “when a worker show up at work despite feeling so ill that he or she judges that sick leave would have been appropriate ” (Janssens et al. 2016). Workplace sexual harassment was associated with a 55% increased risk of reporting presenteeism (Cho et al. 2016). Also bullying is known to be associated with presenteeism. Although the reasons for presenteeism among employees exposed to bullying are not fully explored, it may happen for a number of subjective reasons, i.e., the targets may feel personally obliged to perform their work duties adversity (Mikkelsen and Iversen 2002). The victims may believe that others depend on them or that not attending work could be conceived as implying a lack of commitment to the workplace or they may fear being deprived of important information or work tasks, which would impact negatively on their work situation (Conway et al. 2016). The yet

limited research includes a Dutch cross-sectional study (Janssens et al. 2016) that found significant relationships between high levels of bullying (OR = 1.32, 95% CI = 1.09 to 1.61) and sickness presenteeism. Three Danish studies showed that compared to non-bullied employees, more targets went to work even when they were sick (Conway et al. 2016; Ortega et al. 2010), whereas one Danish study failed to find an association between workplace bullying and sickness presenteeism (Eriksen et al. 2016). While LTSA puts targets at risk of being fired, sickness presenteeism on the other hand may increase job stress (Elstad and Vabø 2008), which may lead to a deterioration of their mental and physical health. A Danish study indicated that depression was among the possible health consequences of presenteeism (Conway et al. 2016). Since workplace bullied have a higher risk of being sick listed, the higher rates of presenteeism may simply be related to the higher number of days at which a person is sick (due to bullying) and therefore “at risk” of having days of presenteeism (Gerich 2015). Further, the decision process may not exclusively open to the individual’s free choice due to factors that affect employees’ vulnerability and that those factors that may affect an employee’s decision between sickness presenteeism and sickness absence (Gerich 2015).

### **Intention to Leave the Workplace and Turnover**

A longitudinal study in a representative sample of the Norwegian workforce ( $n = 1,775$ ) (Berthelsen et al. 2011) indicated that workplace bullying was positively associated with reports of intentions to leave the workplace. The employees reporting exposure to workplace bullying at time 1 were more likely to report having changed employer at time 2 (OR = 1.96 [95% CI = 1.21–3.16]). Another Norwegian prospective study had a 5-year follow-up time and used two different measurements of workplace bullying (Glambek et al. 2015). The authors found an increased probability of having changed employer during the 5-year period after reporting exposure to bullying (Glambek et al. 2015). Finally, a 3-wave prospective cohort study of 2154 Danish healthcare workers showed a strong relationship between exposure to workplace bullying and turnover 2 years later [OR of frequently bullied = 3.1] (Hogh et al. 2011).

### **Early Retirement and Disability Pensioning**

Some studies from Norway and Sweden showed a higher risk of receiving disability pension. A retrospective case-control study showed that among Swedish home care workers, receiving disability pension, were approximately twice as likely to report exposure to workplace bullying, both 5 and 15 years earlier (Dellve et al. 2003). A Norwegian longitudinal study showed that compared to nontargets, employees who self-labeled as targets of bullying at baseline had a significant higher chance of reporting being on rehabilitation or disability pension on follow-up (OR = 5.62 [95% CI: 1.76–18.02]) (Berthelsen et al. 2011). Independently of assessing bullying behavior or using the one-item measure, another Norwegian study found that exposure to bullying behaviors (OR = 2.81 [95% CI: 1.32–6.01]) and self-labeled bullying (OR = 2.95 [95% CI: 1.22–7.15]) were significantly associated with receiving disability benefits 5 years later (Glambek et al. 2015). The study also looked into unemployment and found that self-labeled exposure to bullying was

related to unemployment 5 years later (OR = 3.69 [95% CI: 0.79–17.34]), and with regard to exposure to bullying behaviors, the relationship was likewise significant (OR = 4.60 [95% CI: 1.43–14.78]).

A prospective register-based Norwegian study found that bullying was a significant predictor of disability retirement (hazard ratio = 1.55; 95% CI 1.13–2.12) also when controlling for job demands and missing job control (Nielsen et al. 2017). Both men and women had a higher risk of disability when bullied compared to employees who were not bullied, but women had the highest risk.

### **The Impact of Workplace Bullying at the Organizational Level**

Bullying not only affects the bullied individual as described above. Individual, organizational, and contextual factors all play a role in the occurrence of workplace bullying, and the frequency of bullying seems to be higher as the size of the companies increase. The variance in negative behaviors at work can be explained by job characteristics and the social environment (Balducci et al. 2011). The experience of laissez-faire leadership showed relatively strong associations with elevated levels of role conflict as well as by an immediate superior role ambiguity (Skogstad et al. 2007), and may escalate into bullying. Laissez-faire leadership may result in high levels of psychological distress among those involved and even among those observing the bullying (Skogstad et al. 2007). Hence, the occurrence of workplace bullying may have an influence at the entire workplace. Employees that report workplace bullying have two times higher risk of being on LTSA. Indeed, previous research has shown that also witnesses of bullying assessed their work environment more negatively than employees not witnessing bullying (Hansen et al. 2006; Hauge et al. 2007). According to the commonly used definition, workplace bullying is described by negative acts that occur repeatedly over a prolonged period of time (e.g., 6 months) and are characterized by an imbalance of power between the perpetrator and the target (Nielsen et al. 2010). Thus, workplace bullying manifests itself as a persistent and systematic victimization of a target that finds it difficult to defend him/herself against (Nielsen et al. 2010). As the non-bullied co-workers share the same psychosocial working environment, it is obvious to investigate if workplace bullying affects LTSA among all employees. A recent empirical study found that non-bullied employees at workplaces, where workplace bullying were reported had more LTSA, than employees in work units without bullying (Hansen et al. 2018). The results indicated that health among the non-bullied co-workers was affected by working at a workplace where bullying occurred, but other unknown characteristics could also explain the association. Hence, it is possible that work unit level of workplace bullying also is associated with unemployment and turnover. No studies were identified on work unit level of sexual harassment and LTSA and health among non-bullied colleagues.

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### **Summary**

Since the mid-1970s, researchers have explored the health effects of exposure of a variety of negative acts in work settings. A growing body of research has documented that exposure to workplace bullying is a major source of distress at

work that in turn is associated with subsequent health problems. The consequences for the subjected individuals may be severe and entail increased physiological arousal and sleep problems and be associated with an increased risk of developing depression, cardiovascular disease (CVD), diabetes, and sleep problems. For depression, CVD, and diabetes, the pattern of association can sometimes be described as dose-dependent. Also sexual harassment at work has been shown to be associated with subsequent health problems. A review concluded that workplace sexual harassment was associated with negative outcomes such as ill physical and mental health and symptoms of post-traumatic stress disorder and sleep problems. Research has also shown that workplace bullying may have economic consequences for individuals in terms of turnover, unemployment, and LTSA and may have an impact at the workplace (i.e., more LTSA among the non-bullied colleagues). Likewise, employees exposed to discrimination and sexual harassment at work are at higher risk of being long-term sick listed and leaving the labor market. However, an elevated risk of LTSA was observed among men only, in relation to exposure to unwanted sexual attention from colleagues, managers, and/or subordinates.

This chapter underlines that workplace discrimination is related to psychological and physiological stress reactions in terms of sleep problems and low salivary cortisol and various disease outcomes. It is possible, and even likely, that physiological stress reactions constitute a link between bullying and sexual harassment at work at the one the hand and on the other hand disease and negative employment outcomes. Yet, since the assessment of bullying and sexual harassment typically is based on self-report data (with risk of misclassification) and that the long-term health and social effects of these phenomena cannot easily be studied in experimental designs, the knowledge about causation is still incomplete.

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# Work–Life Balance: Definitions, Causes, and Consequences 24

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**Abstract**

This chapter reviews the multiple definitions of work–life balance, including definitions focused on the equity of time spent in the work and non-work domains, satisfaction with performance/time spent in each domain, and the salience of each role for an individual. There is a general consensus that a preferred definition should focus on work–*life* rather than work–*family*, in order to include non-family responsibilities and demands, such as study or travel commitments. The chapter also discusses the common antecedents and consequences of work–life balance arising from both work and non-work domains. These include work demands and resources, family demands and resources, and personality antecedents including evidence associating psychological capital constructs with work–life balance. Finally, this chapter considers the future directions for work–life balance research, focusing on technological advancements (e.g., Fitbits) and individual levels of mindfulness and resilience. The chapter concludes by noting the increasing evidence linking employee appointments and retention with an organization’s positive work–life balance culture.

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**Keywords**

Work–life balance · Technology · Culture · Salience · Work · Family · Satisfaction · Performance

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**Introduction****Defining Work–Life Balance**

“Eight hours to work, Eight hours to play, Eight hours to sleep, Eight bob a day. A fair day’s work, For a fair day’s pay.” This mantra was intoned by stonemasons who walked off their jobsite at Melbourne University in 1856. According to Franklin (2010), these skilled workers were among the first in the world to achieve an 8-hour working day. The nineteenth-century movement for a 40-hour working week recognized the rights of humans for lives that included work, recreation, family, and recuperation and effectively preempted and sculpted the shape of the modern concept of work–life balance. Initially a simple formula in an era when the workforce was predominantly male, the concept has remained difficult to define and operationalize (Kalliath and Brough 2008a). This could largely be due to paradigms suggesting that balance was about portions of time and the domains of work, home, and social life were separate entities. Kanter (1977) challenged any notion of such separation, tendering that the different domains of workers’ lives were permeable and interconnected.

Subsequently, the interface between work and people’s non-work activities has been of particular interest to organizational psychologists. The interface has been described in terms of incompatibility (most commonly referred to as “conflict”;

Carlson et al. 2000). Following a scarcity model of personal resources, the work–life interface has typically focused on how participation in multiple life roles depletes resources and produces stress and strain (Goode 1960). Alternatively, other authors have adopted a role expansion or accumulation perspective, suggesting that participation in multiple life roles can derive rewards, gratification, energy creation, and growth (Marks 1977; Sieber 1974). In this view, the interface between work and other life roles has been termed *enrichment* (Brough et al. 2014a; Carlson et al. 2006), *enhancement* (Voydanoff 2002), or *facilitation* (Wayne et al. 2004). In addition, societal changes precipitated by the entrance of large numbers of women into the workplace, simulating consequent changes in traditionally socially predetermined gender roles balanced against organizational imperatives for productivity gains, have also exacerbated the importance of the work–life interface (Brough et al. 2007; Lappegard et al. 2017).

Within the last 20 years, scholars have attempted to provide a more integrated view of the work–family interface, and work–life balance has been a dominant concept reflecting this perspective. However, while the term work–life balance is commonly coined, it is “a concept whose popular usage has outpaced its theoretical development” (Valcour 2007, p. 1513). Across the literature, there is still not a clear consistency in terms used to articulate the construct, and the themes that underpin conceptualizations of the construct are varied. Initial attempts to operationalize work–life balance drew upon the two primary perspectives in the extant literature, that is, role conflict and role enrichment. Within these approaches, work–life balance was commonly represented by an absence of work–family conflict coupled with high levels of work–family enrichment (Duxbury and Higgins 2001; O’Driscoll et al. 2006).

Other early conceptualizations of work–life balance focused on the notion of equal distribution of resources across work and family or other life roles. Following this approach, Kirchmeyer (2000) suggested that balance is achieved when an individual’s time, energy, and commitment are evenly distributed across life roles. Meanwhile, Marks and MacDermid (1996) defined *role balance* as being fully engaged across all life roles. Greenhaus et al. (2003) also progressed the equality approach, suggesting that work–life balance is “the extent to which an individual is engaged in and equally satisfied with his or her work role and family role” (p. 513). Components of this definition include equal time, involvement, and satisfaction across an individual’s work and non-work roles.

The equality approach, however, has received criticism, with researchers suggesting that it fails to account for an individual’s role preferences or their *subjective* sense of balance (Brough et al. 2007). For example, Kalliath and Brough (2008b) described balance as the extent to which investment in roles is consistent with the importance or *salience* an individual places on a role. Similarly, work–life balance has been described as the extent to which an individual’s needs for autonomy, competence, and connection with others are met. While, Voydanoff (2002) focused on the fit with available resources, suggesting that work–life balance is achieved when personal resources are adequate to meet demands in work and family roles, thereby enabling effective participation in each domain.

As with the salience perspective, other authors have described work–life balance as a psychological construct with a focus on *satisfaction* across multiple roles (Kalliath and Brough 2008a). Valcour (2007) suggested that satisfaction with work–life balance is “an overall level of contentment resulting from an assessment of one’s degree of success at meeting work and family role demands” (p. 1512). Valcour (2007) operationalized work–life balance via both *affective* (contentment) and *cognitive* (assessment of success) components. Similarly, Kirchmeyer (2000) defined work–life balance as “achieving satisfying experiences in all life domains and to do so requires personal resources such as energy, time, and commitment to be well distributed across domains” (p. 80).

Grzywacz and Carlson (2007) suggested that a conceptualization of work–life balance should consider the impact of an individual’s balance, or lack of balance, on their work and family environments. They defined work–life balance as the “accomplishment of role-related expectations that are negotiated and shared between an individual and his/her role-related partners in the work and family domains” (p. 66). In this context, work–life balance is operationalized by individuals’ perceptions of whether expectations are met that are shared and agreed with their work and family role partners. As such, it shifts the concept of work–life balance from psychological constructs (e.g., satisfaction, salience), to a focus on role-related performance.

Some authors have rejected the concept of “balance” based on the inherent implication that equal time be split between multiple roles. Halpern and Murphy (2005) likened the concept of “balance” to a balancing beam, with work and family roles on either side of a fulcrum, where time spent in one role will always negatively impact the other role. In this way, work–life balance could be seen as an unrealistic expectation. Alternatively, terms such as *work–life integration* or *work–life harmony* have been employed, to reflect a more holistic appraisal of this concept (Greenhaus and Allen 2011). Timms et al. (2015a) portrayed work–life balance in terms of complementarity, rather than compatibility of domains, suggesting that the experience of multiple roles can enhance an individual’s overall sense of well-being. For example, Gini (1998) viewed work as providing a valuable sense of identity necessary within modern society and noted the grief inherent in the loss of this identity associated with job loss or retirement. Similarly, May et al. (2004) observed that work contributes a sense of personal worth and individual well-being, thereby contributing to human thriving. This is consistent with Carlson et al.’s (2006) construct of enrichment, where positive experiences in each domain of people’s lives improve and enhance the quality of life in the other domains.

Allen (2013) employed the term *work–family balance* but applied it to the multiple domains of individuals’ lives. Other researchers (e.g., Kalliath and Brough 2008b; Keeney et al. 2013) have asserted that the term *work–life balance* is more inclusive of those employees who are not parents but who nevertheless wish to accommodate interests such as study, sports, religious observance, and travel with their work commitments. A recent refinement by Casper et al. (2018) suggested that this concept could be more accurately stated as *work–non-work balance*. They accentuated employees’ assessment of how personally favorable the combination of work and non-work roles was for them. This has resonance with Brough et al.

(Brough et al. 2014b) observation that people could experience substantial time commitments at work that did not necessarily interfere with their subjective sense of balance between the domains of their lives. Casper et al. (2018) identified three subjective balance domains previously not acknowledged by researchers: *affect* (emotional), *effectiveness* (sense of success), and *involvement* (level of engagement) as instrumental in contributing to individuals' sense of balance between their work and non-work domains. In this chapter, the term *work–life balance* is employed, while acknowledging the variations in the published definitions of this construct.

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## Causes and Consequences of Work–Life Balance

Since Kalliath and Brough's (2008b) call for systematic reviews of the antecedents, moderators, mediators, and consequences of work–life balance, there has been a proliferation of studies focusing on the antecedents and outcomes of work–life balance. A summary and synthesis of these key antecedents and outcomes are provided below. First, the evidence associated with three types of antecedents of work–life balance, (a) work-related, (b) family-related, and (c) other non-work-related, is reviewed.

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### Job Demands

A majority of the research on work–life balance has focused on its work-related antecedents. These studies primarily draw on resource-based theories (viz., job demands–resources, conservation of resources, work–home resources model, and resource–gain–development perspective) to explain the impact of work-related demands and resources upon work–life balance. Job demands are the physical, psychological, social, or organizational aspects of the job requiring constant physical and psychological effort. Job demands are commonly defined as *time-based demands* (e.g., overtime and nonstandard work schedules), *strain-based* or cognitive demands (e.g., task difficulty and mental load), affect-based or *emotional demands* (e.g., negative mood and leader or co-worker hostility), or *physical demands* (e.g., manual jobs that require intense labor; Brough and Biggs 2015). Evidence indicates that job demands generally have a negative influence on work–life balance. For example, both Brough et al. (2014b) and Haar et al. (2018) found that cognitive job demands decreased employees' perceptions of their work–life balance, while Syrek et al. (2013) demonstrated that time pressures reduced work–life balance. Job demands reduce perceptions of work–life balance primarily due to the effort exerted to meet these job demands, which subsequently hinders an individual's efforts to fulfill their responsibilities within their non-work domains.

However, some research has indicated that specific job demands can actually *enhance* levels of work–life balance. For example, LePine et al. (2005) distinguished between *challenge demands* and *hindrance demands*, suggesting that challenging job demands may have the potential to promote personal gain or growth, positive

emotions, and an active style of coping. Similarly, Green and Skinner (2005) found that amidst the increased workloads, longer working hours, and greater time pressures, some employees have learnt to work “smarter” through experience and time management training to achieve an acceptable level of work–life balance.

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## Job Resources

Job resources are the physical, psychological, social, or organizational aspects of the job that facilitate the achievement of work goals. In general, employees strive to protect their current resources and acquire new resources, which enable them to cope with their job demands (Halbesleben et al. 2014). Similar to job demands, job resources are also categorized as *time-based resources* (e.g., job flexibility and alternative work schedules), *cognitive resources* (e.g., mental resilience and attention), *emotional resources* (e.g., mood and optimism), or *physical resources* (e.g., strength and skills). Evidence is consistent that job resources have a positive impact on work–life balance. For example, Hill et al. (2001) found that job flexibility in terms of timing (flextime) and work location (flexiplace) generated a positive spillover effect from work to home, helping employees to achieve work–life balance. Similarly, Ferguson et al. (2012) demonstrated that both co-worker and partner support reinforced positive experiences facilitating work–life balance. Finally, both Greenhaus et al. (2012) and Brough et al. (2005) also showed that having a supervisor who was supportive of an employee’s family demands was positively related to the employee’s levels of work–life balance.

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## Family-Related Demands and Resources

Less attention has been focused on the family-related antecedents of work–life balance. The associations between family-related antecedents and work–life balance are generally weaker than compared to the associations between work-related antecedents and work–life balance. Alongside partner support (Ferguson et al. 2012), other specific family resources demonstrating an influence for work–life balance include family support (Russo et al. 2016), family-to-work enrichment (Chan et al. 2016), spending quality time with children (Milkie et al. 2010), partner’s work–life balance satisfaction (Stock et al. 2014), and home-based business (Walker et al. 2008). Interestingly, these family resources have been found to benefit female employees more than male employees. Family demands which have been examined in relation to work–life balance include family involvement (Aryee et al. 2005; Stock et al. 2014) and caring for children and/or aging parents and relatives (Brough and O’Driscoll 2005; Neal and Hammer 2017). Family demands predominately affect employees juggling both work and family commitments and generally hinder an individual’s ability to achieve their desired level of work–life balance (Chan et al. 2017).

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## Impact of Social-Economic Status

Education is the most robust predictor of the quality of work people can perform. Lower educational attainment is associated with lower economic status and menial (and therefore, less flexible) work. According to Montez et al. (2014), workers with the least choice of flexibility in their work are single parents (predominately single mothers) with only a rudimentary education. These workers experience high levels of work–family conflict and insecurity due to severe competing demands on their time and consequently experience lower health outcomes. Stack and Meredith (2018) reported that single working parents experienced grinding poverty, psychological distress, and anxiety, even when employed on a full-time basis, because of their low hourly rates of pay. According to Danziger and Waters Booth (2008), although the non-work needs of low SES workers echo those of higher SES workers, they are less likely to be accommodated by employers due to the casual nature of the work. With regard to specific Australian experiences, Carney and Stanford (2018) reported that insecurities facing low SES workers include reducing wages, increasing casualization of the workforce, underemployment, and indifferent protection by such mechanisms as enterprise agreements. Similarly, the Australian Institute of Health and Welfare (2019) reported that while 30% of Australians work part time, 9% of employed people are underemployed. This reveals that although part-time work constitutes flexibility for some workers, for others it represents insecurity and a reduction in living standards.

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## Personality-Related Antecedents

Aryee et al. (2005) found weak associations between proactive personality characteristics and work–life balance, and between neuroticism and work–life balance, and suggested that personality variables are more strongly related to work–family enrichment than to work–life balance. Kossek and Lautsch (2012) described *work–family boundary management style* as a personality-related antecedent of work–life balance, which refers to how an individual demarcates their work and family boundaries and roles. Boundary management styles include *segmentation*, *integration*, and *alternating*. In general, segmentation (delineating work and personal life as separate domains) facilitates work–life balance, integration (delineating work and personal life as freely interacting domains) reduces levels of work–life balance, while alternating (clear periods of segmentation and integration) facilitates work–life balance in the long term (Kossek and Lautsch 2012; Matthews et al. 2010).

Psychological capital (PsyCap) comprising self-efficacy, optimism, hope, and resiliency has generally been demonstrated to have a positive influence on levels of work–life balance. Drawing on Hobfoll’s (1988) conservation of resources (COR) theory, specifically the tenet that people strive to retain, protect, and build resources, Siu (2013) demonstrated that the four components of PsyCap each significantly enhanced individuals’ work–life balance over time. Similarly, Chan et al. (2016) also

found that domain-specific self-efficacy (self-efficacy to regulate work and life) facilitated employees' achievement of work–life balance, as they were more likely to believe in their own ability to maintain a balance between work and non-work demands.

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## Outcomes of Work–Life Balance

### Work-Related and Family-Related Outcomes

Research on work–life balance has primarily focused on its work-related outcomes, which primarily consist of job satisfaction, turnover, turnover intentions, work engagement, organizational citizenship behavior, job performance, job involvement, and career outcomes. Less attention has been given to the family-related outcomes of work–life balance which primarily include family satisfaction, family functioning, and family performance. For example, evidence of significant associations over time between work–life balance and both job satisfaction and family satisfaction have been demonstrated with samples of workers drawn from numerous national cultures (e.g., O'Driscoll et al. 2004; Spector et al. 2007). Evidence also suggests that work–life balance also *mediates* the associations between job stress and adverse mental health outcomes (e.g., depression and anxiety) for workers (e.g., Timms et al. 2015b). Similarly, Chan et al. (2017) demonstrated that work–life balance mediated the associations between both work and family demands and an employee's perception of work engagement. Chan et al. (2017) noted that the relationships between work demands and work engagement were stronger, compared to the family demands and work engagement pathways. Furthermore, the mediation of family demands and work engagement by work–life balance was reduced to non-significance when an employee's level of self-efficacy was controlled. Chan et al. (2017) concluded that “when prioritising work responsibilities, employees [still] sacrifice their family and personal roles in the process” (p. 830). Importantly, it appears that an employee's personal characteristics, including their levels of self-efficacy, appear to influence work–life balance outcomes to a similar or even greater extent than family demands directly.

Overall, when employees perceive themselves as having an acceptable level of work–life balance, they experience positive work-related outcomes due to the accumulation of resources, increase in self-beliefs to achieve goals, positive spillover of resources from the non-work to work domain, and reciprocity of favorable treatment to the organization. Sometimes, work–life balance may not directly impact work outcomes but instead may facilitate the accumulation of resources such as affective commitment (Kim 2014) which in turn does enhance work outcomes such as job performance. Importantly, the evidence has established that both formal and informal access to appropriate organizational work–life balance policies clearly assists employees to manage their multiple role demands (Brough and O'Driscoll 2010). Consequently, these employees have positive work attitudes and performance levels. Conversely, *not* having appropriate access to organizational work–life



balance policies, or having an organizational culture which discourages this access, is associated with negative work attitudes and performance, including employee turnover (Brough et al. 2009).

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## Future Directions for Work–Life Balance

### Recovery and Resilience

It is apparent that work–life balance is more complex than a simple conflict between domains. As discussed at the start of this chapter, the recent focus on values, satisfaction, and experiences provides welcome depth to this field (Casper et al. 2018; Kalliath and Brough 2008b). Consistent with this shift to explore balance with life more broadly, there has been growing recognition that activities outside of work can have restorative benefits for individuals, enhancing subsequent levels of work performance (Sonnetag 2003). Employees who demonstrate appropriate “recovery” (or “resilience”) from their work demands are more engaged, have higher job performance, and display more organizational citizenship behaviors (Binnewies et al. 2010). These benefits have been found when recovery is achieved in the evening, over weekends, or while on vacation (Fritz et al. 2010). It is proposed that such recovery enables resources to be replenished, thereby enabling employees to cope better with subsequent job demands.

An inherent risk when discussing recovery is that blame for burnout and strain falls solely on the individual for not managing to appropriately recover outside of work. However, it is apparent that appropriate provisions of organizational support and work–life balance policies, including the provision of an organizational culture encouraging work–life balance and recovery techniques, do reduce employees’ experiences of psychological strain and burnout (e.g., Brough et al. 2009). Furthermore, it is likely that the recovery from the demands of family/carer responsibilities is just as important as the recovery from work demands. Further research is required to explain more specifically how recovery experiences impact employee outcomes beyond well-being and productivity, to include, for example, broader improvements in work–life balance (Sonnetag et al. 2016).

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### Mindfulness

Mindfulness has also recently been a focus of mental health research and, for example, has recently been applied as an intervention for occupational stress and well-being (e.g., Eby et al. 2017). Mindfulness is the nonjudgmental awareness of your surroundings, “being attentive to and aware of what is taking place in the present” (Brown and Ryan 2003 p. 822). Evidence indicates that mindfulness can be beneficial when employed to manage competing role demands. For example, Michel et al. (2014) trained employees to use mindfulness as a segmentation strategy aimed to reduce strain-based work–family conflict. Compared to the control group, the

mindfulness group demonstrated significant reductions in conflict and significant increases in psychological detachment. Trait mindfulness has also been found to improve sleep quality and vitality and subsequent reports of work–life balance (Allen and Kiburz 2012).

Both the application of recovery and mindfulness to the work–life balance research field emphasizes a focus on the *individual* employee, as was mentioned above. It is important to recognize that individually focused interventions can only succeed to a certain extent. Experiencing chronically high levels of work and/or family demands in an organization offering limited access to available work–life balance policies will produce adverse employee outcomes which are only partially offset by levels of recovery, resilience, and mindfulness.

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## Technology

At the broader level, there has been a rapid shift in technology use at work. These changes have provided greater flexibility and choice in where, when, and how an employee works, offering opportunities to bolster work–life balance levels (Day et al. 2010). However, this flexibility can also be problematic, with the boundaries between work and home becoming increasingly indistinct. Employees may now access emails on their smart phones immediately after waking and also work online late into the evening. Evidence suggest that the chronic practice of “constant availability” is detrimental by, for example, impinging on an employee’s recovery time (Barley et al. 2011; O’Driscoll et al. 2010; Lupton 2018). Furthermore, the impact of smart devices worn on the body (e.g., iWatch, Fitbit, Garmin) has yet to be empirically assessed in relation to employee mental health and the implications for work–life balance. These devices mean that even when an employee is away from their computer or mobile phone (e.g., practicing work recovery in a gym class), they may still receive work notifications. The negative impact of technology on employee’s mental health outcomes has stimulated some legislation to control its use (particularly in regard to work email), outside of work hours to assist employees to achieve deliberate segmentation of their work and non-work lives (e.g., O’Driscoll et al. 2010). It is likely that the formal control of such technology will increase in the future, occurring either at organizational policy or at national legislative levels, in order to safeguard employees’ levels of work–life balance.

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## Conclusion

This chapter serves to update our current thinking about work–life balance. The chapter discussed the multiple definitions of work–life balance which commonly occur and acknowledged that the field has moved beyond a simple focus on work and *family*, to a focus which includes a variety of work and other life demands salient to an employee. This broader definition of work–life balance is consequently applicable to a larger subset of employees, rather than those simply caring

for young children. The predominate antecedents and consequences of work–life balance which guide current research were also discussed. The focus on work/non-work demands and resources remains common. It is apparent that an abundance of chronic demands from multiple domains, coupled with inadequate levels of person and organizational resources (e.g., time, support), remains the strongest causes of conflict or imbalance. An imbalance of multiple role demands may be manageable in the short term and especially so with the use of individually focused recovery/resilience strategies, but such an imbalance rarely produces positive outcomes in the longer term. For those employees with a choice of employer, preferences are increasing for employers offering desirable organisational work–life balance policies, and who also enable *access* to these policies; that is, organisations with a *positive work–life balance organisational culture*. Finally, the recent technological developments that can lead to a state of employee permanent availability were noted, contradicting the recognized benefits of work “downtime” or recovery. Finally, it was suggested that it will become increasingly necessary for organizations to formally mandate the use of such technology within their work–life balance policies.

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## Cross-References

- ▶ [Impact of the Digitization in the Industry Sector on Work, Employment, and Health](#)
- ▶ [Interactions of Work and Health: An Economic Perspective](#)
- ▶ [Sexual Harassment and Bullying at Work](#)
- ▶ [Shift Work and Occupational Hazards](#)
- ▶ [Underemployment, Overemployment, and Mental Health](#)
- ▶ [Work and Health](#)

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# Using Arts to Support Leadership Development

# 25

Julia Romanowska and Töres Theorell

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## Abstract

The authors describe theories underlying the use of fine arts in efforts to improve psychosocial work environments. Direct influence on the emotional brain from strong experiences of arts may start processes that improve the environment via strengthening of empathy. Regeneration and energy mobilization are central concepts. A practical experiment designed as a random trial with an intervention using strong

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_21](https://doi.org/10.1007/978-3-030-31438-5_21)

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experiences of arts in a program with repeated exposures once in a month for 9 months for managers was compared with a more conventional program with a similar amount of lectures lasting for the same period. Follow-up after 18 months of the managers themselves and their employees showed more benefit for employees in the arts group than in the other group. These benefits included coping patterns, psychological well-being, and regeneration (plasma concentration of DHEA-s). Weaknesses and strengths of these findings are discussed against the background of other research.

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**Keywords**

Music · Poetry · DHEA-s · Regeneration · Psychological stress · Manager intervention · Psychological well-being

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**Introduction**

Most organizational interventions aiming at improved psychosocial climate in workplaces are based upon cognitive reasoning. Logical arguments are intended to lead to changes in organizational behavior. In the present contribution, the main argument is that cognitive processes are not sufficient in psychosocial intervention – aesthetical, emotional, and ethical mechanisms may both prevent and enhance beneficial changes in the workplace. This becomes particularly relevant when we discuss managerial interventions. The results of a controlled intervention study using the art-based leadership concept, *Shibboleth* (Romanowska et al. 2011, 2013, 2014, 2016), form the basis for the present discussion. Managers who were randomly assigned to an art-based intervention program lasting for 10 months improved more significantly in several ways with regard to psychosocial attitudes as well as leadership behavior than managers in the comparison group. Managers in the comparison group were assigned to a more traditional intervention program with lectures and discussions of the same duration and intensity. In addition, a follow-up 9 months later showed more improvement among employees whose managers had attended the art-based program than among those whose managers had attended the comparison intervention. The significant differences in development for the employees in the art-based group ranged from coping pattern (less covert coping) and self-esteem (less performance-based self-esteem) to mental health (less sleep disturbance, depressive mood, and emotional exhaustion symptoms) and regenerative hormones (DHEA-s).

**This text partly builds upon** chapter: Using *Shibboleth* to Support Leadership Development Through an ‘Aesthetic’ Approach in Sweden (Romanowska 2019). [https://link.springer.com/chapter/10.1007%2F978-3-319-99049-1\\_8](https://link.springer.com/chapter/10.1007%2F978-3-319-99049-1_8)

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**Conceptual Framing**

The point of departure is that many leadership problems cannot be tackled using cognitive and rational methods. Such methods might even reinforce leaders’ destructive tendencies (Romanowska 2014, 2016). Seeing leadership as a way of living and

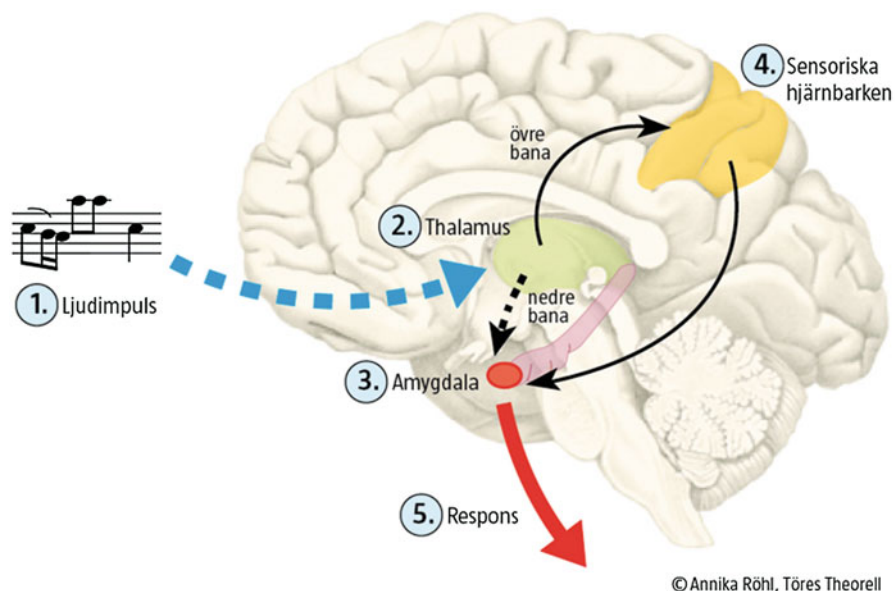
not just leading requires a fundamentally different way of learning, a learning that is integral to living and working (Antonacopoulou et al. 2006); this is about *the experience of learning* (Antonacopoulou 2014). In recent years, there has been a move toward arts-based methods in leadership development (see Springborg 2014 for a review, Taylor and Hansen 2005; Taylor and Ladkin 2009). It has been suggested that arts-based methods cultivate creativity through aesthetics, a knowing beyond logic and rational thinking, which has been found to help leaders develop different ways of seeing and acting.

Shibboleth's vision of learning even goes beyond this mode of learning by aesthetics (which is not strong enough to foster moral responsibility) toward a new mode of *learning-by-aesthetics*, building on the concept of practical wisdom/*phronesis* (Aristotle 1984). (*Phronesis* means a sense of appropriate action in situations of uncertainty in the concrete ethical life, which means thinking urgently and creatively, using feelings and ethics.) *Learning-by-aesthetics* stresses the cultivation of the inseparable virtues of (1) aesthetics, (2) emotions, and (3) ethics: (1) "phantasia," interpretive imaginary openness, (2) emotional engagement with others, and (3) ethical sensibility/critical reflexivity. Accordingly, the vision of aesthetics means fostering the character and humanity of leaders and the power of moral judgment to serve the common good and is in tune with the vision of "sensuous learning" (Antonacopoulou 2010, 2012; Pässilä and Vince 2016; Sutherland 2013; Taylor 2015).

The Shibboleth concept contains a range of techniques – experiencing of performances, written expression, and group reflection. Shibboleth's learning approach includes four ways of knowing: experiential, presentational, propositional, and practical (Heron and Reason 2008). This oscillation between feeling and thinking may serve as an introduction into imaginative and unconscious ways to deeper experiences and lead onward to new ideas. Yet, there are also elements of *propositional* knowing – through the acts of writing and group reflection included in Shibboleth – which is an intellectual knowing in terms of ideas and generalizations about our being-in-a-world, offering a "redescription" of experiences.

One important aspect of arts experiences is that they differ neurophysiologically from rational cognitive reasoning. As pointed out by Le Doux (see Fig. 1) and co-workers, both visual and auditive stimuli with emotional connotations reach the emotional brain more rapidly via a fast "lower" route from the hearing centers than the cognitive brain via a slow "higher" route. Anxiety is the emotion studied most frequently in this context. The fact that the emotional brain is faster in its reactions than the cognitive brain means that higher brain centers can be surprised by strong emotional stimuli and start reorientation analysis that would not take place in a purely cognitive process. This may be one of the explanations why arts experiences add to regular teaching based solely on cognitive analysis.

The reinforcing combination of demanding content and Shibboleth's challenging, fragmentary artistic technique may have a mutually enhancing effect on the three forms of aesthetics (aesthetical, emotional, and ethical), provoking strong emotions and imaginative images. In her idea of "transformative aesthetics," Fischer-Lichte (2008) stresses the significant transformative potential that arts performances have for participants, triggering sensations and associations and thence, through



**Fig. 1** Illustration of spread of sound impulses (ljudimpuls) in the brain reaching the central station thalamus from which impulses are spread in two way, firstly via the lower route (nedre bana) to the emotional brain (here represented by amygdala which are central for regulation of stress and depressive reactions) and secondly via the higher route (övre bana) to the sensory cortex (sensoriska hjärnbarken) where it is cognitively processed. The lower emotional route is much faster than the higher cognitive route

reflection, changing their attitudes. During a Shibboleth performance, the spectators' perception swings continually; they are left without guidelines and caught in liminality, unable to control this ambiguous process. Such states of instability and elusiveness alienate spectators from their day-to-day environment. They may experience this as a crisis, remaining destabilized long after the performance and only reorienting themselves later after reflection. The contradictions of the text and music and the ongoing, unpredictable shift between art forms and the switch between reading voices may all reinforce destabilization and increase the tension between decoding the text and presence. The experience this gives, which is likely to be perceived as a crisis, may have an important reflexive impact that calls for critical judgments. Correspondingly, Antonacopoulou and Sheaffer (2014) introduce a new mode of dynamic learning that occurs in the midst of crisis, "learning in crisis," that makes it possible to navigate the unknown and unknowable and heightens practical judgment (phronesis).

Many scholars have described the impact of the arts on our moral judgment. The arts, which are "the language of suffering," are searching for the truth of the human condition, according to Adorno (1973), and offer a unique opportunity for criticism. Ricoeur (2008) claims that through art we create "imaginative variation of the ego" that provides a "redescription" of the world, particularly the worlds of action and suffering.

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## Context and Content

Fifty leaders were recruited, representing a wide variety of professional backgrounds. They included police officers, reservists, clergymen, head teachers, nurses, psychologists, doctors, prison directors, warehouse managers, public sector managers, IT directors, and creative practitioners. Participants were recruited through a variety of channels: voluntary organizations within the Swedish Armed Forces, the Swedish Reserve Officers Union, the Swedish Criminal Investigation Department, the Swedish trade union for managers, and advertisements in a daily newspaper.

Initially, all leaders attended a standardized 2-day leadership course that aimed to provide all participants with the same pre-understanding of leadership, equalizing differences before the start. The participants were then randomly divided into two groups – a Shibboleth group and a control group – but were not told what the two different programs involved. As far as possible, the study was constructed so as to be symmetrical. Both programs involved 13 3-h sessions over 10 months, and each session had a similar structure.

The evaluation of the outcomes is notable for its multilevel approach: (1) the participants and also four of their subordinate co-workers were evaluated in terms of their mental health, mirroring their psychological resilience; (2) blood samples were collected to test for stress-related hormones, mirroring neurobiological resilience; (3) leader behavior was evaluated using self-rating and co-worker rating, making it possible to evaluate a leader's self-awareness; (4) two follow-ups were undertaken, the first 2 months after the end of the interventions and the second 6/7 months later, to help evaluate the long-term impact; (5) an additional set of psychological tests was conducted in order to examine possible changes in the leaders' intrapersonal and interpersonal development; and, finally (6), the study recorded the subjective experiences of the Shibboleth participants during the whole intervention, providing an understanding of their learning process.

The control program was based on the educational model of the Swedish Defence University and led by leadership trainers from the Swedish Armed Forces. The theoretical approach was transformational leadership, and the emphasis was on putting the newly learned knowledge and behavior into practice. The program included lectures, reflection, individual feedback, and group exercises that put the participant in unexpected and ambiguous situations. The participants had opportunities to share their experiences and discuss different solutions to concrete leadership scenarios.

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## The Shibboleth Intervention

In contrast to the control group, the participants were not given any information about the program at the start nor an opportunity to introduce themselves. Each Shibboleth session consisted of writing in a diary for 3–5 min, so as to switch focus and attention; experiencing a performance (60–70 min); written reflection to capture subjective, spontaneous impressions (3–5 min); guided group reflection (40 min);

chatting in smaller groups without guides (30 min); guided group reflection (30 min); and writing a summary of the session (3–5 min).

The written reflections and the two group reflections were prompted by the question “What is on your mind?”. No instrumental questions were asked and there were no references to the topic of leadership. The discussion was carefully guided by a moderator, but the group was free to decide the content of the discussion. The participants were not given any information about the performances in advance but were given details of the authors and music included in the performance at the end of each session. After a few days, each participant was sent a summary of the discussion and the moderator’s reflections.

**A Shibboleth performance** is a sort of literary and musical collage woven together associatively: a fragmented and rapidly shifting flow of form and content. Two performers, a man and a woman, alone on a stripped-down stage, take turns to read animatedly and rhythmically, switching quickly from one to the other. Short and often contrasting phrases from poetry, prose, documentary texts, and philosophical reflections come together with music in an intense flood of polyphony, the streams interacting or disengaging, constantly alternating between artistic genres. The often-contradictory combinations of text with music, and text with text, and the way they alternate stimulate various senses that are forced to come face-to-face with one another. The result is a concentrated, dreamlike structure with multiple voices, unexpected interruptions, various pitches and leaps, and shifts between conflicting scenes and emotions.

The various pieces of text in the performances are based on quotations from a variety of sources, which are then pasted together to form a new work with a new meaning. Among the writers represented are Pessoa, Perec, Jelinek, Dostoevsky, Hillesum, Kafka, Jabès, Cioran, and Mayakovsky. The performances may include up to 35 different pieces of music, mostly art music ranging from baroque to avant-garde and world music. The texts deal with the big, universal questions and depict man-made disasters, destructivity, and evil as well as man’s greatness, selflessness, and dignity. Unique, deeply moving life stories, often with a tragic ending, are used to reflect a broad spectrum of human experience and human suffering: genocide (the Holocaust, the gulag, Rwanda), abuse of power, violation, dissociative identity disorder, sexual abuse, loneliness, collusion, etc. But they also portray their opposites: love, compassion, moral courage, faith in god, meaningfulness, etc.

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## Process of Learning

The psychological progress made by the leaders is clearly shown in the analysis section below. The subjective experiences of the participants and the significance of the Shibboleth experience for them both during and after the Shibboleth program enabled us to follow the psychological processes taking place in each individual leader. This “insider perspective” is specifically able to provide an insight into the Shibboleth learning processes and specify the necessary key

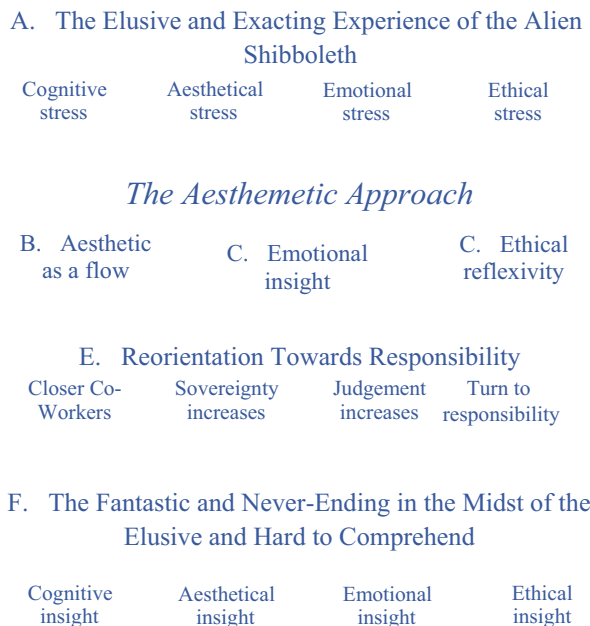
characteristics that constitute the core of Shibboleth’s impact. Building on this analysis, a more generic model of the transformation process is introduced in the section “[The Theoretical Implication: The Concept of Aesthematic Transformation](#)” (see Fig. 2) and discussed in relation to the notion of *aesthetics*, which is introduced in order to conceptualize the transformative power of the Shibboleth concept.

### Analysis of the Leaders’ Experiences of Shibboleth

The phenomenological analysis (Karlsson 1993) is based on the written reflections of 23 participants during sessions, retrospectively written “course” evaluations, and interviews. Data from all participants has been brought together into a narrative in one concerted voice, allowing for variation and discrepancies as well as coherence. The intention with this was to deepen understanding of the Shibboleth experience rather than to investigate how widespread and frequent a particular experience was. Nevertheless, the coherence of the participating leaders’ experience of Shibboleth was striking. The interpretive voice of the researchers is intertwined with the authentic, experiencing voice of the participants, the latter featuring throughout the text in the form of quotations.

In summary form (see Fig. 2), the leaders moved from a demanding experience of stress (A) to insight in an *Aesthematic attitude* (B, C, D) that moved through a flow of aesthetics (B), emotional insights (C), and ethical reflexivity (D) toward a new

**Fig. 2** The six main characteristics of the structure of the participants’ experience



assumption of responsibility (E) and enduring inspiration (F). The six characteristics are presented in an order suggesting that the experience had a specific overall direction. However, the order does not imply a strict chronological or causal sequence. Rather, the characteristics may coexist in varying combinations throughout the whole process.

### **A. The Elusive and Exacting Experience of the Shibboleth**

Encountering Shibboleth was an elusive and unnerving experience placing participants in a situation beyond their sphere of experience. The participants were confronted with an experience that appealed to the sensations and where a common-sense approach was inadequate. This situation elicited various dimensions of stress:

**Cognitive stress.** The situation was difficult to comprehend. “What has this got to do with leadership??? Nausea.” The participants expected “a lot of methods and theories.” “I want to learn a structured way of working by myself . . . The person next to me was about to start crying.”

**Aesthetic stress.** The performances were experienced as inaccessible and provocative. “It was not tangible. I could not intellectualise.” The text was perceived as “incredibly complex” and “often incomprehensible, strange thoughts, connections.”

**Emotional stress.** The performances “broke down defence mechanisms.” “You couldn’t defend yourself, it took your breath away, you were shaken up.” The deeper layers of the self were affected in an uncontrollable way and described as the “wordless feeling of an infant” or expressed by crying or as a strong repudiation when leaving the room.

**Ethical stress.** The content was perceived as a “morally binding manipulation” that did not concern the leaders. Why should they “be subjected to things you never normally encounter, be shaken up by things you sidestep or aren’t obliged to consider?” One “feels almost as a victim of abuse.”

## **Aesthematic Approach (B, C, D)**

### **B. Aesthetic as a Flow**

The participants submitted to the experience without seeking satisfaction through control and instant comprehensibility. This was followed by an overwhelming feeling of surprise and sense of liberation. The artistic technique seems to force the imagination to fill in the gaps and to piece segments together to “uncover” the unformulated part.

### **C. Emotional Insight**

The performances took the participants on “amazing journeys through other people’s eyes” through “life’s contrasts and contradictions.” “They took in the multifaceted reality of the various characters and were moved by their suffering.”

Engaging in other people’s painful reality provokes an “inner journey like no other,” and participants came face-to-face with their own vulnerability.

A new subjectivity emerged, new emotional meanings and connections, “feelings I had never experienced before,” creating a richer spectrum of experience. “I feel I have changed. At work, they say I seem more focused. . . the difference is that I FEEL more.”

#### **D. Ethical Reflexivity**

Opening up to other people’s suffering belongs in the world of ethics. The emotional response in its cognitive dimension gets an ethical turnaround and culminates in considerations to do with the human condition. But it is not moral solutions that are sought.

To confront other people’s stories is to confront one’s own. This demanded a response in the participant’s concrete reality. “Questions about daring to be human have awakened thoughts about myself. What is it that makes me not approach people in that way?” About the Nazi document: this is relevant to me too. As a civil servant, how far am I willing to go?” This reflection on how life should be lived gave rise to a questioning of their lives. The participants re-evaluated their previous standpoints: “stereotypical values that have never been reconsidered.”

#### **E. Reorientation Toward Responsibility**

After the end of the intervention, the participants testified about their changed lives, about having a “different attitude to oneself, to others and to situations.” This included a new consciousness – “my way of reflecting has changed” – and an awareness that values “permeate everything you do” and that man’s humanity is linked to an ethical responsibility. The participants went back into the world with their new understanding embodied in action.

#### **Closer Co-workers**

“I have started to think more about the stories each of my co-workers carry with them. . . that they have something that is important for me to understand. . . I see my co-workers in a different way.” This act of listening meant that leaders took the individual as their starting point. They felt “greater respect” for co-workers and were “humbler when addressing them as individuals. I can separate their results from their human value.”

#### **The Ego Shrinks and Sovereignty Increases**

While the distance between leaders and co-workers decreased, the leaders felt increasingly distanced from themselves, and participants experienced a surprising sense of freedom from the need to self-aggrandize. “I am unconcerned about prestige.” Shibboleth helped participants to “get things in the right proportion” and work out “what is important [to them] in life.” Egos shrank, and the sense of sovereignty increased and manifested itself as moral integrity and courage.



### Reality Appears More Complex While Judgment Increases

One clearly articulated ethical turning point was a new awareness of the reality of evil. “I did not want to see evil. . . It has been a real eye-opener for me that an ordinary person is capable of doing anything. Even my children, and I. . . my viewpoint has shifted from ‘this must have been a mistake’ to ‘this is actually how it is and how are we supposed to live with that?’” This new perspective is now seen as a productive one from the point of view of man’s freedom and the choice to resist: “One can certainly rise up against the masses.” There is a shift in the basic ethical position – from not being able to bridge the gulf between the evil that happens and what one would like to happen to refusing to see evil as inevitable and instead seeing it as something that cannot triumph and as something we are free to refuse to engage in. “I had changed in terms of how I would act if I was asked to conduct experiments on humans in a concentration camp. I had thought I wouldn’t have the power to change anything. My answer now is that I would refuse, even if it meant that my children and I would be executed.”

### Turn from Power to the Seriousness of Responsibility

Again, we see a fundamental shift from thinking in terms of power to thinking in terms of responsibility. This responsibility cannot be handed over to someone else. “My responsibility to act, that stuck with me. Not being the silent majority. . . Not waiting too long.” “My responsibility as a human being is greater than the responsibility I have as a civil servant. If my job turns into an oppressive role I need to have the strength to step away.”

## F. The Fantastic and Never-Ending in the Midst of the Elusive and Hard to Comprehend

The fantastic and never-ending and the elusive and hard to comprehend can be seen as a manifestation of the simultaneous validity of contrasting poles addressing various dimensions of insights:

**Cognitive insight.** The participants come to Shibboleth with their views colored by their pre-understanding. Shibboleth was perceived as useless, “a violation.” A year and a half later, their perception has changed, and the past is illuminated by the light of the new.

**Aesthetic insight.** Shibboleth offered experiences that the participants “had never had before.” The “alien” Shibboleth was now assimilated as a kind of acknowledgment of life, as if, through it, life took on a clearer form.

**Emotional insight.** The participants carried with them traces of Shibboleth that were “etched within.” These traces “often pop up in my mind” as words, or a song, and continue to produce emotions enabling new ways to act.

**Ethical insight.** An ethical sensitivity was now deeply integrated into the participant’s judgment. “I do not need to reflect, it’s part of me. . . It’s unconscious.” The most significant changes mainly occurred unconsciously. “Strange that we are influenced without knowing it. . . it’s a little scary because in itself it is not a choice, but it’s a real revelation, how do you explain it?” The participants felt as if they were having an internal conversation.

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## **The Theoretical Implications: The Concept of Aesthetic Transformation**

The findings show that the participants experienced Shibboleth as a transformative power that led to a reconsideration of their self-image, perception of the world, and leadership. The learning process was perceived as unpleasant and exacting, although it was also seen as creative. Illusions crumbled, and existence became more vulnerable, more demanding, and more solemn. At the same time, the participants described themselves as more capable, judicious, and life-affirming. It might be claimed that the positive changes do not outweigh the negative. The theory behind the aesthetic transformation has been discussed more in detail elsewhere (Romanowska 2014, 2016).

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## **Evidence of Impacts and Interpretation**

How did the Shibboleth group compare to the control group? We found striking, statistically significant differences between the two groups during 18 months of monitoring, indicating a long-lasting impact. The results should of course be interpreted with some caution, but the statistical findings are in accordance with the Shibboleth leaders' "inside" perspective.

The Shibboleth leaders were found by their co-workers to be more responsible and more likely to take a stand, with a greater capacity to cope with ambiguity, complexity, and stress. Prosocial motivation increased, indicating a closer connection with co-workers. In contrast to the opinion of their subordinates, the leaders underestimated their leadership responsibility. A tendency among leaders to underestimate points to greater effectiveness and ethical capacity (Krishnan 2003). Subsequently, both the leaders and their co-workers reported improved self-esteem, a better ability to deal with stresses, and fewer symptoms of mental ill-health; they were also in a better frame of mind, had more energy, and said they were sleeping better. In addition, a significantly better development over time of the blood concentration of the regenerative hormone DHEA-s was observed in the Shibboleth employees compared to the control group employees during the studied 18 months.

In summary, the changes in the leaders – increased self-awareness, humility, responsibility, integrity, stress tolerance, and prosocial motivation (altruism, empathy, straightforwardness, tender-mindedness, trust, and compliance) – indicate increased psychological and neurobiological resilience in both the leaders and subordinates.

The control program leaders themselves felt that they had improved as leaders, but co-workers reviewing their managers reported a decline in their willingness to assume responsibility as well as a diminished capacity to withstand complexity. The managers became prone to substantial self-overestimation – a dangerous tendency that encourages hubris and undermines connection to the co-workers (Krishnan 2003) – while their co-workers reported a more introverted manner when dealing with conflicts, greater exhaustion, depressive tendencies, and poorer sleep. This

decreased psychosocial resilience was also reflected in a less favorable development of the concentration of DHEA-s.

## **Aesthemic Leadership**

The development of the Shibboleth leaders can be described as a journey from the desire for affirmation of the self and the familiar toward a more open, communicative position expressed as an aesthemic attitude. (“At first, we were pre-programmed, wanted to get straight to the purpose of it. But there was no quick packaging; I had to use my imagination, to associate in a different way. I tried to bring it down to a more concrete level . . . but that ruse didn’t work and, in the end, we were all on the same page.”)

The aesthemic leadership attitude reflects a readiness to assume responsibility in an alien or vulnerable situation. (“Everyone has a responsibility in all situations, it is something I now look at differently.”) Usually this is less about immediately finding the correct answers or solutions than about facing our conflictual reality with an open mind and our eyes open. (“Shibboleth is an exercise in finding an approach. . . you have to be prepared for the unknown . . . life consists of a lot of components, you have to allow yourself to be carried along.”)

The aesthemic attitude manifests itself in the release of a dynamic, directionless, and associative flow of imagination (“You can’t control everything, you just have to let it come to you. It flows; is this because I otherwise hold back?”) that, through emotional insights more deeply embedded in our minds (“You have to delve into darker emotions and vulnerability, you can get very scared.”), leads to an ethical thoughtfulness that takes us beyond our ego to a greater engagement in the situation in which we find ourselves. (“I started looking at myself, what is good and evil? When do I choose it? . . . like concentration camps . . . do you make the choice now, or later? . . . this is something I’ve never been through before.”) Such an ethical position entails a universalist way of thinking, as it relates to all people (Lévinas 1985).

The leaders felt after the intervention that their lives seemed more complex and exposed. One might argue that an aesthemic leadership attitude could be counter-productive if it led to increased vulnerability and weakness and thus inefficient leadership. However, findings indicate that leaders became more courageous, resilient to stress, and capable of intervening in the world. (“Everything has been taken down to a deeper level and become more weighty and serious . . . I don’t think it has become easier, quite the opposite . . . more things to take into consideration and I feel alone with my responsibility. But at the same time, I feel comfortable. . . I do not need to plug all the holes but must stand up, here and now, and say if something is wrong . . . It is something that has changed in me recently . . . sometimes you want to avoid having to fight. . . but now I don’t avoid it, I fight . . . even if I would really like just to leave the room and let it take care of itself.”) They also are fulfilled by a love of life. (“This immense love and gratitude for life . . . I have never experienced it before. Not on this level.”)

The findings can be interpreted as an expression of psychic growth in the Shibboleth leaders toward a more complex and integrated “self” in which an awareness of the world’s and one’s own inadequacies coexists with an awareness of one’s own empowerment. (“My whole life has been affected by the course.” “I’m more grown up after this.”) Cultivating the virtue of aesthetics, the participants seemed to extend psychological boundaries inward and outward – “aesthetic stretching” echoing Piaget (1932): Inwardly, they seemed to expand their *existential self*, trying to grasp deeper, complex layers of the human in them, which could be interpreted in new ways to reveal new truths about one’s life and existence in general, in line with de Beauvoir and her concept of the *Ethics of Ambiguity* (1948). Outwardly, they seemed to expand their *relational self* to become more closely connected to others through bonds of common humanity, which lies at the heart of altruism and in which moral imagination plays a critical role (Monroe 2011).

A sense of being part of a universal “we” is crucial for social impact and constitutes the core of effective leadership (Haslam et al. 2010). One can observe a shift in the participants from “I” to “us,” from exercising power by using strategies to influence others toward a willingness to be influenced by others in order to take responsibility on the basis of moral judgment. (“I feel a responsibility to humanity I have not experienced before.”) This increased awareness of moral responsibility may explain the feeling among the Shibboleth leaders that one can always do more (see their underestimation of their leadership responsibility above). According to Lévinas (1985), a moral person never believes that he or she has done enough: “Don’t ever console yourself that you have done everything you could, because it’s not true.”

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## Lessons Learned

A concept like Shibboleth may not be appropriate for everyone. One participant was extremely uncomfortable and left the program early. Two other participants strongly disliked the concept but continued to participate despite their protesting, and the results show positive changes in both them and their subordinates. On two occasions, two people left the room during a performance. However, it may be that such interventions are particularly appropriate for leaders, and specifically leaders in high-ranking positions, as there may be a great temptation inherent in these sorts of posts to lose contact with reality and the self.

I hope that it will be possible to recreate Shibboleth-like conditions, but it is important not to simplify the intervention by reducing the aesthetic idea of learning, which is about learning detours. The following are reflections on some of the challenges presented by Shibboleth and lessons learned. Running the program in the way we did may have allowed each individual to embrace the intervention uniquely and to find responses that had meaning in their own life and could transform the aesthetic experiences into a lived reality.

**Following the participants’ development process:** It is emotionally demanding to enter into the participants’ own world as reflected in their immediate reactions and written diary notes that may become more personal and poignant over time.

However, it is imperative to understand the processes induced in the participants and to follow their development. The diaries should be anonymous and collected in after each session (to be given back to the participants on the next occasion) and then conferred by facilitators.

**Counteracting overprotective attitudes and the facilitation of understanding:**

It is sometimes difficult to overcome one's wish to teach or to guide. Instead of informing, instructing, or delivering the "correct" truths and clarifying the usefulness of the arts or conveying an expectation that the participants should learn from what they are experiencing, it is imperative to give back responsibility to the participants, trusting their ability to cope with situations. The worst questions to ask are "What did you learn?" or "What did the performances mean?". Shibboleth is not a place for facilitating understanding but for fostering the power of the imagination (the aesthetic dimension of aesthematics).

**Counteracting repression or the ethics of security:** By shining a light on the darker sides of our lives, the wounds may be deepened, and our vulnerability exposed. Seeing people leaving the room in indignation or in tears made us want to protect them. At those times, it is important to trust in participants' powers of containment and ability to engage only in what they are able to cope with emotionally. Shibboleth is not somewhere to shelter from one's emotions but a place for sensitization, which fosters psychological resilience (the emotional dimension of aesthematics).

**Counteracting the temptation to affirm participants:** Yielding to the participants' needs for self-fulfillment, or what we believed to be their needs, did not seem to be a successful approach. It is important to shift the focus from the participants and their sphere of interest to "the other," to the content of performances, which is an indirect route to human experiences that are otherwise impossible for any one individual to have during their life. Shibboleth aims not to actualize the self but to quiet and transcend the self, fostering ethics and a common humanity (the ethical dimension of aesthematics).

**Create a wholeness:** For the facilitators, running the sessions is an experience parallel to the experience of the participants, and this binds the facilitators and the participants together into one whole – yet without any individual contact between them, not even during breaks. The pedagogical model, contents, and artistic technique, an act of reading with performers and spectators "face-to-face," combined with the contributions of the participants themselves to create a wholeness that is the essence of the artistic intervention and calls for a response.

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## Conclusion

Using a specific intervention including intensive art experiences – during 10 monthly sessions – including a variety of literary forms and music and group discussions as well as diary notes, it was possible to influence the attitudes and behaviors of managers in the direction of improved prosocial motivation, leader responsibility, and stress resilience. The controlled follow-up showed that this also had favorable

consequences for the employees since after 18 months in comparison to the comparison group, these employees were significantly more benefited with regard to the development of coping patterns, self-esteem, mental health, and blood concentration of the regenerative hormone DHEA-s. The argument is that art experiences could have profound effects on attitudes and behaviors of managers and that wisely planned use of such experiences could beneficially affect the work environment. All programs including arts experiences need to be adapted to the special characteristics of the organization, however.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [Organizational Justice and Health](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)
- ▶ [Regeneration and Anabolism: The Good Perspective](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress and Autonomic Nervous System Activity](#)

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# Organizational-Level Interventions and Occupational Health

# 26

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_22](https://doi.org/10.1007/978-3-030-31438-5_22)

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## Abstract

Adverse factors from the psychosocial work environment have been shown to increase the risk of cardiovascular diseases, mental health problems, and musculoskeletal problems in prospective studies. These adverse psychosocial work factors include high psychological demands, low job control, job strain, low social support from coworkers and/or superiors, low reward, and effort-reward imbalance. Organizational-level workplace interventions aiming to diminish the prevalence of these adverse work factors are pertinent prevention strategies to improve worker health. These interventions aim to reduce exposures occurring upstream on the causal pathway leading to deleterious health outcomes. If these interventions are successful in reducing adverse psychosocial work factors (intermediate effects), they could also lead to the reduction of adverse cardiovascular, mental, and musculoskeletal health outcomes (final effects).

This chapter will first present an overview of the state of the evidence regarding the effects of organizational-level interventions that aim to reduce exposures to adverse psychosocial work factors and related health outcomes. This overview will be followed by a brief discussion of important quality criteria required to conduct rigorous research in this area. Three organizational-level intervention studies meeting most of these quality criteria will then be presented in depth. Finally, public health policies that aim to promote a healthy psychosocial work environment will be discussed.

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## Keywords

Workplace intervention · Organizational intervention · Psychosocial intervention · Demand-control-support · Effort-reward imbalance · Psychological demands · Job control · Social support

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## Introduction

The psychosocial work environment is an important determinant of health. Prospective studies have shown that an adverse psychosocial work environment is associated with the development of cardiovascular disease and hypertension (Babu et al. 2014; Gilbert-Ouimet et al. 2013; Kivimaki et al. 2012; Landsbergis and Schnall 2013; Nyberg et al. 2013), mental health problems (Bonde 2008; Ndjaboue et al. 2012; Netterstrom et al. 2008; Stansfeld and Candy 2006), and musculoskeletal problems (da Costa and Vieira 2010; Hauke et al. 2011; Kraatz et al. 2013; Lang

et al. 2012). These health problems are a considerable burden from both an occupational health and a public health perspective. Cardiovascular diseases are the main cause of death worldwide (World Health Organization 2011), and hypertension is the leading risk factor for cardiovascular disease (Ezzati et al. 2002). For their part, mental health problems account for close to a third of the disease burden associated with noncommunicable diseases in high-income countries (World Health Organization 2008). Moreover, mental health problems and musculoskeletal problems are the two most common and costly health problems experienced by the working population in industrialized countries (European Agency for Safety and Health at Work 2009; European Agency for Safety and Health at Work 2010; Public Health Agency of Canada 2013; Whiteford et al. 2013; World Health Organization 2008).

Two well-defined and internationally recognized models are used to assess the psychosocial work environment: the demand-control-support (**DCS**) model (Johnson et al. 1989; Karasek and Theorell 1990) and the effort-reward imbalance (**ERI**) model (Siegrist 1996). Briefly, the DCS model suggests that workers simultaneously experiencing high psychological demands and low job control (known as job strain) are more likely to develop stress-related health problems (Karasek and Theorell 1990). Moreover, low social support at work can moderate this association (Johnson et al. 1989). For its part, the ERI model proposes that efforts (e.g., pressure to work overtime, increasingly demanding work, constant time pressure, repeated interruptions) should be rewarded in various ways: income, respect, esteem, and occupational status control (e.g., job security, promotion prospects, unforced job changes) (Siegrist and Peter 1996). Workers are in a state of detrimental imbalance and thus more susceptible to health problems, when high efforts are accompanied by low reward (Siegrist 1996; Siegrist et al. 2004). Approximately 20–25% of workers in industrialized countries are exposed to these adverse psychosocial work factors (Brisson et al. 2011).

Given the high burden associated with cardiovascular diseases and mental and musculoskeletal health problems and the role of adverse psychosocial work factors in their development, the World Health Organization (2010) identified preventive workplace interventions as relevant and pertinent settings to improve the health of the population as a whole. These types of interventions are considered preventive as they aim to reduce the risk factors upstream on the causal pathway between work and adverse health outcomes. As such, if these interventions are successful in reducing adverse psychosocial work factors (intermediate effects), they could also lead to the reduction of adverse cardiovascular, mental, and musculoskeletal health outcomes (final effects).

This chapter will first present an overview of the state of the evidence regarding the effects of organizational-level interventions that aim to reduce adverse psychosocial work factors. This overview will be followed by a brief discussion of important quality criteria required to conduct rigorous research in this area. Three intervention studies meeting most of these quality criteria will then be presented in depth. Finally, public health policies that aim to promote a healthy psychosocial work environment will be discussed.

## Organizational-Level Psychosocial Interventions and Health: State of the Evidence

A number of systematic reviews have been conducted to evaluate the effects of psychosocial workplace interventions. These types of workplace interventions can typically be categorized into individual-level and organizational-level interventions (Bongers et al. 2006; Egan et al. 2007). While individual-level interventions generally focus on the workers themselves and, for example, how they interact or cope with their work environment, organizational-level interventions aim to change the work environment itself. Given that organizational-level interventions specifically target the causes occurring in an unhealthy work environment, these types of preventive interventions are hypothesized to be more effective in improving health outcomes than individual-level interventions (Semmer 2006).

To our knowledge, six systematic reviews and two meta-analyses have examined the evidence regarding the health effects of organizational-level interventions that target the psychosocial work environment. In three systematic reviews (Bambra et al. 2007; Egan et al. 2007; Montano et al. 2014) and one meta-analysis (Richardson and Rothstein 2008), the effects were investigated in various working populations and on various health outcomes (see Table 1). The other three reviews and one meta-analysis investigated specific health outcomes (Corbiere et al. 2009; Duhoux et al. 2017; Stock et al. 2018) and/or a specific population, i.e., healthcare workers (Duhoux et al. 2017; Ruotsalainen et al. 2015) (see Tables 2 and 3).

In the systematic review by Montano et al. (2014), 39 studies published between 1980 and 2012 were identified that evaluated the effect of organizational-level interventions on various health outcomes. Not all organizational-level interventions target the psychosocial work environment. In this review, interventions were classified according to three categories referring to the work conditions targeted by the intervention: (1) material, (2) work time-related, and (3) work organization (which includes the psychosocial work environment). Of the 39 studies reviewed, 32 studies included at least one intervention targeting work organization. Half of these studies reported significant health improvements. Compared to interventions targeting only one of these three categories, interventions targeting more than one category tended to report a significant health improvement. Indeed, significant health improvements were reported for six of the 16 studies (35.7%) when only the work organization category was targeted, 1/3 studies (33.3%) when work organization conditions were combined with time conditions, 6/10 studies (60%) when work organization conditions were combined with material conditions, and 3/3 studies (100%) when all three conditions were targeted.

Two companion reviews published in 2007 aimed to synthesize the evidence of organizational-level interventions intended to reduce adverse psychosocial work factors specifically related to the DCS or the ERI models. The objective of these reviews was to synthesize the evidence of the psychosocial and health effects of macro-level work reorganization (i.e., interventions that aimed to increase employees' opportunities to make decisions or participate in decision-making processes at work (Egan et al. 2007)) and micro-level work reorganization (i.e.,

**Table 1** Systematic reviews and meta-analyses examining the health effects of workplace interventions

Author (year)	Type of review	Interventions examined by the review	Years included in search strategy	No. of included articles	Outcomes included in the identified studies	No. of included articles that evaluated organizational-level interventions that aim to improve psychosocial work factors
Montano et al. (2014)	Systematic	Organizational-level	1980–2012	39	Varied; included cardiovascular, mental, and musculoskeletal health outcomes	32 studies included at least one intervention targeting the “work organization” category
Egan et al. (2007)	Systematic	Organizational-level, specifically interventions to increase employee control	Until November 2006	18	Varied, included cardiovascular, mental, and musculoskeletal health outcomes Only studies that also included psychosocial work factors as outcomes were included	18
Bambra et al. (2007)	Systematic	Organizational-level, specifically task re-structuring interventions	Until December 2006	19	Varied; included cardiovascular, mental, and musculoskeletal health outcomes Only studies that also included psychosocial work factors as outcomes were included	19
Richardson and Rothstein (2008)	Meta-analysis	Individual- and organizational-level	Not specified	36	Mainly various mental health outcomes	5

**Table 2** Systematic reviews examining the effects of workplace interventions on specific health outcomes

Author (year)	Type of review	Interventions examined by the review	Years included in search strategy	No. of included articles	Outcomes included in the identified studies	No. of included articles that evaluated organizational-level interventions that aim to improve psychosocial work factors
Corbière et al. (2009)	Systematic	Individual- and organizational-level	2001–2006	24	Mental health	10
Stock et al. (2018)	Systematic	Organizational-level	2000–2015	28	Musculoskeletal health	1

interventions that aimed to change the psychosocial work environment by changing the structure of work tasks (Bambra et al. 2007)). Both reviews only included studies that evaluated both the psychosocial and health effects of interventions.

The systematic review conducted by Egan et al. (2007) reviewed 18 intervention studies published between 1981 and 2006, 12 of which used a prospective design with a control group. Altogether, the results were mixed. Of the 18 studies, 8 observed improvements in psychosocial work factors, and 11 observed improvements in workers' health. However, a more consistent result was observed in the subgroup of studies where psychosocial work factors had improved. Indeed, in this subgroup, improvements in workers' health were observed in the large majority of studies (7/8 studies).

The review by Bambra et al. (2007) included 19 studies published between 1986 and 2005 that corresponded to one of Karasek's (2004) three types of task structure interventions (task variety, teamworking, and autonomous groups). Again, the results were mixed. In four of the eight task variety interventions and in four of the seven teamworking interventions, an improvement in some psychosocial work factors was observed, but little to no beneficial effect was observed on health outcomes. Among the six autonomous group interventions, the authors observed a general deterioration of the psychosocial work environment, but the effects on health were negligible. Of note, the authors reported that the motivation for the intervention was important; interventions implemented with the motivation to increase employee well-being tended to have more beneficial psychosocial and health effects, whereas these effects were adverse or negligible in interventions in which the motivation for implementation was more economically based (Bambra et al. 2007).

In the meta-analysis by Richardson and Rothstein (2008), both individual-level and organizational-level interventions were evaluated, but separate analyses were

**Table 3** Systematic reviews and meta-analyses examining the health effects of workplace interventions among healthcare workers

Author (year)	Type of review	Population	Interventions examined by the review	Years included in search strategy	No. of included articles	Outcomes included in the identified studies	No. of included articles that evaluated organizational-level interventions that aim to improve psychosocial work factors
Duhoux et al. (2017)	Systematic	Primary care nurses	Individual- and organizational-level	2000 to November 2015	8	Mental health (restriction by search strategy)	3
Ruotsalainen et al. (2015)	Meta-analysis (Cochrane)	Healthcare workers	Individual- and organizational-level	Until November 2013	39	Mental health	7

conducted to isolate the effect of organizational-level interventions. Of the 36 studies identified, five were organizational-level intervention studies published between 1983 and 2000. The interventions generally aimed to improve social support at work or increase workers' participation in decisions. Although their search strategy was not restricted to these, these five studies mainly examined mental health outcomes. The effect size, defined by the mean differences between intervention and control group, was nonsignificant (standardized mean difference = 0.144 (95% CI - 0.123–0.411), 5 studies, n = 221 participants), thus suggesting no significant beneficial effect.

Two systematic reviews specifically aimed to synthesize the evidence regarding the effects of organizational-level interventions on either mental health outcomes (Corbiere et al. 2009) or musculoskeletal health outcomes (Stock et al. 2018). In the systematic review by Corbières et al. (2009), organizational-level intervention studies were not evaluated separately but in combination with interventions at the individual level, such as cognitive-behavioral interventions, relaxation techniques, and physical exercises. Of the 24 studies identified between 2001 and 2006, 10 evaluated the effect of organizational-level interventions that aimed to improve psychosocial work factors. Corbières et al. (2009) mentioned that interventions that aimed to improve psychosocial work factors and that used a participatory approach observed significant improvements in workers' mental health.

In the recent systematic review by Stock et al. (2018), 28 studies published between 2000 and 2015 were identified that aimed to evaluate the effectiveness of organizational-level interventions to prevent or reduce work-related musculoskeletal disorders. Of these, only one intervention study was identified that specifically targeted adverse psychosocial work factors. Stock et al. (2018) stated that this study provided little evidence regarding the effectiveness of organizational-level psychosocial interventions to reduce musculoskeletal problems and that more high-quality research is needed in this area. The other organizational-level interventions identified in this review mainly targeted biomechanical work exposures.

Finally, the authors of one systematic review (Duhoux et al. 2017) and one meta-analysis (Ruotsalainen et al. 2015) were specifically interested in the health effects of workplace interventions conducted among healthcare workers. In the systematic review by Duhoux et al. (2017), eight articles published between 2000 and November 2015 were identified that aimed to evaluate the effectiveness of interventions aiming to improve the mental health of primary care nurses. Of these, three studies were organizational-level interventions that aimed to improve psychosocial work factors. Improvements in the mental health outcomes (burnout) of primary care nurses were observed in these three studies. In a Cochrane systematic review and meta-analysis, Ruotsalainen et al. (2015) identified 39 studies of randomized controlled trials of workplace interventions aiming to prevent psychological stress in healthcare workers. Of these studies published before November 2013, 20 were categorized as organizational-level interventions. Among these, five types of interventions were identified: those that aimed to improve work schedules, working conditions, support and mentoring, and communication skills as well as those that aimed to change the content of care. A number of outcomes were evaluated

including occupational stress, burnout, and symptoms of anxiety and depression. Of note, adverse psychosocial work factors were considered as stress outcomes in this study. This meta-analysis showed that improving work schedules was significantly associated with a reduction in workers' stress level (standardized mean difference =  $-0.55$  (95% CI  $-0.84$  to  $-0.25$ ), 2 trials, 180 participants). No clear benefit of any other organizational-level intervention was observed.

Taken together, the results of the systematic reviews presented above show that the findings regarding the health effects of organizational-level psychosocial interventions have been generally inconsistent. Indeed, on average, less than half of the reviewed studies observed improvements in health outcomes. Of note, mental health outcomes were the most common outcomes examined in the reviewed studies. These systematic reviews also demonstrate that a great deal of heterogeneity exists in this domain, both in terms of the types of interventions implemented and the types of methodologies used to evaluate these. Given that workplace interventions take place in complex social structures and often include multiple components, a better understanding of the content and context of interventions and their evaluation may help explain the varying effects observed in the literature. As such, the inconsistencies observed regarding the health effects of organizational-level psychosocial interventions may be explained by the interventions themselves (including their context, development, content, and implementation) as well as by certain methodological limitations in the evaluation of the interventions. In order to advance our knowledge in this area, a number of important issues have to be taken into account (Kristensen 2005; Nielsen and Randall 2013). The next section of this chapter will discuss these issues by presenting important criteria that are recommended in order to conduct and evaluate high-quality organizational-level intervention studies.

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## **Criteria for Conducting High-Quality Organizational-Level Psychosocial Intervention Studies**

The intervention research framework elaborated by Goldenhar et al. (2001) is an exportable framework that can be used in a number of workplace settings and contexts. In this framework, three phases for a rigorous intervention research process are proposed and described, namely, (1) the development phase, (2) the implementation phase, and (3) the effectiveness phase. The goal of the development phase is to identify the changes needed to improve the work environment and workers' health as well as the best way in which to bring about these changes. In the implementation phase, these changes are implemented as interventions and are systematically documented. The goal of the effectiveness phase is to evaluate whether the intervention was successful in improving the work environment and/or reducing health problems. Table 4 presents an adaptation of Goldenhar's framework. This table describes the questions that should be answered at each phase as well as suggestions for the corresponding quantitative and qualitative methods that can be used to answer them. In each of the three phases, several quality criteria are necessary or recommended in order to conduct high-quality research on organizational-level



**Table 4** Adaptation of Goldenhar's three-phase intervention framework: questions relevant to each phase and examples of quantitative and qualitative methods that can be used to answer them

Intervention phases	Examples of corresponding methods	
	Quantitative	Qualitative
<b>1. Development</b> What theories apply? What changes are needed? What are the best ways to bring about these changes?	A priori risk assessment	Focus groups with employees Meetings and follow-ups with managers and union representatives or intervention teams
<b>2. Implementation</b> Type of changes implemented? How many workers are affected by these changes? What is the actual degree of transformation achieved?		Intervention logbooks to document interventions Focus groups with employees Meetings and follow-ups with managers and union representatives or intervention teams
<b>3. Effectiveness</b> To what extent does the intervention reduce: Adverse psychosocial work factors? (intermediate effects) Health outcomes? (final effects)	Quasi-experimental studies with pre- and post-intervention measurements and a control group	

Adapted from Goldenhar et al. (2001) and Brisson et al. (2006)

psychosocial interventions. These factors should be considered a priori. We have previously presented these criteria in detail (Brisson et al. 2016) and offer a brief summary here.

In the **development phase**, researchers and/or practitioners identify the changes needed to improve the work environment and health of a target population and the best ways to bring about these changes. For this phase, four quality criteria are recommended. First, it is important to obtain and continually reaffirm a **strong commitment from head and line managers** of the participating organization(s) (Nielsen 2013) as this favors the development and implementation of organizational changes required to reduce adverse work factors. Second, this phase should include an **a priori risk assessment** of adverse psychosocial work factors and health outcomes. This helps identify high-risk groups within the study population (Goldenhar et al. 2001) as well as potential intervention priorities. Third, this

assessment (and all subsequent assessments) requires *the use of validated instruments*. Fourth, qualitative tools such as *focus groups and follow-up meetings with employees and managers* (i.e., a participative approach) could be helpful in identifying intervention targets and in determining implementation strategies. These complementary tools also stimulate the continuous implication of both employees and managers in the development and implementation phases.

In the **implementation phase**, organizational changes (i.e., interventions) are implemented. An important quality criterion of this phase is the *systematic documentation of how an intervention is carried out*. This could be useful at later stages in order to enlighten an intervention success or failure. Of note, there is no “one-size-fits-all” solution to improve the psychosocial work environment; *interventions have to be tailored to an organization* and to its priorities and context. Since adverse psychosocial work factors can take a variety of forms, improving them often requires the use of *multiple component interventions*. Indeed, although single-target interventions may be successful in addressing one specific problem, more comprehensive and multi-targeted interventions tend to have better success in improving workers’ health (Corbiere et al. 2009; Montano et al. 2014).

In the **effectiveness phase**, researchers and/or practitioners evaluate whether the intervention was successful in reducing adverse work factors (intermediate effects) and related health outcomes (final effects). Seven quality criteria should be considered. First, a *prospective design with pre- and post-intervention measurements and a comparable control group* are essential to provide a valid assessment of intervention effects. The control group (in which no intervention takes place) allows us to distinguish between the changes that occurred as a result of the intervention from the changes that would have naturally occurred over the same time period; this distinction is crucial (Kristensen 2005). Second, an *appropriate follow-up time* has to be defined. This requires that sufficient time has elapsed between the implementation of interventions and the evaluation of effects (Smith et al. 2011). Longer follow-up durations that include more than one post-intervention measure will also make it possible to evaluate whether short-term improvements are sustained over time. Third, a *good participation proportion* reduces the risk of introducing a selection bias due to differences between study participants and nonparticipants (Rothman et al. 2008). These differences should be carefully examined and reported, as should the participation proportions at each measurement time. Fourth, the *sample size* has to be sufficiently large to provide the statistical power necessary to detect the effects of the intervention. Fifth, it is important to appropriately *control for confounding factors* and take into account that these may change over time. Sixth, the demonstration of a beneficial effect of an intervention should *exclude the possibility for this effect to be attributable to a regression to the mean*. This statistical phenomenon occurs when more extreme measurements tend to be followed by measurements that are closer to the mean (Barnett et al. 2005). Finally, *cluster analysis* should always be considered when the intervention is implemented at the departmental level given that measurements on units within a cluster tend to be more similar (Fitzmaurice et al. 2004).

## Meeting the Quality Criteria: Examples from Three Organizational-Level Psychosocial Intervention Studies

This section will provide an overview of three organizational-level psychosocial intervention studies (Bourbonnais et al. 2005, 2006a, 2011; Brisson et al. 2006; Gilbert-Ouimet et al. 2011) that meet most of the quality criteria outlined in section “Criteria for Conducting High-Quality Organizational-Level Psychosocial Intervention Studies.” These three studies aimed to reduce adverse psychosocial work factors and improve worker health. In addition, in one study, the intervention effects on ambulatory blood pressure and hypertension prevalence were also assessed. The study designs, examples of implemented organizational changes, main results, and contextual elements of these studies will be presented.

The three intervention studies used a quasi-experimental before-after design. Pre- and post-intervention measurements were taken between 2000 and 2010. Post-intervention measurements were collected 6–36 months after the implementation of interventions. All three intervention studies included a control group composed of workers with socioeconomic and work characteristics that were similar to those of the intervention group. Participation proportions were very good in both groups, with most proportions ranging between 73% and 86%.

The three intervention studies were supported by strong commitments from the head managers of the participating organizations. These studies followed the three-phase framework of Goldenhar et al. (2001). First, for the development phase, an a priori risk assessment was conducted which consisted of a quantitative assessment of adverse psychosocial work factors from the DCS and ERI models as well as psychological distress. Psychosocial work factors were assessed using validated instruments (Brisson et al. 1998; Karasek et al. 1998; Larocque et al. 1998; Niedhammer et al. 2000) as was psychological distress (Bellerose et al. 1995; Ilfeld 1976; Perreault 1987; Préville et al. 1992). This a priori risk assessment provided an initial portrait of the organizational situation and aided in the identification of intervention priorities. Second, during the implementation phase, interventions were implemented and systematically documented using mainly qualitative methods but also, to some extent, quantitative ones (Bourbonnais et al. 2006b; Brisson et al. 2006). The intervention was defined as all organizational changes that were implemented with the explicit goal (or the clear consequence) of improving one or more adverse psychosocial work factor from the DCS or ERI models. Decisions regarding the implementation of these changes were made by managers (Bourbonnais et al. 2006a; Brisson et al. 2006) or by an intervention team composed of employees and manager representatives (Bourbonnais et al. 2005). Finally, during the effectiveness phase, intervention effects were evaluated using quantitative assessments of psychosocial work factors and health outcomes.

## Populations and Characteristics of the Three Studies

Table 5 presents the populations and characteristics of the three intervention studies. Below is a brief description of each study.

The **long-term care centers study** (Bourbonnais et al. 2005) was conducted among healthcare providers in 12 long-term care centers in Quebec City. The intervention group was composed of 195 workers from four centers. The control group was composed of 298 workers from eight other centers. Multidisciplinary work teams of 10–15 workers were put in place in each of the four intervention centers. Each team was composed of employees and manager representatives. Action plans were developed separately in the four intervention centers to address their specific priorities, which were identified through the quantitative a priori risk assessment. Examples of action plans were (1) stabilization of work teams and improving the quality of care (psychological demands); (2) clarification of roles, tasks, and functions of the members of the caregiver team (reward and job control); (3) staff training, development of leadership skills, team consolidation, and sense of belonging (social support); and (4) developing a support group and a reward program (social support and reward). These action plans were presented to the managers by the researchers. After this presentation, the intervention team received the management's approval and support to implement the actions.

The **acute care hospitals study** (Bourbonnais et al. 2006a, 2011) was conducted among healthcare providers working in two acute care hospitals in Quebec City. Both hospitals offer general and specialized short-term care. The study population included all care providers in direct contact with patients (nurses, orderlies, and auxiliary nurses), who occupied permanent full-time, part-time, or temporary positions or who were on call. There were 492 care providers in the intervention group and 618 in the control group. Intervention priorities were identified by an intervention team (Beermann et al. 1999) that included two researchers, one research assistant, three head nurses, three registered staff nurses (one from each targeted care unit), one beneficiary attendant, one reception clerk, one representative from human resources, and one from nursing, as well as two local union representatives (nurses and beneficiary attendant unions). During eight 3-h meetings held over a 4-month period, two researchers accompanied the intervention team in identifying problems related to adverse psychosocial work factors and possible solutions. These were synthesized under 56 intervention targets (Bourbonnais et al. 2006b) classified according to six problem categories (team work and team spirit, staffing, work organization, training, communication, and ergonomics) and according to four adverse psychosocial work factors (each problem could be linked to more than one psychosocial factor). Of the 56 intervention targets, 43% aimed to improve psychological demands, 24% reward, 20% decision latitude, and 13% social support at work. A total of 63 solutions were suggested to address these targets, and a number of these were implemented (Bourbonnais et al. 2006b), including transmission of information on the evening and night shifts (social support), management of

**Table 5** Examples from the three organizational-level psychosocial intervention studies: characteristics of the studies

Study	Population N (% women)	Follow-ups	Intervention group	Control group	Intervention	Outcomes
Long-term care centers study <sup>a</sup>	Healthcare providers in 12 long-term care centers N = 493 (78% women)	Baseline 12 months	195 healthcare providers of 4 centers 81% and 79% participation at pre- and post-intervention	298 healthcare providers of 8 centers 82% and 86% participation at pre- and post-intervention	A priori risk assessment of psychosocial work factors and psychological distress Development of action plans by intervention teams Implementation of the plans by teams with support of direction Documentation of the interventions	Psychological distress
Acute care hospitals study <sup>b</sup>	Healthcare providers in 2 general hospitals N = 1110 (80% women)	Baseline 12 months 36 months	492 healthcare providers of 1 hospital 73%, 77%, 60% participation at pre- and post-intervention follow-ups	618 healthcare providers of another hospital 69%, 62%, 60% participation at pre- and post-intervention follow-ups	A priori risk assessment of psychosocial work factors and psychological distress Identification of priorities by the intervention team (2 researchers and 12 employees) Implementation of interventions by managers Documentation of the interventions	Psychological distress Burnout
White-collar insurance services study <sup>c</sup>	White-collar workers of 3 insurance organizations N = 2167 (60% women)	Baseline 6 months (shown) 30 months (not shown)	1093 workers of 1 organization 81%, 86%, 85% participation at pre- and post-intervention follow-ups	1074 workers of 2 other organizations 81%, 86%, 85% participation at pre- and post-intervention follow-ups	A priori risk assessment of psychosocial work factors and psychological distress Identification of priorities through focus groups with workers Implementation of interventions by managers Documentation of the interventions	Hypertension Blood pressure Psychological distress Musculoskeletal symptoms

<sup>a</sup>Bourbonnais et al. (2005)

<sup>b</sup>Bourbonnais et al. (2006a, b, 2011)

<sup>c</sup>Brisson et al. (2006), Gilbert-Quimet et al. (2011), and Trudel et al. (2011)

replacements at the unit level rather than at the hospital level to improve stability of the personnel (psychological demands), regular work team meetings (job control and social support), and special training to cover specific needs such as palliative care (job control). Other solutions requiring the approval and support of management could only be implemented on a mid- or long-term basis. These solutions included better training for new nurses during the probation period (job control), enrichment of tasks for beneficiary attendants (job control), new system of medication distribution (psychological demands), and revision of the information and communication system through the hospital, between units, and between shifts (psychological demands and social support). These solutions were consistent with the adverse psychosocial work factors identified as intervention targets (Bourbonnais et al. 2006b).

The **white-collar insurance services study** (Brisson et al. 2006; Gilbert-Ouimet et al. 2011) was conducted among three semipublic organizations with jobs covering the full range of white-collar positions, including senior and middle managers (5%), professionals (38%), and technicians and office workers (57%). The intervention group was composed of 1093 workers from organization A. Organization A was composed of 12 departments, 9 of which were targeted by the intervention based on an a priori risk assessment (described below). The control group was composed of 1074 workers, who were either employed in 2 other semipublic insurance organizations (B, C) or working in the 3 departments of organization A, for which no intervention was implemented. In this study, an a priori risk assessment was performed separately for each department. If the prevalence of an adverse psychosocial work factor was higher than in reference populations, this factor was identified as an intervention priority. The results of this risk assessment were presented in written reports and during an oral presentation to the managers of each department. A second part of the development phase was to conduct focus groups with workers in order to identify, from the workers' point of view, organizational changes that would help reduce the adverse psychosocial work factors previously identified as intervention targets (Brisson et al. 2006; Trudel et al. 2009). These ideas were then presented to managers in written reports and during an oral presentation as suggestions for interventions. During implementation, key informants from each department kept a logbook systematically documenting every change implemented in their department that aimed to improve the psychosocial work environment (Gilbert-Ouimet et al. 2015). Changes implemented were consistent with intervention priorities identified a priori and covered all four adverse psychosocial work factors (Gilbert-Ouimet et al. 2015). Reward and social support were the most commonly targeted psychosocial work factors. The intervention group also implemented four times more major changes than the control group. These major changes were defined as those which reached a large percentage of employees in the department and brought about a genuine transformation in the work environment from the viewpoint of the key informants. Examples of major changes were slower implementation of a large project to prevent increased workload (psychological demands), increased workforce and replacement of long-term leaves (psychological demands), grouping teams together to facilitate the use of expertise and to promote synergy

(psychological demands and social support), career and skills development (job control), and improvement of management practices (psychological demands, job control, and social support).

## Intervention Effectiveness

Table 6 presents the effectiveness of the three intervention studies in reducing adverse psychosocial work factors. In the intervention groups, all three studies showed significant improvements in two (Bourbonnais et al. 2005, 2006a) or three (Brisson et al. 2006) adverse psychosocial work factors. In the long-term care centers study, statistically significant ( $p$ -values < 0.05) decreases in the prevalence of job strain (from 46.5% to 38.5%) and of low job control (82.9–76.7%) were observed at post-intervention. Although nonsignificant, there were also reductions in high psychological demands (59.4–57.8%), low social support from colleagues (33.2–27.4%) and from supervisors (30.5–26.8%), and ERI (48.9–46.3%). In the acute care hospitals study, two psychosocial work factors significantly improved 12 and 36 months post-intervention: high psychological demands (means of scores decreasing from 12.5 to 11.8 to 11.6) and ERI (from 1.10 to 1.08 to 1.00). Finally, in the white-collar insurance services study, significant decreases in the prevalence of high psychological demands (50.1–47.8%) and low coworker social support (53.9–50%) as well as low reward (sub-scale “lack of respect and esteem”; 36.1–29.8%) were observed. No improvements (Bourbonnais et al. 2005) or a single improvement (Bourbonnais et al. 2011; Gilbert-Ouimet et al. 2011) was observed in the control groups.

Of note, there was a significant reduction in the prevalence of high psychological demands in two of the three studies (Bourbonnais et al. 2011; Gilbert-Ouimet et al. 2011): the acute care hospitals study and the white-collar insurance services study. In these studies, decreasing the workload was identified as an intervention priority. Acting upon this psychosocial work factor implies improving components of the workload (e.g., increasing staff or replacing workers on sick leave), which can be difficult to accomplish considering the context of strong competition in the current globalized economy. However, findings of these two studies support the promising fact that it is possible to improve workers' workload.

Table 7 presents the comparison of health outcomes from pre- to post-intervention in the intervention and control groups. All three studies showed a decrease in the prevalence of high psychological distress in the intervention group, but this was only statistically significant in the white-collar insurance services study (32.9–29.2%). In the acute care hospitals study, work-related burnouts (means of scores decreasing from 48.2 to 46.3 to 43.2,  $p < 0.05$ ) and client-related burnouts (34.9 to 36.2 to 33.0,  $p < 0.10$ ) also decreased between pre-intervention and 12- and 36-months post-intervention. In the control groups, there was no improvement in any of the mental health indicators and in the long-term care centers study; psychological distress even increased in the control group (nonsignificant). In the white-collar insurance services study, a significant reduction in systolic (–2.3 mmHg) and diastolic (–1.3 mmHg)

**Table 6** Examples from the three organizational-level psychosocial intervention studies: comparison of psychosocial work factors in the intervention and control groups from pre- to post-intervention

Study	Psychosocial work factors	Intervention group		Control group	
		Baseline (prevalence; %)	12 months (prevalence; %)	Baseline (prevalence; %)	12 months (prevalence; %)
Long-term care centers study <sup>a</sup>	High demands	59.4	57.8	56.5	53.4
	Low control	82.9	76.7*	87.1	85.4
	Job strain	46.5	38.5*	47.6	44.8
	Low social support from colleagues	33.2	27.4	31.6	32.6
	Low social support from supervisors	30.5	26.8	37.7	33.9
	Low reward	41.3	44.4	57.5	53.0
Acute care hospitals study <sup>b</sup>	ERI	48.9	46.3	51.2	48.8
	High demands	12.5	11.8*	13.3	12.9
	Low control	69.9	68.7*	69.4	68.0*
	Low social support from colleagues	12.5	12.5	12.5	12.2*
	Low social support from supervisors	11.5	10.8*	11.1	10.4
	Low reward	30.8	31.11	30.2	30.0
	ERI	1.10	1.08*	1.2	1.16

(continued)



**Table 6** (continued)

Study	Psychosocial work factors	Intervention group		Control group	
		Baseline (prevalence; %)	6 months (prevalence; %)	Baseline (prevalence; %)	6 months (prevalence; %)
White-collar insurance services study <sup>c</sup>	High demands	50.1	47.8*	35.9	37.2
	Low control	56.2	56.7	59.9	59.5
	Low social support from colleagues	53.9	50.0*	52.4	49.5
	Low social support from supervisors	52.1	52.2	54.6	53.8
	Low reward	50.5	51.0	58.2	54.8*
	Low respect and esteem	36.1	29.8*	NA	NA
	ERI	29.8	29.2	21.4	20.6

\*denotes statistical significance ( $P$  value  $<0.05$ ) for intragroup comparison between pre- and post-intervention measures

<sup>a</sup>Bourbonnais et al. (2005)

<sup>b</sup>Bourbonnais et al. (2006a, b, 2011)

<sup>c</sup>Brisson et al. (2006), Gilbert-Quimet et al. (2011), and Trudel et al. (2011)

**Table 7** Examples from the three organizational-level psychosocial intervention studies: comparison of health outcomes in the intervention and control groups from pre- to post-intervention

Study	Health outcomes	Intervention group		Control group	
		Baseline (prevalence; %)	12 months (prevalence; %)	Baseline (prevalence; %)	12 months (prevalence; %)
Long-term care centers study <sup>b</sup>	Psychological distress	44.9	42.3	43.6	46.0
		Baseline (mean score)	12 months (mean score)	Baseline (mean score)	12 months (mean score)
Acute care hospitals study <sup>c</sup>	Psychological distress	21.9	20.6	22.6	22.4
		Baseline (mean score)	36 months (mean score)	Baseline (mean score)	36 months (mean score)
	Client-related burnout	34.9	33.0 <sup>a</sup>	36.3	37.8
		Baseline (mean score)	36 months (mean score)	Baseline (mean score)	36 months (mean score)
	Work-related burnout	48.2	43.2*	48.1	48.3
		Baseline (mean score)	36 months (mean score)	Baseline (mean score)	36 months (mean score)
White-collar insurance services study <sup>d</sup>	Systolic blood pressure (mean)	126.5	124.2*	124.5	124.2
		Baseline (prevalence; %)	6 months (prevalence; %)	Baseline (prevalence; %)	6 months (prevalence; %)
	Diastolic blood pressure (mean)	80.8	79.5*	79.3	79.0
		Baseline (prevalence; %)	6 months (prevalence; %)	Baseline (prevalence; %)	6 months (prevalence; %)
	Hypertension	31.0	27.5*	25.2	30.9
		Baseline (prevalence; %)	6 months (prevalence; %)	Baseline (prevalence; %)	6 months (prevalence; %)
	Psychological distress	32.9	29.2*	30.1	30.9
		Baseline (prevalence; %)	6 months (prevalence; %)	Baseline (prevalence; %)	6 months (prevalence; %)

\*denotes statistical significance ( $P$  value  $<0.05$ ) for intragroup comparison between pre- and post-intervention measures.<sup>a</sup>denotes borderline statistical significance ( $P$  value  $<0.10$ ) for intragroup comparison between pre- and post-intervention measures<sup>b</sup>Bourbonnais et al. (2005)<sup>c</sup>Bourbonnais et al. (2006a, b, 2011)<sup>d</sup>Brisson et al. (2006), Gilbert-Quimet et al. (2011), and Trudel et al. (2011)

blood pressure means was also observed. The prevalence of hypertension also significantly decreased from 31.0% to 27.5%. No such difference was observed in the control group. Hypertension prevalence even rose from 25.2% to 30.9% (non-significant) in the control group.

Changes in health outcomes should be statistically compared between the intervention and control groups in order to accurately assess the intervention effect. These complementary analyses were performed in the acute care hospitals study and in the white-collar study. In the acute care hospitals study, the mean scores for client-related and work-related burnout were significantly lower ( $p < 0.05$ ) in the intervention group than in the control group at 36-months post-intervention. The difference in mean score for psychological distress was of borderline significance. In the white-collar study, the change in the prevalence of psychological distress (decrease) was significantly different from the change (increase) observed in the control group ( $p = 0.03$ ). The effectiveness of the intervention in reducing blood pressure was also evaluated. The differential decrease in blood pressure between the intervention and the control group was 2.0 mmHg (95% CI:  $-2.9, -1.7$ ) for systolic blood pressure and 1.0 mmHg (95% CI:  $-1.7, 0.4$ ) for diastolic blood pressure ( $p < 0.01$ ) (Trudel et al. 2011). The differential change in hypertension prevalence was also statistically significant ( $p < 0.0001$ ) in favor of the intervention group. Taken together, these results demonstrate a beneficial effect of the interventions on health outcomes.

In conclusion, improvements in the psychosocial work environment were observed in the three organizational-level psychosocial intervention studies. Improvements in blood pressure levels, hypertension prevalence, psychological distress, and burnout prevalence were also observed. The next section will highlight the contextual elements that are of particular importance for understanding these findings.

## **Contextual Elements Facilitating or Hindering Intervention Effectiveness**

In the three organizational-level psychosocial intervention studies presented above, improvements in both the psychosocial work environment and workers' health outcomes were observed. Several important contextual elements occurred in these three studies that had an impact on the development, implementation, and evaluation of the interventions as well as on intervention effectiveness. This section will discuss these elements in depth.

In the long-term care centers study, the main contextual elements that favored the improvements observed were the active support of high managers and the fact that the intervention team was representative of all care providers for each work shift (e.g., members of the management, head nurses, union representatives, nurses, assistant nurses, and support staff) (Bourbonnais et al. 2011). However, it was pointed out that the 12-month intervention period was insufficient to adjust and implement some of the action plans (Bourbonnais et al. 2011). Qualitative interviews

revealed that workers had great expectations toward the interventions. The only-partial implementation of the action plans generated frustration. This might help to explain the rise in the prevalence of low reward observed from pre- to post-intervention (41.3–44.4%). A longer intervention period might have led to a more thorough implementation of the action plans. A longer follow-up might also have revealed that the nonsignificant improvement observed for psychological distress was in fact the start of a larger beneficial effect. This underlines the need to evaluate both the short- and long-term effects of psychosocial workplace interventions.

In the acute care hospitals study, a large majority of the solutions proposed by the intervention team were implemented (80%) (Bourbonnais et al. 2011). One of the main intervention targets was to improve social support by stimulating “team work and team spirit.” However, contextual difficulties were suggested as having prevented the improvement of social support. These difficulties involved the conflicting needs and priorities of management and employees as well as communication problems between workers from different work shifts and care units. Nevertheless, in the intervention group, the level of social support remained stable, while in the control group, social support from supervisors deteriorated.

Compared to the two intervention studies conducted among healthcare providers, the beneficial effects observed in the white-collar insurance services study were facilitated by three main components. First, the study took place among white-collar workers benefiting from regular daytime schedules (8 h00–16 h00). Considerable evidence has demonstrated that shift work and night work have deleterious health effects (Ulhoa et al. 2015). As such, it is possible that non-regular schedules diluted beneficial intervention effects among the healthcare providers. Second, interventions in the white-collar insurance services study were mainly implemented at the departmental level, meaning that they were specific to each department’s priorities. This was not the case in the interventions among the healthcare providers. Members of a hospital intervention team reported that “means of communication were deficient, which made it difficult to share information between people working different shifts and with other care units in the hospital” (Bourbonnais et al. 2006b). Third, the intervention group of the white-collar insurance services study was involved in a reward promotion program at the time of the study. This program could help explain management’s interest in acting to improve reward.

The results of the 30-month follow-up of the white-collar insurance services study are not presented here. Preliminary results show that the beneficial effects observed in the intervention group were maintained at 30 months, supporting the long-term effectiveness of such organizational-level psychosocial interventions in reducing blood pressure and improving mental health.

The three intervention studies presented in this chapter had some substantial strengths. They respected most of the quality criteria presented in section “[Criteria for Conducting High-Quality Organizational-Level Psychosocial Intervention Studies](#)” of this chapter. First, the participative process of these studies relied, from the start, on both management commitment and employee involvement, which are recognized conditions for successful preventive interventions (Goldenhar et al. 2001; Mikkelsen et al. 2000). Second, the studies used a quantitative a priori risk assessment as well as

qualitative methods that allowed intervention targets and priorities to be identified. Third, the multiple component interventions made it possible to target several of these priorities simultaneously. Fourth, the studies relied on a sound theoretical background favoring a choice of targets and solutions based on four well-defined psychosocial work factors whose deleterious effects on cardiovascular health outcomes (Babu et al. 2014; Gilbert-Ouimet et al. 2013; Kivimaki et al. 2012; Landsbergis and Schnall 2013; Nyberg et al. 2013) and mental health problems (Bonde 2008; Ndjaboue et al. 2012; Netterstrom et al. 2008; Stansfeld and Candy 2006) have been observed in various work settings. Relying on well-defined psychosocial work factors also had the advantage of allowing researchers to translate what managers and staff considered “irritants” into higher-order theoretical concepts, thereby increasing their level of understanding of the adverse impact of these work exposures on health. Finally, the three-phase theoretical framework used (development, implementation, and effectiveness) is exportable to other workplaces.

### **Impact on Organizational and Management Practices**

The results of the white-collar insurance service study led to the elaboration of a guide of organizational practices beneficial to workers’ health (Gilbert-Ouimet et al. 2009). This guide was intended to promote the implementation of organizational practices that have the potential to improve the psychosocial work factors from DCS and ERI models, that is, psychological demands, job control, social support at work, and reward. The guide includes 18 practices that are coherent with available empirical evidence and researchers’ expertise. The organizational practices were classified according to five organizational dimensions, namely, (1) participative management, (2) interpersonal aspects and support, (3) work organization, (4) career and skills development, and (5) mission, culture, and leadership. These dimensions were selected from theoretical models of organizational performance and change (Burke 2002; Peters and Waterman 1982). Table 8 presents the 18 organizational practices and the psychosocial work factor(s) they target.

A recent research project identified factors facilitating or preventing the implementation of the practices suggested in this guide and in other tools to improve psychosocial work factors (Biron et al. 2015). Over 100 managers of four organizations participated in the project. To identify factors influencing implementation of the organizational practices, self-reported questionnaires were administered at baseline (N = 144) and 3 months later (N = 157). The results showed that managers were more likely to implement these practices when (1) their organization gives high priority to mental health; (2) they have more job control; (3) they have better relationships with their subordinates; and (4) they are less psychologically distressed. Also, men and older managers were the most likely to adopt organizational practices promoting employees’ health (Biron et al. 2015). It is worth noting that managers’ workload was not identified as a factor influencing implementation of

**Table 8** Organizational practices that aim to improve psychosocial work factors according to five organizational dimensions

Organizational dimension	Organizational practice	Psychosocial work factor(s) targeted
Participative management	1. Creating committees, workshops, team meetings (participation in decision making)	Job control Social support
	2. Having individual meetings with managers (adjustment of the tasks and workload and talk about difficulties)	Psychological demands Job control Social support
Interpersonal aspects and social support	3. Holding reward activities (for the work done)	Reward
	4. Highlighting employees' successes	Reward
	5. Holding interpersonal activities	Social support
Work organization	6. Revising work processes	Psychological demands Job control Social support Reward
	7. Introducing work tools that facilitate work task (s)	Psychological demands
	8. Implementing organizational changes progressively	Psychological demands
	9. Increasing staff (temporarily or permanently)	Psychological demands
	10. Replacing employees on sick leave	Psychological demands
	11. Introducing flexible scheduling	Psychological demands Job control
	12. Enriching tasks	Job control
Career and skills development	13. Revising task complexity	Psychological demands Job control
	14. Coaching/mentoring	Social support Reward
	15. Encouraging participation in training activities	Job control
Mission, culture, leadership	16. Communicating objectives, mandates, issues	Social support
	17. Defining and diffusing politics and action plans to employees	Psychological demands Job control Social support Reward
	18. Managing the planning of the workforce	Psychological demands Job control

Adapted from Gilbert-Ouimet et al. (2009)

these practices, suggesting that adopting good management practices doesn't increase the workload of managers (Biron et al. 2015).

## Future Research

The three intervention studies presented in this chapter provide evidence that it is possible to conduct high-quality organizational-level intervention studies. These studies respected most of the quality criteria outlined in section “[Criteria for Conducting High-Quality Organizational-Level Psychosocial Intervention Studies](#)” of this chapter. Consistent findings were observed across all three intervention studies. That is, all three studies observed improvements in the psychosocial work environment and on workers' health outcomes in the intervention groups, while almost none was observed in the control groups. Together, these findings are noteworthy given the inconsistent results observed in the literature regarding the health effects of organizational-level interventions, as described in section “[Organizational-Level Psychosocial Interventions and Health: State of the Evidence](#)” of this chapter. As such, considering and meeting the quality criteria detailed in section “[Criteria for Conducting High-Quality Organizational-Level Psychosocial Intervention Studies](#)” of this chapter should help in the execution of future rigorous research in this area. These criteria should be considered before the beginning of the intervention process, that is, before intervention development begins. Moreover, respecting these quality criteria may foster intervention success or, at least, provide a better understanding of intervention failures.

It is important to note that the three intervention studies presented in this chapter used a quasi-experimental design and that very few randomized controlled trials have been conducted in this context (Montano et al. 2014). Although often considered the “gold standard” in intervention research, conducting a randomized controlled trial is often not feasible and may even be undesirable in a number of real-life situations (Kristensen 2005; Nielsen and Randall 2013). However, alternative experimental designs are available and should be considered in future intervention research. For example, the stepped wedge cluster randomized trial implies a randomized and sequential allocation of the intervention to all participants, which could improve both acceptability and feasibility (Schelvis et al. 2015). Such alternative designs could strengthen our ability to draw causal inferences on the effectiveness of workplace interventions.

A limitation in this field of research is that the differential effects of workplace interventions according to sex/gender and socioeconomic status are rarely studied (Bambra et al. 2007; Egan et al. 2007). Indeed, most studies statistically control for sex/gender and socioeconomic status in their analyses, possibly concealing important differences. These differences are plausible given that the prevalences of adverse psychosocial work factors tend to be higher in women than in men (Brisson et al. 2011) and among workers of lower socioeconomic status (Adler and Newman 2002). More so, differences between these subgroups have been observed in the effects of psychosocial work factors on cardiovascular and mental health outcomes

(Backe et al. 2012; Belkic et al. 2004; Bonde 2008; Eller et al. 2009; Hemingway and Marmot 1999; Kivimäki et al. 2006; Landsbergis et al. 2013; Netterstrom et al. 2008; Stansfeld and Candy 2006). In the white-collar insurance services study, beneficial effects on psychological distress and blood pressure were observed in both women and men, which supports the consistency of the intervention effects across both sexes/genders. The potential modifying effect of socioeconomic status is also poorly documented. Indeed, previous intervention studies were mainly conducted among workers from similar occupation categories, therefore limiting the possibility to examine such effects (Montano et al. 2014). Future research should explore potential differences between women and men and according to socioeconomic status and report if such differences exist.

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## The Role of Public Health Policies

A recognized strategy to promote the implementation of organizational-level interventions is in the form of public health policies. Organizations can be supported by these policies in order to partake in the primary prevention of adverse psychosocial work factors and thus improve the health of the working population. Worldwide, several interesting initiatives of this kind exist. For example, the United Kingdom's Health and Safety Executive proposed a set of managerial standards to reduce or control adverse psychosocial work factors (Health and Safety Executive 2007). Six factors were targeted: workload, control, support, interpersonal relationships, roles, and transformation (organizational changes). Several case studies published on the Health and Safety Executive website report positive improvements in the psychosocial work environment and a reduction in sickness absence (Health and Safety Executive n.d.).

In Canada, there are two voluntary standards that aim to promote organizational practices that support favorable psychosocial working conditions: *Psychological Health and Safety in the Workplace* (CAN/CSA-Z1003-13/BNQ9700-803/2013) and *Prevention, Promotion and Organizational Practices Contributing to Health in the Workplace* (BNQ9700-800/2008). The first standard, launched in January 2013, specifically aims to improve the mental health of workers. The organizational practices it promotes are easily tied to components from the DCS and ERI models (Canadian Standards Association et al. 2013). A group of Canadian researchers are currently conducting case studies in order to document the successes and failures in implementing this standard (Mental Health Commission of Canada 2015). Regarding acceptability of this standard for stakeholders, a recent study showed that the standard was positively described as a resource that could provide direction, tools, and guidance to address psychosocial factors in the workplace and that standard implementation was associated with a broad range of potential benefits for employees, employers, and workplaces (Kunyk et al. 2016).

The second standard was published in 2008 (Bureau de Normalisation du Québec 2008) in the province of Quebec (Canada) and is currently being reviewed for pan-Canadian application. This standard, most commonly called the Quebec Healthy



Enterprise Standard, aims to improve the work environment in order to sustainably improve the physical and mental health of workers. It addresses four areas of activities: Lifestyle habits, Work-life balance, Workplace environment, and Management practices. This latter area specifically targets the organizational and management practices that promote a healthy psychosocial work environment. Recently, a research project aimed to evaluate the effects of the Quebec Healthy Enterprise Standard on adverse occupational exposures and health outcomes of workers from ten Quebec organizations that implemented the standard (Aubé et al. 2019; Letellier et al. 2018). Generally, an improvement in the psychosocial work environment was observed among organizations more exposed to organizational-level psychosocial interventions from the Management practices area compared to organizations that were less exposed to these interventions (Letellier et al. 2018). More specifically, beneficial effects of interventions were observed for three psychosocial work factors: social support at work (prevalence decreased by 13% in exposed organizations while only decreasing by 2% in less exposed organizations), reward (decreased by 14% in exposed, increased by 11% in less exposed), and ERI (decreased by 6% in exposed, increased by 17% in less exposed). Moreover, beneficial effects of the psychosocial interventions were also observed on workers' psychological distress; the prevalence of high psychological distress decreased over a period of 2–3 years from 32.2% to 26.6% (a 17% decrease) in organizations more exposed to these interventions, while the prevalence only decreased by 4% in organizations that were less exposed. Few effects were observed on musculoskeletal outcomes (Aubé et al. 2019). These results suggest that psychosocial workplace interventions implemented in the context of this standard improved the psychosocial work environment and had beneficial effects on workers' mental health.

It is interesting to note that in Quebec, the Quebec Healthy Enterprise Standard is part of two public policies. The first one is the *Programme National de Santé Publique* (National Program of Public Health) which aims to orient the activities of public health employees in each regional Public Health Department (Ministère de la Santé et des Services sociaux 2015). The second one is the *Politique Gouvernementale de Prévention en Santé* (Government Policy in Health Prevention), which aims to financially support multi-sectorial initiatives for improving population health (Ministère de la Santé et des Services sociaux 2016).

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## Conclusions

Cardiovascular diseases, mental health problems, and musculoskeletal problems result in important costs and losses to productivity from an occupational standpoint, but these health problems also incur a heavy economic and social burden from a public health perspective. Given the role of adverse psychosocial work factors in the development of these health outcomes, organizational-level interventions aiming to reduce these adverse work factors are thus important in the contexts of both occupational health and public health. At the occupational health level, organizational-level interventions promote a healthy and productive workforce. At the public

health level, workplaces are considered pertinent settings to improve the health of the population as a whole.

As supported by the presented evidence, organizational-level psychosocial interventions appear to be a promising approach that could lead to significant benefits in disease prevention. Indeed, in the three intervention studies presented in this chapter, improvements in psychosocial work factors, blood pressure levels, hypertension prevalence, psychological distress, and burnout prevalence were observed at post-intervention. More evidence is needed to assess the effect of these types of interventions on workers' musculoskeletal health. At the population level, blood pressure reductions in the range observed in one of these studies may prevent a large number of premature deaths and disabling strokes. Indeed, at the population level, lowering the mean systolic blood pressure by 2 mmHg could result in approximately 10% lower stroke mortality and 7% lower mortality from ischemic heart diseases or other vascular causes in middle age (Lewington et al. 2002).

In order to advance our knowledge and as demonstrated by the three intervention studies presented in this chapter, it is important to follow a rigorous intervention research process. The quality criteria presented in this chapter are prerequisites to advance research in this area. Future research should also explore potential differences between women and men and according to socioeconomic status and report if such differences exist. Moreover, using alternative experimental designs could strengthen our ability to draw causal inferences on the effectiveness of organizational-level interventions.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [From National Labor and Social Policies to Individual Work Stressors](#)
- ▶ [The Demand Control Support Work Stress Model](#)

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# Financial Gains, Possibilities, and Limitations of Improving Occupational Health at the Company Level

# 27

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## Abstract

Putting a price on people and measuring the financial gains from investments in human resources stem back to the Romans and the eighteenth century, respectively. In the 1960s, the interest increased tremendously. Researchers in economics, accounting, sociology, and psychology argued that to increase and improve investments in the workforce, accounting and calculation methods for estimating the financial gains need to be developed. Accounting and utility models were suggested. Additionally, numerous investigations of financial gains were performed. Unfortunately, many of these studies were of poor quality. However, during the last couple of decades, some good studies have demonstrated the

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© Springer Nature Switzerland AG 2020  
T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_23](https://doi.org/10.1007/978-3-030-31438-5_23)

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profitability of improving occupational health at the company level. In the present chapter, some well performed recent studies as well as the most common shortcomings in many studies will be referred to. Special attention will be devoted to the issue of productivity. The reason why financial gains are subject to an (increasing) interest is to increase and improve investments in the workforce. However, Swedish studies have demonstrated that although calculating the economic benefits of investments is important to create attention, it is not enough to start a process of change at the company level. The latter is a much wider and a much more complicated issue. The calculus needs to be put into a wider context, i.e., a performance management context. In the last section of the chapter, a framework for designing and analyzing occupational health management is suggested.

### Keywords

Occupational health · Financial gains · Productivity · Human resource costing and accounting · Occupational health management systems

## Introduction

Putting a price on people in the workforce is not a new issue. Examples of this idea refer back to, e.g., the Roman age (Guillet de Monthoux 1983) and to the medieval wars. In case of the latter example, the value of prisoners of different rank was settled in a price list for trading purposes. The price list below (Table 1) was agreed upon between Austria and Sweden in 1642 based upon the following price list (in thaler). A field marshal was considered to generate a high income when selling him back to the (former) enemy, whereas a soldier without rank was very cheap for the enemy to buy.

Because the prisoner was conceived as the general property of the capturing soldier, a quick decision had to be reached already on the battlefield whether to kill or spare the prisoner's life. Costs of keeping the prisoner had to be compared with expected future income, i.e., a cost-income evaluation had to be performed very quickly. When the state moved in to claim ownership of the prisoner, the efficiency of the market declined. The incitement for the individual soldier to capture a prisoner was lost. After the revolution, France forbade the trade of prisoners. Casualties increased dramatically according to Frey and Buhofer (1986).

**Table 1** Market price (in thaler) on prisoners during the medieval European wars according to Frey and Buhofer (1986)

Field marshal	20,000
Colonel	1000
Cavalry captain	200
Infantry captain	150
Noncommissioned officer	16
Private	8

The consequences of taking prisoners and then selling back demonstrate a historically early example of financial gains of good occupational health (OH) in an occupation with high risk and hazards including severe injuries and fatality. This economic thought with respect to the workforce was also prominent among philosophers like Adam Smith and Karl Marx. Von Thunen held that to fail to see people as capital resources may be especially harmful in times of war because then "...a hundred men may be sacrificed during a battle to save one canon." "The reason for this is that ... the purchase of canon costs the public money, while people may be obtained free of charge..." (Schultz 1961), p 2. A more contemporary example concerns US Steel that 100 years ago claimed that the return of every dollar spent on health investments in the workforce was 2.3 times as high.

Although there are many early examples (Johanson 1992), the development did not really take off until the early 1960s when Brummet et al. (1968) proposed accounting methods for treating human resources. They labeled this *human resource accounting* (HRA). For example, models were developed for managerial purposes as well as for reporting human resource investments and values to capital markets (Brummet et al. 1968; Hermansson 1964). The American Accounting Association defined HRA as "the process of identifying and measuring data about human resources and communicating this information to interested parties... It involves measuring the costs incurred by business firms and other organizations to recruit, select, hire, train and develop human assets. It also involves measuring the economic value of people to organizations" (Flamholtz et al. 1985).

However, the idea of measuring human resources stems not only from accountants and economists; psychologists and sociologists have also proposed that the financial utility of different activities in the field of human resource management ought to be measured. In 1965, Cronbach and Gleser (1965) developed models for estimating the utility of personnel selection. They used the concept "utility analysis" (UA) which was defined as a way of forecasting the net financial benefits resulting from human resource interventions.

In the 1960s, HRA rose rapidly to the upper echelons of the research agenda, and during this period, basic academic research to develop and assess the validity of models for the measurement of human resource cost and value was performed (Flamholtz et al. 1985). Already in the 1970s, a widespread erroneous belief emerged suggesting that HRA was concerned only with treating people as financial objects. "Although preparing financial statements that included human resources was undoubtedly a part of HRA, it was not by far the most significant part. Yet precisely because it was dramatic and innovative, 'putting people on the balance sheet' became the dominant image of HRA for many people" (Ibid., pp. 2–3). At the end of the 1970s and in the beginning of the 1980s, the interest in HRA declined within both academia and the corporate world. However, when the interest declined in the USA as well as in France and other countries, it increased in Sweden and later in the other Nordic countries.

Accounting for investments in people (e.g., OH) became a big issue in Sweden in the 1980s. To embrace HRA and UA, Gröjer and Johanson (1996) suggested the concept of Human Resource Costing and Accounting (HRCA), and in the late 1980s,

the Swedish government became interested in the ideas. Sick leave rates as well as personnel turnover rates were very high at that time, and in 1991 the government initiated a discussion of a legal obligation for firms with more than 100 employees to submit a public human resource profit and loss account on an annual basis. The idea was that if information about the employers' costs for sick leave and personnel turnover was specified in a human resource, profit and loss account attention and change in behavior would occur at the level of the organizational boards.

The viewpoint in the present chapter is that if improvement of OH is at stake, learning from company performance management would be beneficial. OH management is not unique. Rather, it is comparable to other performance management systems. A basic condition is that attention to the issue of OH needs to be addressed. One way of creating attention is by demonstrating financial gains of OH investments. Using the financial language also underlines the importance of integrating OH performance management with financial performance management. The consequences of this perspective are that improving occupational health at the workplace involves several issues. These issues concern not just the processes of strategies, targets, and follow-ups but also factors such as responsibilities and reward processes as well as coherence with basic OH views. The demands on an OH management system that improves health at the workplace will be discussed in the last section of the present chapter. First, recent studies of the financial gains of OH investments will be addressed.

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## **Financial Gains of OH Investments, Recent Studies**

Many studies in the area provide a promise that the link between OSH investments and productivity is subject to investigation. However, a closer examination leads to disappointment. The word productivity has usually meant either reduction of sick leave or cost savings. The studies are usually conducted in the USA where the incentive to make profitability studies is greater than, for example, in Sweden, due to the major differences in social security systems. In the USA, it is sometimes included in the employment contract that the employer will pay expenses for, for example, health insurance, hospital care, and medicine. Most of these studies are of limited quality. Often, evaluations have been made only after a change effort, which makes it impossible to compare with what it was before. Most evaluations are also made too soon after a change. Another problem is that it is difficult to collect data because they are to be found in several different and uncoordinated information systems, such as accounting, production, sales support, or personnel systems. A third problem is that many studies are based on cross-sectional data as opposed to longitudinal data.

Comprehensive scientific research reviews, however, show that there are some good longitudinal studies, which show strong indications of the relationship between ill health and poor financial company performance (Aldana 2001; Golaszewski 2001). For example, stress, BMI (weight), and multiple concurrent stress-related risk factors show a clear connection with higher healthcare costs (Aldana 2001). An international review of OH investments regarding prevention efforts showed a return

of up to twice the investment (Bräunig and Kohstall 2013). A study on Swedish workplaces demonstrated high productivity gains (Roos et al. 2005). Through a long-term, systematic and scientific qualitative preventive work involving both the workplace and the employee, productivity increased by up to five percent. Payoff time was shorter than 8 months. This is to say that there are clear indications that OH investments provide great opportunities for increased profitability.

Even if some high-quality studies exist with respect to productivity, many more studies are needed. In a Swedish study of 108 private and public organizations, it was investigated to what extent productivity was an effect of work environment investments. It was found that productivity effects were seen to be by far the biggest output of the investments (Johanson 1997). Productivity effects were about five times higher than the decrease in sickness absence costs. The respondents were also much safer in their assessments of effects on productivity than other effects, such as sickness absence. On average, 72% of the productivity improvements identified was due to the investment made. The corresponding figure for sick leave cuts was only 35%.

A tricky issue is how to measure productivity in financial terms. In a large register-based study conducted during the first decade of the 2000s in the four Nordic countries, Denmark, Finland, Norway, and Sweden, the connection was investigated between employee well-being and productivity defined as value added (Foldspang et al. 2014). Existing national registers were used for data acquisition. Employee well-being was divided into two components, questions that can be attributed to the physical and psychosocial work environment. The statistical material in Denmark and Sweden enabled investigation of the link between individual data and company data. It turned out that employees' perceptions of the physical work environment were a good predictor of the development of business performance (measured as value added). Between the perception of the psychosocial work environment and the development of value added, there was no corresponding relationship. The results were the same in Norway and Finland. However, in these countries, the analysis was not possible at the individual level but was carried out at industry level. The Norwegian material also showed that a reduction in sick leave had a positive effect on the value added.

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## **The Financial Gains of OH: A Newcomer for Measuring Productivity in Financial Terms**

In order to implement improvements in the working environment and to promote employees' health, it is important to be able to analyze and discuss "the solution," i. e., the trade-off between short-term demands of organization management and the long-term benefits of the improvements – in the language of cost and benefit analyses of the resources at stake (Berlin and Adams 2017).

An improvement in the health and performance and reduced sickness absence of employees does not always present enough argument for investments in OH. By showing the cost related to OH and work environment, related problems in excess of

the worker's wage and the potential benefits to be gained by the organization due to investments can be more persuasive. This has been confirmed in several decision-making experiments in the 1970s and 1980s mainly in the USA (Johanson 1992).

In the Miller and Haslam (2009) study based upon interviews with OH and safety professionals, three reasons including the legal requirements, economic incentives, and the moral reasons were at the forefront as to why employers invest in employees' health. It is therefore not strange to state that the "language of economics" when communicating with the necessary people can be used to make a good business case for any intervention that may have a better chance of making it through the decision stages and a lasting positive impact on the operations of the organization. According to van Dongen et al. (2013), the OH decision-making starts with the initiation stage where the need for an intervention is established followed by the developing and implementation stage and then the business case in order to receive senior management approval. Information on the financial implications of OH interventions, especially the employer's costs and benefits during this stage, is of great importance. This rational decision-making process works when it comes to single projects, but it has its limitations when a sustainable integration of OH is an ongoing concern. Johanson (1999) found that although managers individually learned and made different decisions with financial OH information, a long-term organizational learning did not occur. In spite of the fact that profitability with respect to OH investments was shown, some barriers were revealed with respect to integrating the financial perspective in the ongoing business management. These barriers concerned the existing accounting system but also motivation and commitment to a changed behavior, i.e., to include human resource costing and accounting in the day-to-day talks and decision processes (Johanson 1999). Barriers and prerequisites for a long-term integration of OH in management practices will be discussed in the last section of the chapter.

Economic evaluation is a comparative analysis where at least two or more interventions that require resources are compared to one another in terms of costs and benefits. An economic evaluation combines information about whether an intervention is more or less effective with information about whether it is more or less costly. The most common types of economic evaluations used to help decision-makers to define basic benefit packages are *cost-effectiveness analysis* and *cost-utility analysis*. In a cost-effectiveness analysis, the effects are expressed in a natural one-dimensional measure or in clinically relevant effect measures, e.g., number of pain-free days or number of cases or injuries avoided. The result of a cost-effectiveness analysis is often expressed in terms of a cost-effectiveness ratio, e.g., cost per accidents or injuries avoided. In a cost-utility analysis, the cost is related to the effect measures expressed as survival and quality of life years, i.e., number of quality-adjusted life years (QALYs). The results are presented in analogy with a cost-effectiveness analysis as the cost per QALY. The identified benefits can clearly be seen here as emphasizing the health aspect, but it can even be described in terms of changes in the produced quantity and quality resulting from an intervention.

Most OH decision-makers, such as organization management experts, are familiar with the concept of cost-benefit analysis (CBA). In a CBA, both the costs and

benefits are measured in monetary units. In OH intervention studies, the CBAs are mostly described as return on investment (ROI) analysis which also is a sort of performance measure. Generally, employers are interested in CBAs with ROI as the main performance outcome because it is simple to understand and provide quick insight into the impact of an intervention on the organization's net benefits. Other methods such as *the payback period* are also commonly reported, but they provide less information related to the net present value (NPV) to analyze the profitability of investments over a period of time. There is a danger that managers will be motivated to choose the investment that maximizes their performance measure rather than maximizing the NPV.

To conduct an economic evaluation of OH, the cost and benefit measures that are to be included in the evaluation depend on the perspective from which the economic evaluation is performed. The perspective determines which costs and consequences are deemed relevant and therefore included in the analysis (i.e., all stakeholder costs, company costs, insurer costs, etc.). Most economic evaluations of OH interventions are performed from the employer's perspective. Other relevant perspectives, for example, workers and insurers, have also been used. A broader societal perspective is generally recommended because it provides insight into the net benefits of the intervention to the all decision-making parties. At least, thinking on the societal level brings a sense of the social security system into the frame of the analysis. When the employer's perspective is applied, it is often the case that the health-related expenses incurred by an employer (e.g., productivity implications) are included as the key worker outcomes. So, the value of worker health is often integrated in economic evaluations of OH interventions, but other methods may be needed to capture the productivity values related to the state of health of the worker or the values related to employee health or the productivity gain or loss by itself.

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## Making Sense of Productivity Loss

Productivity losses can also be a consequence of absenteeism and presenteeism – being ill but at work with a reduced capacity (Turpin et al. 2004). Other definitions of presenteeism only describe the act of being ill but at work (Johns 2010). Productivity loss arising due to impaired work performance, work disability, or work discontinuation is a major concern for workers, employers, and society at large. Apart from these sources mentioned above, finding a replacement for an affected worker experiencing, for instance, health problems or disability may present costs also referred to as friction period cost.

Productivity estimation based on sickness absenteeism is an important component in demonstrating the cost-effectiveness of OH interventions from the employer perspective (Krol and Brouwer 2014). Other productivity estimations have included presenteeism and the multiplier effects in co-workers participating in team work (Pauly et al. 2008; Stromberg et al. 2017; Zhang et al. 2015). Although the aforementioned studies claim that the cost associated with presenteeism may be higher

than absenteeism, the exact influence of presenteeism on productivity loss has yet to be established.

Different productivity loss instruments exist although the validity of the estimates they provide has been fiercely debated. Many of the measures lack basic psychometric properties but nonetheless lay claim to being construct valid (Ospina et al. 2015). This has often proven impossible to estimate; therefore, proxies of productivity loss which are estimated using self-reported data on absenteeism (i.e., sickness absence and/or presenteeism) are mostly used.

Studies quantifying productivity loss use several approaches. The valuation approaches include output-based methods, productivity in natural units, the human capital approach (HCA), the friction cost approach (FCA), the US panel approach (USP), the multiplier approach (MA), and workers' compensation expenses (CE) (Steel et al. 2018b). The two main approaches for estimating costs of productivity loss due to absenteeism and/or presenteeism are the human capital approach (HCA) and the friction cost approach (FCA) (Koopmanschap et al. 1995; Weisbrod 1961). The HC approach values production loss as all losses in terms of gross earnings of individuals due to illness and premature death. The FC method values lost productivity based on the time and resources (i.e., replacement costs) used to find a replacement for an absent worker within a friction period. Studies that have compared productivity loss values using both valuation approaches find that the results differ. (For more information about the main debates and developments regarding the measurement and valuation of productivity loss, please see the other publications cited in this paragraph.)

There is no standardized way of estimating the costs to facilitate the comparability of economic evaluations of occupational health interventions. The practical challenge to overcome is how to monetize self-reported productivity loss (Steel et al. 2018a). At the organization level, methods based on the premise that managers have a good sense of how the organization's productivity is affected by health-related problems have been used to estimate the costs of productivity loss from the employer perspective using the multiplier approach. From this way of valuing productivity loss, the economic consequences of impaired work performance have been shown to be substantial depending on the severity of illness (Pauly et al. 2008; Stromberg et al. 2017). To summarize, it seems that research regarding measuring and valuing productivity losses needs to be improved, no matter their sources.

Previous research could show that there is a positive association between work performance impairment and quality of life, implying that impaired work performance may be associated with lower quality of life (Brouwer et al. 2005). The conclusions were that productivity losses should rather be captured separately and included in economic evaluations. This position is supported by the work of the Washington Panel on cost-effectiveness analysis (Sanders et al. 2016). However, the quality of life measures for, e.g., the widely used QALYs have not yet been frequently used in economic evaluations of OH interventions. The presumption is that the use of QALYs is an unfamiliar terrain with occupational health decision-makers and that QALYs seem to be insensitive to mild conditions and in working groups which is the focus of OHS interventions. Other outcomes that occupational

health decision-makers feel is most important in terms of ill health such as “disease-adjusted working years” have been suggested (van Dongen et al. 2013). This outcome aims to express the amount of working years lost because of poor working conditions and work-related illness.

In order to estimate the economic consequences of impaired work performance based on the severity of illness, it has been suggested that costs of productivity loss are indirectly estimated using quality of life data and other background characteristics of the respondent (Brouwer et al. 2005). The response to this call was what resulted in the interest of deriving an algorithm that can predict productivity losses based on quality of life data using the EuroQol EQ-5D. Krol et al. (2014) study followed up with prediction models predicting the expected level of productivity in terms of absenteeism and presenteeism for multiple EQ-5D health states. The main finding of the study was that the predicted productivity loss related to absenteeism, but not presenteeism, closely resembled the levels that were conventionally measured. Another prediction study indirectly estimated productivity losses from EQ-5D. Although the study was based on actual time off paid employment of individuals, the results showed that their models were able to closely predict the minimum (zero days) days off paid employment but not the range where one would expect losses (Mukuria et al. 2017). Obviously, more studies using actual employee data on EQ-5D to predict productivity loss especially due to presenteeism and subsequently value the economic consequences may be desirable.

Typically, the cost of productivity loss by default has fallen to employers at the organization level and rightly so because the return in terms of benefits in an economic evaluation that compares alternative interventions could even be the reduction in productivity losses. The imposed economic burden of impaired work performance and work disability can be large in terms of the societal loss, namely, productivity costs beside other healthcare expenses. Findings from previous studies have also shown that the costs of productivity loss are at times even greater than the direct medical costs of illness or disability. Productivity loss can be reduced or prevented through effective interventions at the company level. In order to provide a justification for employers to pay for interventions, productivity costs should be a core part of any analysis that seeks to determine the appropriate height of spending to improve worker health and the work environment.

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## **Financial and Productivity Calculation Tools of OH Investments**

There exist documented studies on financial and productivity calculation tools ranging from those that focus only on the analysis of work environment risks to those that calculate the economic impact of the risk and those that solely focus on investment analysis. Rose et al. (2013) review on the tools relating the work environment to some sort of financial results found a little less than a dozen of them. Some of the tools are even computer-based with examples including the “potential method” and “product ability tool” to name a few.



A cost and benefit calculation tool should be characteristically better at specific details in terms of the costs (i.e., resources that are used to provide solutions or improvement) and the additional gains that can be achieved with the improvements in the workplace. For instance, by demonstrating that implementing a new machine may decrease sick leave costs caused by injuries and cutdown, the amount of production time – resulting in elevated productivity and improved level of product quality which can, in turn, increase sales profits – can be more convincing than a less detailed cost and benefit calculation.

A recently published tool aiming at integrating financial aspects of work health is a kind of HRCAs tool addressing work health issued by Karolinska Institute (Lohela Karlsson et al. 2016). The aim is to integrate financial aspects of work health with managerial attention, decision-making, and governance inside organizations. This tool, in particular, integrates the development of work environment suggestions for intervening measures combined with investment analysis.

One observation that has been made is that there is a huge gap between these applications developed for the economic analysis of work environment risks and their uptake. As such these tools are less used. A theoretical discussion about possible barriers will be returned to at the end of the chapter.

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## Ethical Considerations

At the beginning of the present chapter, it was referred to prisoners in medieval wars who were subject to pricing. The prize list is challenging for moral ideas. However, the authors Frey and Buhofer (1986) hold that probably human lives were saved because soldiers on all levels got an incentive to take prisons and keep them alive instead of killing them. This utilitarian perspective is contradictive to what the philosopher Kant proposes, i.e., that putting a price on people reduces human dignity. Pricing something means that it could be exchanged with something else. Humans are not exchangeable. The conflict between these two basic principles is obvious even if both of the principles are based on the expectations of future consequences. An even stronger standpoint is the duty ethics that prescribes that you shall never kill.

Our view behind the research addressing productivity and financial gains is based on consequence ethics. A price is not directly put on humans even if a price is indirectly put on employees' actions or absence of actions. A simple example of our standpoint is the statement from a safety engineer in a mechanical industry:

I try to get the people in charge to understand that it is crazy not to invest in rehabilitation and preventive actions. Imagine what the cost is of having an employee not performing 100% or worse – just having them loitering around. It's easier to spend \$18,000 on a new gadget than to invest \$3,000 in rehabilitation or new equipment to increase performance. A co-worker that is loafing with a salary of \$2,000 would cost around \$50,000 per year, including all expenses. If a person has an injured hand and a certain tool costs \$3,000, then in order for it to be profitable he just has to work 4% of his normal performance. Since I convinced the management about this way of reasoning, we have profited a lot and many have avoided to

be put on the sick list. But it takes time. You have to change attitudes and that isn't easy. Some people think that it is a quick process but it took me 10 years.

To conclude, it is suggested that the kind of financial calculations that has been referred to in the above text does not reduce human dignity. On the contrary, the OH investments which have addressed are aiming at human dignity. The use of productivity and financial calculations may create attention to and strengthen OH activities. However, it is also important to underline that in some situations, the calculations can be used in the opposite direction, for example, to fire instead of rehabilitate an employee. Avoidance of such measures emphasizes the importance of clear and sustainable basic organizational beliefs and values. The latter will be addressed in the next section.

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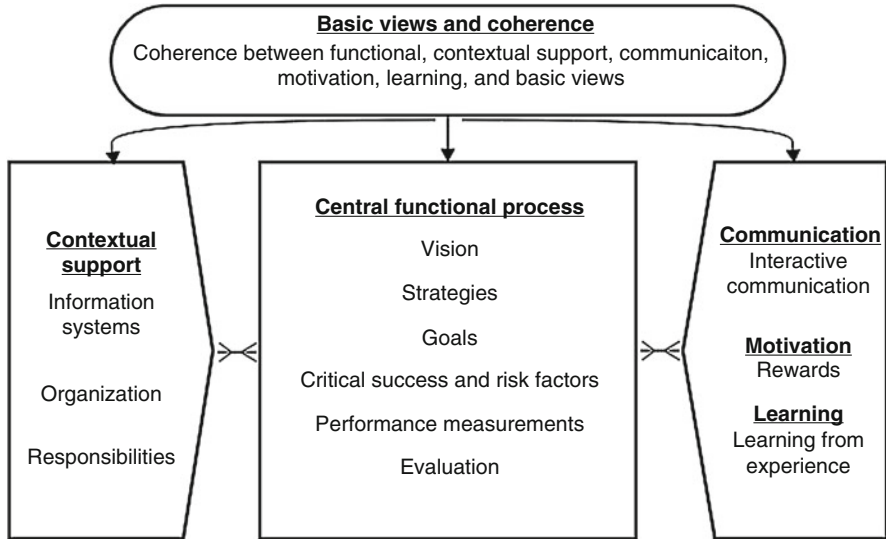
## OH Management Systems, Possibilities, and Limitations

As it has been stated several times, a financial calculation is often (but not always) a necessary condition for creating attention before a project starts, and it is also needed after evaluating a project. However, a sustainable integration of an OH management system in the general management of an organization often meets different barriers. Johanson (1999) found that although individual managers learn and are ready to change their behavior, the organization does not. Organizational learning and change is a much more demanding issue than individual learning and change.

At the beginning of the chapter, it was suggested that improving OH at the workplace could benefit from learning from other performance management systems. This would comprise not just creating attention to OH by means of, e.g., studies of financial gains but also addressing central functional processes such as strategies, targets, and follow-ups as well as contextual factors such as responsibilities and reward processes as well as coherence with basic OH views. In the performance management literature, there has been an ongoing debate about what a performance management system would comprise. Important inputs to this discussions originate from a number of sources primarily Malmi and Brown (2008), Ferreira and Otley (2009), Broadbent and Laughlin (2009), and Johanson et al. (2001). They all have suggested broad frameworks for analyzing and developing performance management systems (PMS). Inspired from these, Johanson et al. (2019) suggest a framework for analyzing PMS. This proposal is also our suggested point of departure for analyzing OH performance management system. The framework comprises the following items.

In the middle of the figure is *the central functional process*, which is normally referred to in almost every performance management system. It comprises the *vision, strategies*, as well as concrete *goals and targets*. Furthermore, it includes *Critical success and risk factors, Performance measurements, and Evaluation*. These functional factors are characterized by financial and nonfinancial elements (Fig. 1).

The functional processes are supported by contextual support processes, such as *organization and information systems*, but also as *responsibilities*. The latter could



**Fig. 1** Framework for analyzing OH performance management system

be of different kinds, formal or informal. Sometimes responsibilities are clarified in some kind of contract. Even these can be of a formal character or just informal (Johanson et al. 2001).

A well-working performance management system is normally based on *interactive communication* between people involved (Simons 1995). The interactivity is a precondition for a continuous *learning process* regarding the content of the functional process but also with respect to a continuous adaption of the complete performance management system in itself.

*Rewards* are another very important condition for an efficient PMS. The rewards could be extrinsic or intrinsic rewards (Flamholtz et al. 1985). The rewards do not just refer to salary and bonus items but also to, for example, top management demand and benchmarking (Johanson et al. 2001).

All organizations and all management systems are based on some kind of *basic views* and values. Sometimes these views and values are explicit but sometimes they are not. Nevertheless, they are extremely important because all other management processes are designed and put into practice with them as a point of departure. Often PMSs suffer from philosophical poverty (Hofstede 1978). Such poverty facilitates an instrumental approach to PMS, where barriers between the basic presumptions and the design of the PMS lead to a deterioration of the PMS. In the present text, basic views refer to what is seriously expressed with respect to what should be obtained by the design and the use of the PMS, whereas values are the fundamental shared values (i.e., fundamental ideas and principles) which exist but which are not always pronounced. The latter can even be unconscious (Alvesson and Sveningsson 2008), which makes it impossible, or at least difficult, to reveal them. Basic values can exist on the group level, on the departmental level, and on the complete organizational level (Table 1).

Concerning *Coherence*, Ferreira and Otley (2009) claim that, “although the individual components of the performance management systems may be apparently well designed, evidence suggests that when they do not fit well together (either in design or use). . . failures can occur” (Ibid p 275). This means that it is important that not just functional but also all other processes are coherent with each other and with basic views and values. In other words, coherence between the functional process, the contextual factors, communication, motivation, and learning are the logical aspects of the systems idea to integrate the diverse elements of the framework.

The framework’s constructs are not, and could never be, an ideal classification system (Gröjer 2001). It is not exhaustive in the way that all possible factors affecting a PMS are included. For example, the processes which are addressed just refer to internal organizational matters, not external. Nor are the categories mutually exclusive (Gröjer 2001). It is difficult or even impossible to sharply distinguish between the different categories.

The framework is not meant to be applied in line with what Lapsley (2009) labels “a tick the box mentality,” because it is not a prescription of what is needed to address when a coherent PMS is designed. Nor does the framework prescribe anything about linear causality. Rather, every PMS is comprised of a number of mutual interactions that may vary in different contexts. It is a framework that has the potential to achieve “a rich understanding” of PMS (Broadbent and Laughlin 2009). To demonstrate the framework, it will now be applied to OH management findings in Sweden.

At the end of 2013, approximately 270 qualitative case studies of OSH activities and management were analyzed using an earlier version of the above framework (Frick and Johanson 2013). The purpose of the study was to explore if it was possible to deepen the common understanding of why OSH management works or why it does not work by means of using the framework. More importantly to know, what are the critical factors if OSH management is supposed to be an integrated part of the general management of an organization?

The results from this analysis demonstrated different deficiencies of the OSH management system. Among others, missing clear responsibility contracts between the various management levels, and counteracting reward processes could be identified as barriers for an improved OSH. These and other factors indicate that the basic views of a good working environment have less weight than a short-term profit ideal. The short-term financial results are often superior to everything else. OSH management then becomes more a matter of following the prescribed procedures (on risk assessment, meetings, plans, etc.) than achieving the aim of a better OSH environment.

The integration of OSH management with the general management of every organization (private or public, small or big) is a precondition for a result- and resource-efficient OSH management. To promote such a work environment, where routines are not ends in themselves but means to steer towards a good working environment with reduced risks and improved health, it was from the study by Frick and Johanson obvious that there were a number of knowledge gaps that need to be addressed.

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## Summary and Suggestions for the Future

The present chapter has contained the following issues and proposals:

- A brief background was given on calculations of financial gains of investments in human capital and more precisely in OH investments.
- Some major studies as well as some shortcomings concerning calculations of financial gains.
- The opinion was expressed that in efforts to increase attention to the financial gains of OH investments, economic evaluations constitute a necessary precondition for understanding and acting to improve OH.
- It was argued that in an ongoing business, attention and understanding of the financial potential are, unfortunately, not enough to obtain change. This has also been shown in earlier research. Financial estimates need to be integrated in a management context where several other managerial processes must also be addressed.
- And finally, a framework was suggested as to what could be useful to increase the understanding of how an OH management system could be designed.

In the future, further research needs to be performed on two areas:

1. Financial gains:
  - Continuous research addressing the financial gains of different OH, e.g., psychosocial, ergonomic solutions, and other physical changes that have a bearing on technological challenges at the workplace.
  - Improvement of understanding and measuring productivity losses related to absenteeism and presenteeism.
  - Improvement of models for evaluations of productivity losses and estimations of the true size of these costs.
2. OH management
  - A further development of the OH management framework to include also factors and processes external to organizations.
  - Investigation of the validity and reliability of the OH management framework in different contexts, i.e., different kinds of private and public organizations.
  - Other theoretical perspectives to the framework may have to be added.

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## Cross-References

- ▶ [From National Labor and Social Policies to Individual Work Stressors](#)
- ▶ [Health Economic Evaluation of Workplace Health Promotion](#)
- ▶ [Interactions of Work and Health: An Economic Perspective](#)
- ▶ [Organizational-Level Interventions and Occupational Health](#)

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# RETRACTED CHAPTER: Health Economic Evaluation of Workplace Health Promotion

# 28

Lei Si and Mingsheng Chen

The editor has retracted this chapter because of significant overlaps with a previously-published article [1] by different authors.

All authors agree with this retraction.

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**Part III**

**Micro-level Determinants of Occupational  
Health**



# The Associationalist Demand–Control (ADC) Theory

# 29

Toward a Sustainable Psychosocial Work Environment

Robert Karasek

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_25](https://doi.org/10.1007/978-3-030-31438-5_25)

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## Abstract

The Associationalist Demand/Control (ADC) theory is a new version of the Demand/Control (D/C) model developed to address psychosocial work environment conditions in current complex global economy. It extends the Demand/Control and Support (DCS) narrative with multilevel versions of Demands, Control and (re-labeled) Stability-Support at the task, organization, and external-to-work levels.

Midlevel structures within complex organization are conceptually introduced - Platforms of Dynamic Stability - to support worker’s possibilities for “bottom-up” participation. Key issues of *coordination* and *association of parts* are used to extend the D/C model’s active work hypothesis (as growth) and to extend the job strain hypothesis (as decline or disease). The very general conception of “ordering capacity” is used to develop hypotheses across disciplines: to link three modern sociological organization theory literatures (*Organization Systems Theory’s* (OST) resource acquisition and limitation issues, the coordination and communication issues in the *Communicative Construction of Organization* (CCO) literature, and dynamic stability issues from *Complex Adaptive System* theory (CAS) to topics in stress physiology and economic theory. The ADC’s general principles are elaborated in four work environment research areas: *multilevel work stress; stability based on long-term and short-term adaptation; person and organizational growth; and job security risks in the global economy*. New multilevel hypotheses also include: macrodecision latitude, organizational homeostasis, high-level social causation of disease, conducive communication, and personal job security platforms.

The ADC theory’s nonmaterialist predictions describe a new form of economic development which is sustainable and climate friendly since it involves neither nonrenewable material resources nor energy transformations, and can also address several current work-related “value perspective” conflicts and outline a new social contract.

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**Keywords**

Job demand-control-support model · Job strain · Work stress · Active work · Associationalist Demand/Control theory · Sustainability · Job Content Questionnaire · Stability-support

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**Introduction**

Profound changes have occurred in the way work is organized and carried out around the world in the last decades due to globalization and unfettered free market-based socio-economic policy. This new generation of psychosocial work environment challenges, from a social research perspective, requires a new multilevel theoretical model equivalently broad in coverage to generate sufficiently robust new hypotheses and measurement tools for work organization solutions in this new context.

Compared to circumstances in developed countries in the 1970s, for many contemporary workplaces the job task alone has relatively diminished effects on worker wellbeing and stress-related outcomes, whereas higher-level social organizational context factors related to work (such as the organization level and external-to-work social structures) have gained importance (Dhondt et al. 2014; Standing 2011). These same organization/company contexts are now compelled to become more dynamically adaptable and flexible to enable the organizations to survive in a global economy that is location-dispersed, yet powerfully financially Internet-integrated. Workers often find themselves now directly facing both turbulent company contexts and unknowable global economic forces – with increasing risks of unstable working conditions and job insecurity. The understanding of worker job contexts, which are themselves undergoing rapid change, requires a more elaborated understanding of both adaptability and stability than was provided by the original D/C model. They require an organizational theory, which evolves beyond the original D/C model's not-so-distant past of more understandable, stable jobs in local companies, dominated by local labor markets and national labor relations and legal protections (Standing 2011). The theory should support possibilities of individual control in these new work life contexts.

This chapter's critical new addition to the D/C model is its focus on work's broader social organization – in the context of a multilevel theory. The complex organization, supplying the jobs, has a constant need of acquiring resource inputs from the environment and the need to support individual-level worker wellbeing job redesign processes. Satisfying these joint goals is a major challenge for theory development. Dealing with multilevel effects is radically more challenging than the original demand control (D/C) task-effect model, requiring bridges across disciplinary boundaries in the natural and social sciences based on the development of both new social structural constructs and modes of social organizational adaption – but it also brings potentially powerful social implications.

This theoretical paper incorporates four sections: first comes a brief critical review of the Demand-Control (D/C) model (Karasek 1979; Karasek and Theorell

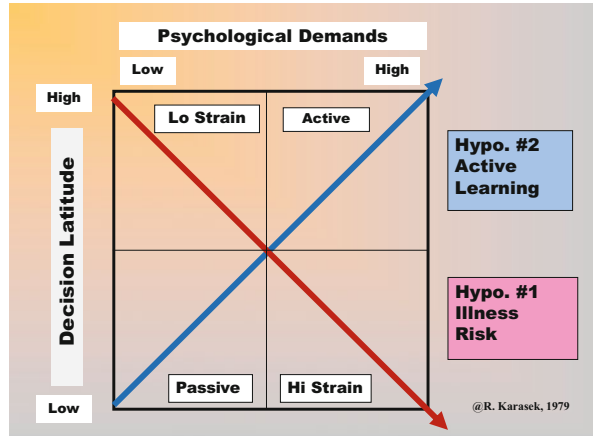
1990). Second, the D/C model's theoretical foundation is extended to a very much more generalized, multilevel Associationalist Demand/Control (ADC) theory based on a broader set of logical propositions: new "definitions," and structural mechanisms to extend demands, control, and a stability-related form of support ("S-S" in the new D/C/S-S model) across multiple levels of psychosocial work experience (task, organization, and external-to-work). Third, the implications of the theory for three current work environment/wellbeing challenges where the ADC hypothesized process are further discussed: (1) stress, disease, and low control in a multilevel workplace context; (2) work organization stability in the context of turbulent external environments; (3) creative growth, development, "active work," and robust adaptation in a multilevel context and sustainable economic solutions, and finally (4) new external-to-work job insecurity risks. The strengths and weaknesses of the ADC theory and status of empirical predictive validation of the multilevel D/C/S-S constructs are tested in a series of five pilot studies (presented in other papers on the revised Job Content Questionnaire (JCQ 2.0)) is briefly reviewed.

A fourth and final section of the paper explores the broader social and political implications of a new economy that could be based on the working conditions here implied: it could be climate-friendly and sustainable because of its focus on a nonmaterialist base for both economic growth and societal health. We further attempt to use this platform to provide an outline to address several work-related "value perspective" conflicts arising in current social-political discussion.

## The Demand/Control Model and the JCQ1

The original task-level D/C model has two hypotheses based on work organization's output goals (demands) and its organizational structure (control/decision latitude), in different combinations. The *active learning hypothesis* predicts positive developmental, active work when high – but not too high – job demands are combined with high control. The *job strain hypothesis* predicts that negative or risk-prone, high job strain occurs when jobs combine high demands and low control (see Fig. 1, Karasek 1979). The D/C model emphasized the effort and energy required by the worker to get the job done. Demands arise from the organization's need to produce output, which translates into mental demands for the individual worker. Demands are operationalized in the Job Content Questionnaire 1 (JCQ1, Karasek et al. 1998) measurement tool as task level demands – psychological job demands – referring to high output per unit of time, rapid, time-pressured work, or conflicting demands. Job control in the D/C model and JCQ1 is labeled decision latitude and combines two related components: skill discretion (the allocation of tasks to individuals related to his/her skills) and decision authority (the individual worker's degrees of freedom or autonomy to use his/her capacities toward the organization's goals, see Karasek 1976, 1979; Karasek and Theorell 1990). When the worker has control over the possibilities for directing energy to active goal attainment, the result is an *active job* via feelings of mastery, and active problem solving leading to motivation. If such action is inhibited, by lack of control, discomfort, exhaustion, dissatisfaction, and stress-related disease result as in a *high strain* job.

**Fig. 1** Demand/Control model



Empirically, the two primary D/C hypotheses represent separate, but linked, contingency predictions involving demands and control – and separate outcomes, health, and behavior – derived from the psychological and sociological literature (Karasek 1976; Theorell and Karasek 1996) that were anchored primarily in micro-level individual/group-based research (see also Gonzalez-Mulé and Cockburn 2017). When the active and strain outcomes are integrated over time and understood either as contributors to individual-level personality dispositions such as mastery and social learning (Bandura 1977) or as cumulative life-event burden health risks (Holmes and Rahe 1967) – their cross-moderating effects can lead to two supplementary hypotheses of “learning inhibits strain” and “strain inhibits learning” (Karasek 1976; Karasek and Theorell 1990).

An often-overlooked fact is that the Job Strain gradient is primarily orthogonal to the classic SES/social class gradient (which instead follows the Active–Passive axis, Choi et al. 2008). Use of the Job Strain axis adds predictive power of work experience on health outcomes more directly into political-economic discussions that previously utilized only SES to model wellbeing effects.

The duality of the Active and Job Strain gradients can also represent an empirical anchor for a new “psychosocial-work-based” social class conception (Karasek 1989), adding robustness to the new model of a sustainable economy of healthy and innovative work (discussed in the paper’s concluding section on social implications).

## Goals for Expansion of the Demand/Control Model

Seen from the perspective of the original D/C model, there are three important goals for the evolution of the multilevel ADC theoretical platform as it moves to multilevel explanation. Our first goal is to generate relevant new hypotheses that can easily

extend the current pragmatically and intellectually useful Demand-Control (D/C) dual narrative, addressing both *negative* (health deficit/disease) outcomes and the *positive* (active, motivational, learning-related) outcomes that are increasingly important in economic policy and that are essential to the job redesign narrative implicit in the D/C model. The second goal is to more precisely and directly assess the job's organization and external context in a world where challenges span intellectual boundaries – generating new research hypotheses.

A third goal is more operational: it is to maintain the international generalizability of its constructs and measures, in spite of the obvious existence of vast inter-country and inter-cultural differences. These measurement issues are discussed more specifically in a separate theory-measurement bridge paper introducing the Job Content Questionnaire 2.0 (JCQ 2.0) (Karasek et al. (in preparation, 2020). Thus, this current chapter postpones review of a variety of limitations in the existing D/C research that relate specifically to the questionnaire research measurement tradition (using the JCQ 1). This will be addressed in future work with specific focus on the newly developed JCQ2.0.

However, we do here address one significant competing psychosocial work organization effects model – one actually derived from the D/C model: the Job Demands-Resources (JD-R) model (Demerouti et al. 2001; Karasek 1976, see p. 73). The JDR illustrates the successful empirical utility of adopting a wider formulation for demand moderators other than job control alone. These added moderators, of numerous types, are termed resources (thus both control and support could qualify) thus allow for a broader range of coverage of psychosocial environment health effects. Unfortunately, this comes at the cost of theoretic predictive specificity. Furthermore, even detailed differences are significant here: a major issue is the sign that associated with demand correlations to outcomes such as “work engagement”: it is a negative sign in JDR research. However, instead, a positive coefficient would be predicted for what are often considered “positive outcomes” and labeled “active work” behaviors in D/C research. Here there is a clear requirement for active work's challenging, mastery-based experiences (i.e., flow), and the positive coefficient is also associated with positive health outcomes, longevity (Gonzalez-Mulé and Cockburn 2017), active leisure and political activity (Karasek 2004a), and postretirement social engagement (Nilsen et al. 2017).

Altogether, a more specifically differentiated predictive model than the JD-R is needed. Expansion of the original D/C/S theory is obviously needed. However, Luchman and González-Morales (2013) in their meta-analysis of 106 studies clearly demonstrate the utility of the original D/C/S framework, as do Fila et al. (2017), in a separate meta-analysis of 141 D/C/S studies, adding multiple moderating effects, and with longitudinal analysis confirmation (Chungkham et al. 2013). Since the original framework remains a highly desirable foundation, the multilevel ADC theory below attempts to “add” consistent conceptual breadth and new level-delimited measurement precision, while retaining useful links to the original D/C/S structure.

### **Moving Beyond the Classic D/C Model to ADC Theory**

While limitations of the D/C/S model listed above can often be articulated in terms of individual-level job work characteristics, the more extensive analysis of current work-related effects requires multilevel work theory and assessment. The D/C/S model used so far has focused on task-level, static conditions at work, and has presumed the existence of a work organizational structure as a “given” – to provide the jobs it describes. However, now as we go to a multilevel explanation, we must directly interpret and assess that organizational context because its dynamic impacts have become so salient.

To address the ADC theory’s major work organization themes, we must go beyond the limits of single-level, single-discipline boundaries. First, the new ADC theory goes further than the classic D/C integration of work sociology and psychology with their bases in human agency and social relations. ADC also addresses work stress from a broad perspective – bringing a microlevel natural science interface with chronic disease physiology. Finally, the ADC addresses work-related creativity and growth – interfacing with both economic science and some of its macrolevel political economic consequences.

A cross-disciplinary theory platform is needed to understand how modern psychosocial work environments can explain such a wide range of health and behavioral outcomes. Thus, a set of foundation principles for such cross-disciplinary theory development for work organization is borrowed from the natural sciences in the form of systems theory and Complex Adaptive Systems theory (CAS). While the social sciences have human wellbeing as a central focus, systems theory – with its natural science origins – does not automatically supply this focus. Thus, we will have to make major modifications of conventional systems theory to make certain that human subjects at the workplace – at the lowest level of an individual-company-environment triad – stay as the highest priority in ADC theory.

We will have to add “mid-levels” within company organizations that can connect (a) organization level processes that determine the “rules” of job design to (b) the processes that can provide the flexible responses needed by the companies to survive in a complex economic environment. Importantly: these mid-level structures can support worker’s possibilities of “bottom-up” participation within the context of a complex organization.

Fortunately, the basic concepts of demand and control can indeed have far more general meanings than the DC framework and the task-based questionnaire scales of the JCQ – as we attempt to explain using the general principles below.

Very broad possibilities to generalize the demands and control and support the concepts are found in a physiological extension of (a) the classic DC job strain hypotheses via Stress-Disequilibrium Theory (SDT; Karasek 2008) which addresses the question of how social control affects self-regulatory stability and chronic disease development – anchored in a significantly extended version of systems dynamics. When combined with the further extension (b) of active work hypothesis to the level of responsive organization and political economy (Conductivity Theory:



Karasek 2004b, c, 2008, 2016), this theory base presents a much broader logical platform for a generalized DC model, now referred to as the Associationalist Demand Control theory (ADC theory).

We utilize a restructured version of systems theory to (a) provide a skeletal framework for integrating multiple levels of appropriate social behavioral knowledge. Simultaneously, with this framework, we (b) supply some metaphorical hypotheses about how transfers of information and resources across levels – which are usually limited to within the separate disciplines – could occur (e.g., Karasek 2008, Figs. 1 and 2). To begin, below we integrate three social science literatures with the general principles (listed below). The sociological literature's Organizational Systems Theory (OST; Katz and Kahn 1978) gives a starting point because of its *systems theory* relationship to our SDT, although this classic form is much too constraining and will be significantly modified for our use. The Complex Adaptive Systems (CAS) literature, which addresses organizational change, helps update the systems perspectives and is metaphorically used to provide multilevel dynamic sights involving learning, interconnection/communication, self-organization, and co-evolution (Holland 2012). Habermas' classic Theory of Communicative Action (1982) might seem very relevant for D/C model extension where communication is central. However, the Habermas theory explicitly excludes the workplace world for his theorization. Thus, to cover workplace communication, we utilize the theme structure from a broad-based sociological literature on organization communication (Communicative Constitution of Organizations (CCO). McPhee and Zaig 2000; Putnam and Nicotera 2009's CCO differentiates multiple routine and flexible communication.

### **Outline of General Theory Discussion**

The theoretic needs above as well as the research themes at the end of the paper extend across many different levels of scientific activity, utilizing both “person” and “organization” as labels – separately and jointly – across a wide intellectual span. We attempt to find a set of common logical propositions to understand – at the person level: stress-disease response (our Challenge I) – and at the “organization” level: company-based work organization in a complex economy (Challenges II, III, and IV). The motivation for this broad integration is the need to address work stress, organization, and economy with the tight interconnections they now have in our current world. But however laudable that goal, our attempt to relate all the psychosocial work-related themes above to a single integrating theory risks encountering strong critique of “ecological fallacy” with respect to standard foundation principles of each of the scientific fields involved.

Thus, to support our claims of the cross-disciplinary utility – and furthermore their pragmatic compatibility with current task-level D/C/S work environment constructs – we explicitly state the basic logical propositions that could be used to support each of the levels of prediction and their relations to generalized definitions of the core theory dimensions in a General Claims Proposition section and then in the research Challenges thereafter.

- (A) *First*, we connect our theoretic extensions to several original D/C work environment core concepts and D/C/S-S dimensions in a new more generalized format.
- (B) *Second*, we introduce the systems theory-based Control/ordering capacity concepts that yield the theory origin and further update the definition for D and S-S concepts.
- (C) *Third*, we provide a list of the six underlying logical claims behind the extended D/C/S-S definitions, examples, and work environment research Challenge themes coming later in the paper.

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## D/C Core Concepts and Newly Generalized D/C/S-S Dimensions

The origins of the more generalized ADC formulation can already be seen in the original 1979 D/C citation above, “*The individual’s job decision latitude is the constraint which modulates the release or transformation of ‘stress’ (potential energy) into the energy of action.*” We must recall that this explanation was presented as a task level research hypothesis, taking as given the existence of a stable organization (of the 1970s) which provided those jobs.

Briefly, now in a more general formulation, ***Demands*** (new definition) are the constant requirement of processing the often plentiful, but disordered energy and resources that are available in the external environment into the ordered energy (work) needed internally for complex organism (or organization’s) survival. This constant process is based on the organism’s use of its ***Skills*** and ***Control*** possibilities (these definitions from the D/C model are basically unchanged, but more broadly applied). The D/C model support definition is broadened to ***Stability-Support***: now spanning both previous individual-level social support and a generalization reflecting organization-level stability. While reflecting the needs for a healthy (i.e., nonstressful) organism stability, it is also a required dynamism of the continual processes that can bring new resources into the organism/organization – given its complement of skills or skill development. These allow not only maintenance of health, but growth and effective adaptation to ever-more complex environmental challenges. We can see now that the ADC concepts will not represent necessarily “fixed patterns,” but forms of work organization-related stability and instability within the context of a dynamically changing environment.

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## General Theory: ADC Theory Core Theory: Person and Organization

### Control, Ordering Capacity, and Regulatory Stability

The D/C tradition has focused on prediction of outcomes in the context of highly structured social organization: that is, workplaces and the labor market/economy. Thus, “control” is not simply one of several possible constructs for an ADC

expansion: but perhaps the most central determinant of structure, function, and predictive utility in psychosocial work environment contexts since it is used to design such structures.

For example, in the ADC context, the concept of “control” is reinterpreted more broadly than in past demand–control discussions. In the turbulent new context of the global economy, for the individual worker it means not only (as in the original D/C model) the person’s control over specific situations, but more broadly, the “control” strategies he or she has developed to maintain the stability of his or her “flows” (i.e., flows of good, nourishing things: the money from wages flows into the bank, and the rent payment flows out from the bank. . .). What is important is that the input and output flows are in balance: even if there is a current acute problem, future strategic solutions to maintain overall are not hard to achieve. Maintaining stability of flows for self and for families is always the major “control” challenge of adult lives.

Thus “control” (decision latitude) is the freedom for people to act using their repertoire of skills within the social structures in which they have made their main investments and have gained their major life-sustaining rewards.

Unfortunately, comfortable current work life scenarios are made more complex by the fact that previously existing platforms of stability from outside work are being undermined by global economic phenomena. People’s previous control strategies may not be enough to maintain equilibrium – with the economic order undermining the effective application of previous strategies. New strategies are needed.

Our more general integrating systems theory language below sometimes uses the single label “organism” to apply to both “persons and organizations.” For the organism – “person or organization” – to maintain “control,” it must have the internal and external resources to maintain self-regulatory stability. Thus, our new core proposition asserts that to survive, an organism requires maintenance of self-regulatory stability in demanding environments. To prevent any complex organism from lapsing into disorder, available resources (energy) from the environment must be constantly processed into the precisely ordered energy needed to sustain lives (sociologically or physiologically) – avoid disease – and to grow. These processes provide the context for three levels of work-environment theory: at the Task, Organizational, and External-to-Work levels.

To achieve its repertoire of responses to the environment, the complex organism (a person or an organization) must internally coordinate its diverse subsystems into effective overall actions in the environment (i.e., like an army coordinating its troops and armaments for a successful battle). Coordination represents the channeling of disorganized energy, with many degrees of freedom, into the constrained energy, with very few degrees of freedom (ordered work is this very general definition) – which can be precisely commanded for work actions to be taken, embodying information about exact times, places, persons, etc. This leads to an obvious definition of *control*: one entity determines (controls) the behavior of another entity (then said to be at a lower level).

Thus, we claim, for complex organisms/organizations – in these current contexts – that what is needed is “ordering capacity” – that capacity which allows this

coordinated subsystem control to be exercisable at the highest level of the organism control (*high-level ordering capacity*) in order to tackle environmental challenges and thus maintain the organism/organization's stability as a whole in an uncertain environment. The "cost" is extremely high in information theoretic terms of a "balancing process" across organizational levels that can both maximize worker wellbeing and organizational survival. An integrated, cross-level "cost-benefit tracking structure" for information resources could help to insure feasibility.

We further claim that the complex organism/organization's requirement of coordination of actions of its subsystems – in the face of challenging environments – is the most difficult burden for the system's central control function in current society (of course the requirements for material necessities such as food remain important: but are less burdensome in Western societies). This statement highlights the importance of the non-material social-economic world, as is further discussed in the paper's conclusion.

De Sitter's early work organizational design recommendations focused on reducing organizational "disturbances" (Achterbergh and Vriens 2010; De Sitter et al. 1997). In a classic text, Ashby's (1956) theory of "Requisite Variety" demonstrates how maintaining the stability of a complex system requires that the central controllers in a hierarchically organized, multilevel system (a person – or – an organization) have the availability of a set of well-coordinated good choices when facing its challenging environment. For example, such choices can enable the person to keep his/her physiological and mental balance – integrating functions of a myriad of mental subsystems – in the context of challenging stressors. Or, at an organizational level, a company's higher-level management can maintain internal operating stability even in the context of volatile external market challenges. Thus, limits on ordering capacity are unhealthy for the individual – and unhealthy for an organization.

The critical underlying problem is that in making well-coordinated actions to affect the environment, organisms/organizations *use up* the capacity to create order in their environments. This raises the obvious question: "How can we get more of this 'high-level' ordering capacity?" The answer, we claim, has been the "missing link" in complex psychosocial work environment theory and many related questions.

## **Further Extension of ADC Definitions for the Work Environment: Demands and Stability-Support**

### **Demands**

Our new perspective also brings with it a somewhat modified perspective of "demands." Since no complex organisms exist without "flows" of resources: continual input and output of energy (nutrients, money, etc.) from their environments, none exist without demands – nor could jobs exist without demands. No organizations are therefore either truly "stable" (truly stable forms are dead). What could be stable, then, is the constancy of "flows." The internal conditions these flows create and the consistency of the actions the organism takes in its environment to maintain

its flows could be stable. The goal of insuring humane work demand levels is reflected our ADC mid-level constructs, such as Platforms of Dynamic Stability.

The need for a structure-based explanation for Demands is shown in the research: psychosocial work demand “hindrance” stressors are differentiated from the “challenge-type” stressors discussed above, particularly those at the task level (LePine et al. 2005; Podsakoff et al. 2007). However, from our ADC perspective, many of the noted hindrances are still seen as “challenges,” with simultaneous moderation by control and stability constructs at the organizational level.

While “demands” as described above are essential in the normal process of gaining resources from the outside environment, we must retain concern to insure that work demands remain “humane” – in the context of Western democratic values of the late twentieth/early twenty-first centuries. Armstrong (2014) notes historically that complex organizational systems have an inherent tendency to press workers’ demands to high levels, while reducing rewards to subsistence and there are many anecdotal signs that demands are increasing again in current times with global competition.

### **Stability-Support**

In the typical scenario of demands: it is not the environment that is constant or stable, but the balance – equilibrium of flows – that could, ideally, be relatively stable (Holland 2012). Our ADC stability-support construct – at the general level - is based on the result of maintaining the above-noted *equilibrium of flows* on the short-term, periodic balancing that represents a constant exposure to challenge – and a simultaneously constant organized, constructive response (based on available ordering capacity, as discussed above) – to maintain a stable platform for wellbeing, insuring success for the next round of challenges. These processes, when basically stable in the longer term, can provide a stable basis of action for working persons (or, for the organization’s subsystems) with respect to the organization as a whole, anchored in ADC concepts. We introduce the construct: Platforms of Dynamic Stability to assist to further explain such processes in Challenge II below.

The classic D/C/S task-level social support construct is assessed in a very comprehensive manner in the separate JCQ2 measurement-focused paper (Karasek et al. (in preparation) 2020).

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## **Three Pairs of Required ADC Theory General Theoretic Propositions**

### **First System Prerequisite: The Stable Complex Organism/Organization**

The primary goal of complex organizational contexts (the psychosocial work environment included) must be to maintain the stability of their organizational structure in the face of an unpredictable environment (a definition of **Demands**). This requires constant transformation of environmental energy/resources (“disordered”) into

Work: energy ordered for the effective use by the organization toward its goals (a goal of **Stability**). The “system-environment pairing” from systems theory describes this input/output transformation.

## **Second System Prerequisite: Coordination of Subsystems of the Organism/Organization**

To achieve its organizational goals, the central **controller** of a complex organization must be able to precisely coordinate all of the actions of its subsystems to most effectively utilizing its capabilities: it must assemble [combine/orchestrate] the most effective association of its part (i.e., Associationalist). Because of the dynamic nature of the stability goal (and our work redesign goals), we speak of control not only over static conditions, but rather the balance or “equilibrium of flows” (inflow of positive resources [e.g., the wage check] and outflow of negative cost/liabilities [the rent check]).

## **First Work Environment Structural Requirement: Full Functional Understanding in a Complex Organization Requires a Mid-level Structure**

It is not possible to describe the main foci of our ADC/D/C/S-S theory using only a two-level, system-environment pair as a base. The existence of a “Mid-level Structure” is a requirement to understand both work stress and worker creativity. There will be both a complex organizational structure above the level of workers’ jobs and an external environment beyond that which must sustain the organization. We utilize the label: Platforms of Dynamic Stability (see below) to identify the mid-level.

## **Second Work Environment Requirement: Dual Stability Criteria: Overall Organizational Stability (Adaptive Logic I) and Top-Down/Bottom-Up Balanced Healthy Job Facilitation (Adaptive Logic II)**

Our ADC theory expansion must address two forms of adaptation: first, description of work-organizational processes relevant to stability of the company organization within its external economic environment – in the long term – to insure the existence of the jobs (Adaptive Logic I), and second, within that context, to illuminate work-organization processes that can facilitate, in the short-term, humane worker-wellbeing job redesign changes. Thus, a new dual focus for hypothesis derivation – dynamic adaptation to needs of workers – and the need to maintain a stable company platform for work activity: job design and company stability are interconnected in ADC theory.

The Platforms of Dynamic Stability construct addresses this connection, supporting theoretic expansion of the D/C/S model toward “high-level” analytic

description via the short-term adaptive mechanisms of Adaptive Logic II. These represent a mid-level balancing of inputs from “above the job” and “below the management” – which can contribute to an overall condition of stability-support for workers and can assist the organization’s stability as well.

### **The Challenge: Limitations on Control over the Balance/Equilibrium of Flows: Organisms/ Organizations**

The necessary coordination of subsystems “uses up” the ordering capacity resources for both persons and organizations. This capacity is limited within “cycles” (this is the natural science’s cornerstone Second Law proposition at the core of all systems theory and CAS). Ordering capacity gets “used up” in the process of the system doing its Work in adapting to its environment: the system gets “tired.” The nutrient value of “food” and other material resources are also “used up” during Work – but there is a significant difference here. Ordering capacity can be – and must be – “restored” to enable the organization to undertake further coordination activities (which can of course be necessary for survival: the search for food, etc.). This is a “sustainable outcome” – but is not possible with material energy and resources.

Thus, all complex systems have two states: full use of ordering capacity to get its goals achieved (Work) and then a periodic return to low capacity state: a restoration period, where no Work can be achieved (Rest: a return-to-baseline). During normal daily life, creation of ordering capacity is done in *cycles of building up* ordering capacity during periods of rest – and *then using up* capacity to meet the challenges of daily life. When this cyclical process happens smoothly, it results in an *equilibrium of flows*, and healthy overall stability (reflected also in effort/recovery research, Sonnentag and Fritz 2015).

We can use a combination of the concepts above to explain an ADC conundrum: “*There can be no life without demands, and there can be no work without rest.*” While the conundrum’s first half does not sound encouraging as a platform for work stress-prevention activity, it is, the second half is distinctly humane.

### **The Resolution: Limitations on Control over the Equilibrium of Flows: Organisms/ Organizations**

We need an answer to the question: “How can we create this new ‘high-level’ ordering capacity?” in order for us to know when there is enough available to maintain stability and when there is enough to support growth (Burggren 2006; Walker et al. 2017). While there have been a multitude of management theory solutions in this general area, the solutions can be completely contradictory and are usually lacking in cross-level structuring. Thus, we attempt our own very general solution.

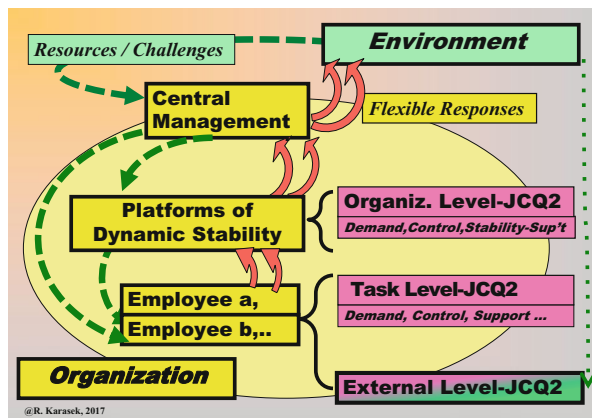
Our own, admittedly speculative, answer as to how high-level ordering capacity *could be created* in complex organisms (organizations) is that it can be created

“internally” via a processing structure. The “processing structure” converts the disordered resources available in the environment into the ordered Work need by the organization. The processing structure “constrains” and “orders” the otherwise random – albeit available – environment energy from outside, and throws away the unusable part as waste (Progogine and Stenders, 1984). Such structures must operate at each internal level within the organization/organism. At each higher level it is built using the critical outputs from the levels of the system just below it as its components. In this way an overall stepwise constraint-based mechanism for creating higher and higher levels of ordering capacity for a complex system can be envisioned. This process is inherently multilevel, with each level identified by its boundary and with transfer of information and resources across levels, consistent with complex adaptive system principles (Holland 2012). What is described above is a multi-level constraint structure built from the “ground-up,” but in many cases there would be an existing constraint structure which either could be modified or could receive added capacity. (Questions about “what components” relating to the processes above are not addressed here. In a physiological context they are addressed by entirely separate scientific narratives on DNA, reproduction, etc.).

A similar use of the conception of “constraints” in the process of language development – for creating higher levels of order in linguistics – can be seen in the work of Chomsky (1956) where he uses “syntax” as the constraining set of “production rules” that allow words to be combined into phrases, and so on to higher levels of language sophistication.

We can see a suggestion of this multilevel order creating process in the linkages between levels in Fig. 2 above – from employees, to mid-level organizational levels and to central management interfacing with the environment (explicitly Karasek 2008, Fig. 1).

**Fig. 2** Multilevel ADC model and platforms of dynamic stability





## Summary

### The ADC Theory “Associationalist” Label

The label has multiple roots. It comes most directly from elaboration of the core logic noted above. ADC “active work” involves participatory engagement processes involving re-combinations of worker’s skills (in the worker “skill-plate” re-arrangements in the Conducivity Game, relevant for job crafting, Karasek 2004d). It also involves the ADC based understanding of “job strain” as coordination failure in physiological/mental subsystems noted below. However, the Associationalist label carries deeper implications. From a historical perspective, Greenblatt (2012) revealingly discusses how the significance of the “association of parts coming together” finds its original anchor in the Greek philosophy of Lucretius. In more current political theory, workers’ “association” movements of 1848 showed a road beyond capitalism based more on worker solidarity and collective competence development (Louis Blanc 1850) than the later Marx’s material re-distribution emphasis.

### Summary of Major Claims

We use a systems theory/CAS to build a cross-disciplinary platform. To make certain that human wellbeing at the workplace stay as the highest priority in ADC theory, we must add “mid-level” structures within company organizations that can connect (a) organization level processes that determine the “rules” of job design to (b) the processes that can provide the flexible responses needed by the companies to survive in a complex economic environment.

We claim that the addition of these mid-level structures facilitate a decentralization of the decision processes in multilevel work organizations, promoting the possibilities of more democratic dialogues for workers – to counteract effects of global economic structures which appear to be ever-more centralized and expansive and in their coverage.

The ADC model, in summary, presents hypotheses about how systems can either organize themselves into higher levels of complexity (the generalized *active work hypothesis*) or dissolve into systems with lower levels of complexity (the generalized *job strain hypothesis*), that is, systems that grow and develop or systems no longer able to sustain their original complexity and capability (decay). Thus, the key issues are *coordination, the association of parts, and ordering capacity* (see below) – rather than the physical reality of the parts themselves – moving beyond a purely materialist construction of reality.

It is important to note as we more fully describe below (Theme III) that our theory and its forms of innovative work and value creation, its stress-related illness social-prevention-based health care all represent “sustainable” forms of economic development, since they neither use material resources nor use material sources of energy to transform material resources to advance economic development.

## Four Work Life Challenges

To adapt the general principles above to contemporary work life, we address three contemporary work environment challenges: multilevel stability, multilevel work stress, person and organizational growth, and a fourth external-to-work issue: job insecurity.

### First Challenge Theme: Loss of Stability: Low Control, Stress, and System Decay

The first challenge is simply to understand how the low control component of the classic job strain phenomenon could be such a consistent cause of physical as well as mental disease (the high psychological demand component of risk has been long demonstrated). There is an enormous literature on the associations between job strain and chronic disease (e.g., Belkic et al. 2004; Gonzalez-Mulé and Cockburn 2017; Theorell et al. 2015, 2016, and also Kivimäki et al. 2012). While the results are generally positive, there is a great diversity of empirical findings (we here note that there can easily be underestimation errors in epidemiological research on job strain associations that are only adjusted for conventional SES, occurring especially with nonnormalized mean-split population samples, such as in the IPD studies (Fransson et al. 2012, see Karasek et al. 2007). Overall, this expansive record of empirical evidence implies an extremely general mechanism of disease causation involved with *low control* and thus requires that our new explanatory frameworks be just as generally applicable.

Our core explanation of the stress-disease linkage, based on self-regulatory stability (Karasek 2008), makes it plausible to understand how low social control possibilities in the *external* environment, for example, at work, could become a central explanatory factor of health status: they could lead to reduced capacities for *internal* control and effective self-regulation. Ordering capacities of the relevant physiological and mental systems become overloaded in the face of demands – used up, without being replenished quickly enough – directly causing health risk. These multilevel systems dynamics physiological explanations are developed in Karasek (2008) as the Stress-Disequilibrium Theory (Recordati 2003; Karasek et al. 2010) and in the context of heart rate variability research by Collins et al. (2005) and Jarczok et al. (2013).

Stress is defined (Karasek 2008; Karasek and Theorell 1990, p. 87) in a generalized system-based manner, as the inability of the central control system to maintain coherent regulatory stability – to maintain control – when facing complex adaptive demands because of insufficient ordering capacity. It represents an overload capacity in the central control system's ability to control its subsystems to ensure effective functioning. This could often be a transient condition, due to insufficient time for build-up of high-level ordering capacity (a deficit in Adaptive Logic II capability). However, when this overload lasts for a long time, the development of a new equilibrium follows, but it will be an equilibrium with a

*lower level* of environmental adaptive capabilities (a *dis-functional equilibrium* with SDT, Karasek 2008). This long-term capability loss is what we define in the human physiological context as chronic disease, for example, high blood pressure. Since this results in long-term loss of function (Adaptive Logic I loss), it is the opposite of growth.

Sterling and Eyer (1988) and McEwen's (1998) "allostasis" process also represents a dynamic, environmentally adaptive physiological explanation of stress physiology. It describes "stability-through-change" processes to revise the original rigid "fixed stability" homeostasis concepts of the mid nineteenth century. However, allostasis is grounded on a concept of life-limited adaptive capacity – a sort of "wear-and-tear"-based paradigm of stress and disease development. Allostasis, in a significant omission, does not cover regeneration or growth (the creation of ordering capacity) – which are a vitally essential aspects of health maintenance. The ADC theory's accommodation of both positive and negative outcomes gives a far broader coverage in that it can address physiological stress-recovery processes of regeneration/growth, and further, as noted below: it can be directly theoretically integrated with social levels of illness-prevention actions.

Today's conventional medical treatments often involve specialized procedures focusing on "low-level" disease-related human physiological deficiencies (such as a protein deficiency, etc.), and the recommended treatments also often involve expensive specialized drugs or focused surgeries. However, recent research on health status in aging patients shows that the most common condition involves simultaneous, multiple, and diverse chronic disease symptoms (Froelich et al. 2019; Licher et al. 2019). Thus, if a single, specific low-level physiological deficit is not the primary source of poor health quality, such specialized, "silo-focused" provision of care is neither likely to either improve overall health nor be economically effective.

However, our general theoretic proposition (number six) relating to creation of "high-level ordering capacity" provides a potential explanation of the multiplicity of disease conditions. Limitations on high-level physiological functionality or ordering capacity – by itself, without the contribution of specific low-level physiological deficits –could be sufficient causal explanation of simultaneous chronic disease progressions of many types.

The perspective above brings the physiological disease causation process to a level that intersects with the psychosocial work reorganization. This generates an "emergent-level" hypothesis (see Discussion) about High Level Social Causation of Disease that implies potency for direct social-level interventions to reduce health risk in a high-level manner (Karasek et al. 2010).

At other levels of analysis covered in this chapter, we also speak of High-level Causation. At the organizational level (see below) company decisions which affect the long-term inability to maintain a stable equilibrium of flows in the face of a demanding can cause "organizational stress": chronic dysfunctions such as loss of output quality, loss of customers – and loss of good job quality. These outcomes can simply be the result of management decisions, without any low-level employee decision participation: another high-level causation example.

## **Challenge Theme II: ADC Stability, Mid-Level Functions and Work Redesign**

A significant increase in sophistication of our “modeling” of organization structure is required to utilize the new demand and control generalizations to support a multi-level understanding of stability, job stress risks, and creative work. The label “organization” in our theory really refers to a generic mid-level social structure. It operates above the worker’s job level, providing the structure and rules for task level jobs. It represents the multi-level constraint structure that simultaneously operates below the environmental level to secure recourse in the external environment upon which all complex organizational structures necessarily depend. Obviously real work organizations could have one, none, or many internal mid-levels. But our purpose here is not to define varieties of organizational structure, but to extend understanding of workplace social organization to a “higher-level” than the previous task base.

In a previous generation of organizational research, Katz and Kahn (1966, 1978) OST utilized a two-level system-environment-based model. However, the OST approach was insufficiently explicit about the dynamics of internal processes to explain currently important mechanisms relating to either stress, on the negative side, or innovative work on the positive side. In this absence there was only a top-and-bottom rigid hierarchy image with tightly-defined worker “roles,” which was accordingly not a theoretical platform to support participative work redesign. Our view is that understanding both work stress and worker creativity requires a complex organizational structure which is simultaneously “above” the level of workers’ jobs, as well as “below” the external environment that must sustain the organization. A mid-level structure is needed.

To link useful OST and CAS propositions to our required sociological structure requires restructuring standard systems theory by adding a mid-level. So a second system-environment pair is nested inside the first system-environment pair, to give three separate levels and to support two separate adaptive processes below (Karasek 2008, Fig. 1).

These new multilevel structures allow worker/management effects on the job to be modeled: (a) the central management (as controller), (b) the employees in many departments, and (c) then the contextual societal environment outside the workplace. These are essential to address as focal levels of work life research. It allows description of a broader range of job design issues and multilevel JCQ 2 organization scale assessments at task, organization, and external-to-work levels.

### **Dual Stability Processes**

To understand stability in the ADC multilevel context, we must also understand the work-organizational processes to maintain stability of the organization (Long-Term Adaptive Stability Logic I) supplying the jobs – and – within that context to illuminate the short-term humane worker-wellbeing job redesign changes that are consistent with the original D/C/S model narrative (Short-Term Adaptive Stability Logic II).

Figure 2, at its top, shows the organization making use of variable response options to environmental challenges. The goal here is similar to the notion of organizational robustness/resilience literatures (Hagedorn-Rasmussen et al. 2016; Lengnick-Hall and Beck 2005; Weick and Sutcliffe 2007; Taylor et al. 2019) about complex organizations maintaining stable function in the context of a changing environment – while still contributing to individual psychological health and work engagement. These relatively long-term adaptations represent Long-Term Stability Processes (our Adaptive Logic I).

The Short-Term Adaptive Change Processes (Logic II) response options generated by the integrated action of many subsystems (e.g., multiple organizational departments, work teams, policies, communication modes) occurring with a kind of easy-to-achieve, moderated flexibility that does not necessarily upset the long-term organizational functions. This dynamic adjustment insures predictable functioning for the company, but nevertheless can protect against job stress and allow employees creative new steps.

From the employee's viewpoint, this represents answers to the questions: "What allows you the secure understanding that your contributions represent a stable future activity platform – allowing the employees (and the organization) optimal long-term planning?" (Logic I) and "What allows you to get your core job tasks done on a daily basis in a satisfying manner, and creatively, but without overload?" (Adaptive Logic II). This humane stability (Griffeth and Clark 2011) could come from participative influence on decisions, from fairness and equity, or from management demonstrated concern about employee wellbeing.

### **Platforms of Dynamic Stability**

Our ADC stability-support construct is based on the result of maintaining the above-noted equilibrium of flows, based on Logic II, the short-term, periodic balancing that represents a constant exposure to challenge – and a simultaneously constant organized, constructive response (based on available ordering capacity, as discussed above) – to maintain a stable platform for wellbeing, insuring success for the next round of challenges. Like a bicycle: it provides the rider stability only while in motion and guided toward a goal. These processes, when basically stable in the longer term, create platforms of dynamic stability in an organizational context – which can provide a stable basis of action for working persons (or for the organization's subsystems) with respect to the organization as a whole, anchored in ADC concepts. This can in turn also support worker contributions to participative workplace innovation (e.g., illustrated in the participative, work-group-based, "skill-plates" prototype work organization rearrangements of the Conductivity Game (Karasek 2004d)).

We label this intermediate level of intersection dual stability processes, integrated and integrated sets of communication and coordination interconnections relating to organizational policies/actions, as *Platforms of Dynamic Stability*. These, albeit metaphorical, generic mid-level platforms are represented as a unitary entity (in spite of the organization's actual multilevel/multifunctional complexity) in the central section of Fig. 2. The balancing brings worker's collective control ordering

capacity – via our Platforms – to affect not only internal management policy relating to job design, but also to affect organizational policy relating to selection of environmental challenges for the company that are humanely congruent.

From the organization viewpoint, these platform as entities can exercise a kind of intelligent response: when the organization as a whole finds a new overall goal, the subsystems can reconfigure quickly to help meet the challenge, and yet maintain stable functioning at the same time: a major ADC goal. The organization’s multiplicity of responses comes from dynamic coordination and continually re-coordinated integration of sub-systems – each one of which otherwise has their own specialized functions, boundaries of responsibility, significant autonomy, and internal stability. And yet when working together they can produce a unitary, coordinated output for the organization (Gittel 2011) resulting in flexible and successful interdepartmental relations. Karasek (2004b) reviewed conducive behaviors of mutual adjustment, and Orton and Weick (1995) reviewed multiple perspectives on loosely coupled systems.

### **Maintaining a Stable Context for Healthy Work**

To insure worker wellbeing, an important additional concept for living systems is that higher-level structures contribute to a *stable context* for lower level systems to function. Once lower-level systems are effectively functioning, they contribute a surplus that allows the higher-level system to function effectively, with enhanced strategic options for actions in the environment: the ADC’s *ordering capacity* (in physiology, this reciprocal support is termed “homeostasis”), and – from time-to-time – growth. This might be considered a type of *organization-level homeostasis*. At the organizational level, companies could provide not only work space, tools, and Internet so that employees can be productive, but policies to insure work life balance, day-care services for children, up-skilling, health promotion (examples in Hagedorn-Rasmussen 2017), contributing to the employee’s overall Platforms of Dynamic Stability.

These multilevel support and balance principles are illustrated for the organizational level, with respect to development of an effective Psychosocial Safety Climate by Dollard and Karasek (2010) in their innovative application of SDT. The organization support structure turns out to be a two-level inter-linked process with the higher level (management) and the lower level (worker) linked in a constructive and dynamic manner – functioning as a dynamic-stability platform (Dollard and Bakker 2010; PSC-12 scale, Hall et al. 2010).

### **Healthy Work Redesign**

As the ADC (and JCQ 2.0) move to multilevel format, so too must work redesign now encompass organizational redesign solutions, beyond the basic D/C task-based implications. Understanding work redesign possibilities in a multilevel and dynamic context requires developing a dual balance: a balance (Mayrhofer 1997) that is itself a balance of two environmental fit challenges: one in relation to job function and the individual worker and a second in relation between the organization and its environment reconciled, and jointly maximized – in the middle.

What is needed is to create fully functional and independent conceptual mid-levels within the organization that can protect against work job stress (Bennett et al. 2003; the Perceived Organizational Support construct, Eisenberger et al. 1986) – and at the same time insure the potential for generating flexible response alternatives for the company (Mayrhofer 1997). Mid-levels provide the possibility of integrating internal processes, seen *from below* relating to job design (i.e., stress prevention) and seen *from above* environmental response and company functional flexibility, thus supporting a top-down/bottom-up (Demerouti 2014) worker/management dialogues on organizational design. Our general propositions above can hopefully facilitate finding the most feasible pathways for the significant communication process demands involved.

### **Challenge Theme III: Growth, Development – and New Risks – from the External Environment**

Our description of growth processes extends the “active work” concept. Growth involves reaching out to “conquer” or “proactively adapt” to the environment and thereby increase ordering capacity in the long term. Resources needed for growth tend to come from new, untapped external sources.

First a general explanation: in the ADC theory of “growth,” the organization – or the person – searches for and finds new environmental resources. It selects those new resources that are cheap, available, and most easily integrated with its existing capabilities. Evolutionary psychologists Tooby et al. (2003) describe selective interactions with the environment as nature’s *only available approach* to increasing ordering capacity in living organisms (of course relying on “human agency,” we could hope for very much faster ordering capacity increases than biology’s natural selection).

Then, hypothesizing further: after multiple generally positive attempts to gain new resources via ad hoc use of the existing skill sets (a Short-term Adaptive logic II strategy), potentially “enhanced” skills would be developed or, newly acquired capabilities would be added to supplement preexisting capabilities – for example, via the “conductive communication” processes below. Furthermore, long-term growth processes also require permanent internal reorganization/re-coordination of subsystem: effectively, a new internal division of labor is eventually required. This effectively (a) consolidates the building blocks for a new “constraint structure,” to use the terminology above from the general theoretic proposition (number six above), or in a workplace context, maximizes synergies between available skilled participants toward solving workplace problems within the organization’s management structure with increased creative vigor. The new structure can effectively capture and utilize this new resources/energy in the long-term (thus creating new *ordering capacity capability*). This form of active engagement with the environment is of course “demanding” (as in D/C Active Work). It is basis of our ADC model’s summary comment about growth: systems adding complexity and capability. It represents a long-term adaptive Logic I outcome.

### **Conductive Communication and Behaviors**

Returning to the specific level of work environment requirements: opportunities arise in the environment that could potentially support growth, but how could robust and adaptive company response also be used to support the creative development of the employee? One possibility is based on the employee skill development and enabling customer communication linkage strategies described in Conductive Economy theory (Karasek 2004b, 2016).

Conductive Communication (Karasek 2004c) is an entirely different form of communication from those mentioned above (bureaucratic, from classic OST) and implies a decentralized set of semi-autonomous processes where skilled workers engage with customers – perhaps directly – in a developmental manner, involving reciprocal flexibility in communication and “language development” (a la “improvisational jazz” (Karasek 2004c).

In conductive behavior, we emphasize the fact that skills bring with them a *need* to be used (Scitovsky 1976) and accordingly have very fundamental motivational implications (White 1959; Maslow 1943 Karasek 2004b). Thus, they fundamentally affect personal engagement (“flow,” Csikszentmihalyi 1990). Well-focused and skilled efforts from the workers also can stimulate growth of capabilities *in the customer*. The growth of capabilities in the customer promotes renewed demand for a new cycle of “skill-inducing” production – eliciting further adaptive and creative work for the original workers (Karasek 1999, 2004b). Such processes could generate the kind of reciprocity of social engagement that can give “meaning” to work and support “conductive growth” of both workers’ and customers’ skills and capabilities, and enhances social identities of participants.

Creativity, growth, and development are important job design themes at the microsocioal policy level reflected in the current “job crafting” literature (Wrzesniewski and Dutton 2001; Grant and Parker 2009; Demerouti 2014). Grant and Parker (2009) list as important for successful “relational” job crafting: motivation, multilevel job social context, reciprocity, and contact with external users and a “social context” – and all these are also addressed by the ADC’s growth processes.

### **Challenge IV: Global Economy and Job Insecurity Risks**

New health and behavioral risks also accompany the current global economy’s work environment effects. We find both a new level of work stress-related risks and – via the workplace’s social interface effects at both the work/family and the worker/labor market interface – modifications of other direct work-content stress effects.

The D/C task-level theory platform addressed the 1970s stable and often rigid company and labor market structures (as measured in the JCQ1). However, the neo-liberal economy – with its diminished national labor protections and traditional community solidarity – could now be seen as requiring the individual worker to construct his/her own “labor market/life interface” – a personal job



protection structure, or *Personal Job Security Platform*. Such personally organized “plans of action” – while not existing as formal social structures – would be an attempt to insure “stability of flows” on the job market. For example, a worker might say: “I must build secure new supports for myself/family at a new level outside my task/my company. I hope that this could insure me many new job opportunities, but I fear it will take a lot of time to maintain, and I hope I have some control/leverage in this new structure.” For job insecurity: demands, lack of control, and insecurity themes above imply an obvious natural extension of the ADC theory’s generalized D/C/S-S framework, and thus can be understood as a hypothesized higher-level “emergent property,” now extended to the labor market. Measurement of these new job insecurity risks will be a significant goal of the JCQ 2.0.

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## Measurement and Testing ADC Theory & The JCQ 2.0

There has been very extensive research over four decades with the D/C model primarily predicting stress-related disease outcomes according the Job Strain hypothesis: a major pillar of research in the field. However, in almost all cases the job circumstances are assessed by self-report questionnaires a significant limitation (often using the JCQ1). Unfortunately, a major data gathering challenge is gaining information about the worker’s detailed social work environment and its requirements: here almost no “objective methods” are economically or socially feasible, and thus, the challenge of self-report bias can usually not be easily eliminated.

A newly developed questionnaire, the JCQ 2.0, (Karasek 2004e; Karasek et al. (in preparation) 2020) has been developed in parallel with the ADC to capture a wider range of task level as well as work organizational and external-to-work psychosocial characteristics of the current global economy. A companion theory-methodology bridge paper and set of empirical finding articles describe the JCQ 2.0 and its function. This instrument has now been tested empirically in four countries with over 16,000 subjects (Germany, Australia, Korea, and China), and so it does indeed provide empirical tests of several significant features of the ADC Model. Support is most often found (see a review of the tests below). Only a fraction of hypotheses, often dynamic in nature implied by the ADC theory, can be tested by worker self-report questionnaires. However, the worker reports may approximate the cumulative effects of the dynamic processes.

We can make assessments consistent with the Platforms of Dynamic Stability construct with the JCQ 2.0 instrument. While it cannot really measure the full organizational structure with worker self-reports: what it does assess is the organizational level as seen from the floor-level hospital/factory workers looking up from below. Whatever its real complexity may be, it is observed as a sort of undifferentiated whole, a unity: “the organization.” We explicitly define this in the JCQ 2.0 questionnaire usage instructions as the place “where the rules are made about how I should do my job.”

## Empirical Validation Studies Testing the ADC and JCQ 2.0

Formazin Martus et al. (in review) 2020a, show the substantial relative importance of the newly developed and theoretically anchored JCQ 2.0 scales in a German Pilot study, in comparison with the original JCQ1 scales and JCQ 2.0's literature-based scales. Agbenyikey et al. (in review) 2020 presents the international comparative reliability and concurrent validity of the JCQ 2.0's full set of new scales across pilot studies of over 16,000 workers in four countries. In another empirical paper (Formazin Dollard et al. (in review) 2020b), the structural validity of “demands, control, and stability-support” constructs are assessed comparatively internationally and simultaneously assessed at task and organizational levels to test the multilevel theory-basis of the JCQ 2.0. A further empirical paper (Formazin Dollard et al. (in review) 2020c) investigates the associations at both task and organization levels between demands, control, and support, in the D/C/S “composite scale” format, and diverse health and behavioral outcome measures testing classic DC hypotheses. Agbenyikey et al. (in preparation) 2020 demonstrates the substantial additional dependent variable variance explanation from the JCQ2.0's External-To-Work context measures.

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## Discussion

We have attempted to provide an extension of the core constructs of the original job-focused Demand/Control model, now sufficiently generalized to provide a conceptual framework for psychosocial work organization analysis of the job's social context as well: at the Task, Organization, and External-to-work levels. We have retained many aspects of the familiar D/C/S narrative (albeit in modified form utilizing Stability-Support), with its dual positive and negative outcome predictive focus, and attempt to retain its utility for international comparability. We have attempted to create a theory platform that is general enough to predict multilevel structures and outcomes, and yet specific enough to address several well-established current research contributions and current research discussions.

Our specific focus on multiple levels of the work sphere of life represents a “micro-to-macro vertical slice” of work life effects, by contrast to the “horizontal” all-life sphere coverage of theories of society developed by sociologists (Parsons 1951; Luhman 1997; Habermas 1981).

There are several advantages of the new theory – and limitations. The broad coverage brings potential advantages for further interdisciplinary research. We have discussed linkages, not only to work and organizational psychology and sociology, but to some aspects of physiology in addressing direct social causation of stress-related chronic diseases. Also, to extrapolate active work to the social content level, we have addressed economic theory's behavioral presumptions. The fact that all of these approaches have been further developed upon a unified set of general principles could be useful for further development of cross-disciplinary solutions to the current political and economic challenges of mature economies.

As already acknowledged in the introduction, the search for general theory for psychosocial work organization research encompassing stability, disease, and growth – crossing multiple levels – brings the major risk of “ecological fallacy”: where theoretic predictions made at one scientific level of explanation cannot be directly inferred to a different level or different discipline. To reduce this problem, we have introduced ADC theory with a set of General Theoretic Propositions to support our hypotheses. We hope to claim multilevel validity only where the constructs developed sufficiently conform to the practices of each of the disciplines involved. At the same time we present research in each of the themes developed, based on the research traditions of each specific field to direct our focus – whether it be contrasting or complementary. We hope to strike a balance between the required new problem-solving breadth and the conventional boundary-defining presumptions of each field.

The multifocal narrative has provided a number of cross-level hypotheses for future research. Our Ordering Capacity conception (OST and CAS systems theory-based) labels these hypotheses as “emergent properties.” Using a CAS vocabulary: *Macro-level Decision Latitude* can be viewed “an emergent property” of high-level collaborative decision-making process among groups of workers. This emergent-level control concept inherently encompasses previous concept of task level control for individual workers, since without such higher-level control, they can remain isolated and dominated by relationships with machines, fixed production routines, or otherwise dehumanized aspects of work organization. *Macro-Decision Latitude* hypothesis is particularly important for the Themes (#1, #2, and #3) noted in the paper with respect to stress/disease, stability, and growth. Five other cross-level hypotheses for future interdisciplinary testing have also been outlined: *Platforms of Dynamic Stability* and *Organizational Homeostasis* affect Theme #2’s organizational stability; *Conductive Communication* affects Theme #3’s growth processes, *High-level Social Causation of Disease* relates to Theme #1’s stress/disease hypotheses, and *Personal Job Security Platform* relates to the 4th challenge: job insecurity risks.

## ADC Theoretical Limitations

Comprehensive discussion of the advantages and disadvantages of the Theme I job strain/disease explanations is found in Karasek 2008 (Collins et al. 2005). In the paragraphs below we focus on several caveats that need to be considered for the new ADC theory with respect to Challenge Themes #2 and #3, relating to social levels above the job itself.

First, the ADC order-creating explanations above may appear to some as sociologically “functionalist” (Parsons 1951) – inherently implying social consensus – because of the compact manner in which they are presented, but this is partly by necessity of brevity given the extreme range of coverage sought. However, in general, it could be argued that D/C combinations are inherently conflict-oriented in that demand tends to increase disorder, whereas control tries to reduce it.

Unfortunately, a full comparison of alternative approaches to ADC at these levels can only be briefly listed here. One classic conflict-based theory, for example,

Dahrendorf (1959) notes, in advocating a “conflict-theory” approach to organizational processes, that human organizational structures (by contrast to biological structures) may be constructed upon dynamically balanced bargains of “conflict” and “disagreement.” Certainly, the ADC model’s focus on “control” could allow social power inequalities in jobs and organizations to be potentially integrated as research foci.

An entirely different set of questions might be raised about the apparent simple stepwise synchrony of the ADC high-level order creation pyramid (as outlined in the general theoretical proposition (number six above) and in Karasek 2008, Figure 2). For example, might it not be true that an organization has to go through a period of stress before receiving energy from the environment in order to grow? Recursively dynamic models of system function and change have been important for constructing other organization and social systems theories. Restating this at a societal level: “does societal change come through conflictual, direction-reversing, contradictory forces” – albeit ultimately evolutionary – thesis/antithesis/synthesis processes: Hegel and Marx’s” societal change format?

To be consistent with the ADC theory, our social change process would be a bit more complex than thesis/antithesis: it involves three stages. Stage 1 would be a new set of goals in a social context – which could be for an organization as well as a society. Let us define these goals as “values.” Stage 2 is a new set of social structures to achieve these goals. In a final Stage 3, the new structures allow participants to develop an entirely new set of “skills.” These occur in combination with a totally new set of social experiences and newly arising motivations. These are precursors to, and then eventually define, a “transition” to new “goals” (new set of “values”), and back to a Stage 1 process – but now at a “higher” level. These as yet untested ADC change/stability hypotheses may provide input to further debate about the dynamics of multilevel processes in organizations, which could either challenge, or hopefully via further elaboration, be integrated with the above classic conception, and are discussed further below.

We hope these multilevel hypotheses support discussion about more decentralized, and thus potentially more directly democratic, workplace level components of our socio-economic system.

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## **Social Implications of ADC Theory**

### **Sustainable, Climate Friendly Psychosocial “Value” in Work and Political Economy: The Societal Necessity of New Economic Paradigms**

#### **Conductive Economy**

Taking a broad perspective, Conductive Economy is a new form of economy of skills and development, based on an extension of DC/ADC model’s active work ideas as Conductive Production. It is relevant in a time when economic policy is increasingly focused on education and growth based on innovative production.

Conductive Production is actually an alternative, constructive model of social production – with a fundamental anchor in the psychosocial content of work (Work Quality Policy, Karasek 1997). It challenges several of the basic behavioral tenets of “Economic Man” (Mill 1836), for example, those based on socially anonymous market-transfer-based value assessment of physically tangible objects and human satisfaction derived from the “utility” their enjoyment. While other “new economy” perspectives with partially similar goals have been offered before (e.g., by Toeffler (1980) Florida’s Creative Class 2005), we hope that this ADC version can provide a more rigorously structured analytic framework for hypothesis testing and research.

This new approach describes a new process linking individual skill development possibilities to very specific customer demands (Conductive Production). New forms of creative coordination/communication could support customer-adapted production. These are now becoming technically feasible through social media, locational point-of-sale data, and electronic currencies. Here, there could be worker-customer microlevel of environmental resource generation for the organization in quite decentralized organizational structures – fitting our Dynamic Stability Platform conception.

These skill-based “needs” are economic drivers that support a healthy new social dynamic for youth job creation, keep the economy flexible, and keep it sustainable (without physical production’s environmental costs). This would allow ADC theory to address alternative pathways for future developed economies: (a) for youth unemployment risks, (b) for robotization threats to sufficient employment levels in a mass-production, commodity-based global economy (Livesey 2017), and for (c) marginalization threats to workers in off-shored employment. Indeed, we hypothesize that such creatively reciprocal linkages are the primary pathway for accumulation of social capital over the long term, as trusting and constructive social relationships are built over time (Karasek 2004b, Olesen et al. 2008).

As a new form of economic development, Conductive economy could potentially offer new solutions or pathways of social-economic transition for several major current social dilemmas.

One current dilemma is a rapidly emerging societal conflict about “valid truth” in social policy debates in Western society: what news is “false news,” etc.? We view this dilemma as the consequence of contemporary multiplicity of “truths.” We suspect that a very significant element of each view of truth relates to an actor’s location at different stages in the “value production” process. One new stage of contemporary “value creation” can be captured with our Conductive Economy theory, with two other stages noted below.

A second and even more glaring current crisis and dilemma relates to climate change – a drastically prominent threat calling for immediate revision of standard social policy models. The potency of the climate crisis builds on the “decoupling dilemma,” which holds that adverse climate change is the inevitable consequence of the very economic development otherwise thought to be essential for human progress (Singham 2019; International Resource Panel 2019).

Fortunately, we claim that the ADC-based Conductive Economy model (Karasek 1999, 2004a, b, c) potentially dissolves the social policy component of this

“decoupling dilemma.” Conducive Economy allows both economic growth and climate neutrality at the same time.

A. Conducive Economy requires No Material Resources. Coal, iron ore, etc., are not needed as a base for generating value. Its “inputs” are not dead material objects or mineral deposits, but living, development-capable human beings. The output is new forms of “creative coordination”: creative associations among the skills of the skilled human participants: of value to both their users and their producers: with positive social relational implication described in Karasek (2004c).

B. Conducive Economy requires No Fossil Fuels or other environmentally degrading scarce energy sources. These are not needed as a “motor” for productive social action. The “motor” of the Conducive Economy is the motivation involved in the creative social coordination in the value creation processes itself. It derives from the fact that “a skill – in the possession of an active human agent – wants to be used.” That is, active human beings after acquiring skills want to use them (a violinist wants to play the violin, the carpenter wants to build furniture, the marathon runner wants to run a marathon, etc.). Furthermore, skilled persons are most motivated to do so in collective social contexts, where their skills are potentially complementary: leading to enhanced bases for social interaction (dance, games, many computer social media activities). However, Internet-based social media unfortunately often lack precisely the direct human-to-human reciprocal social contact that drives the Conducivity “motor.”

## **A New Social Bargain in Historical Perspective: Psychosocial “Value” in Work and Political Economy**

We have claimed (Karasek 1997, 2004a) that there was a “vacuum” in modern social policy in which neither our economic market models nor our normal social welfare states’ redistribution of material wellbeing provides adequate solutions for contemporary problems. Nobel-prize winning economists also see these failures (Krugman 2009; Romer 2016) and now the political instability in both Europe and the USA in the years 2015, 2016 up to now have led to high-level questioning of “the received wisdom” about international economic policy and Western neo-liberal social policy overall – as it has evolved from Adam Smith’s *Wealth of Nations* discourse in 1776 and now as our dominant free-trade economic policies (IMF, World Bank, etc.) (Stieglitz 2019; Autor, Dorn and Hansen 2016).

### **Bargain #2: A New Social Contract**

The ADC Model can support a “New Bargain”: one relating to the social structure of work and the well-being of individuals for the challenges of the twenty-first century.

It is a bargain to at least partially replace the material well-being Bargain #1 of the seventeenth to twentieth century that started in 1690 in England with John Locke’s formulation of 1690 in England with John Locke’s social contract (2003). That bargain offered “everyman” actual control – in the form of “property rights” – of the fruits of their labor and was thus a major step forward for citizens whose property

was otherwise always controlled by an absolute monarch with power legitimized as monotheistic religion-based theocracy (as Devine Right) in the western European countries of Locke's era.

We suggest that the ADC presents a "timely" New Bargain relating to work and well-being (Conference Keynote Resources: Karasek and LeRouge 2016). Bargain #2 offers now – upon a social and psychological work organization platform – another pathway beyond Locke's original materialist Bargain #1, to further positive social progress for our current uncertain times.

The First Half of the Bargain #2 is a creative goal for life: growth of capabilities (skills) for active, living beings (and in a social context: collaborative capabilities from creative coordination). These are based upon new social dynamics to link users' needs and workers' capabilities in smart, adaptive jobs. The Second Half of the Bargain #2 offers health – reduction of stress-related disease – based on a personal maintenance of stable internal self-regulation, which at the social level supports the welfare state's sustainability by reducing social costs. Both could help fill the "vacuum," noted above.

This New Bargain #2 is consistent with several profound current realities. There is no possibility of continuing the pace of material growth – which was, in itself, a sufficient social-change motivator from Locke's seventeenth century era – up until the present decades and now especially in the context of global climate change. The twentieth-century's model of a social welfare state – which is still a material wellbeing model modified with the additional focus of insuring *material equality* – involves bargains politically easiest to attain in times of economic growth and has been/was basically "just" attained in some of the Scandinavian industrial democracies. But to move beyond that success to the "Next Step" – maintaining the momentum for positive Western societal change – requires still further progress. (However, these social welfare states – now with aging populations – now risk insufficient funding for their social care costs. Also, they lack incentives for "growth/youth," broad understanding of chronic disease risk factors, and the ability to maintain population levels.)

However, the above discussion should not imply that Bargain 2 "replaces" our current global materialist economy's "value definitions" and market-structures. On the contrary *it requires our current economy as a "platform."* What we propose is a "marginal pathway" for the future components of economic growth. The advantage is that the current economy platform need not grow larger than it currently is (and it could even become smaller to sustain our planet). Our new marginal pathways could move us beyond our current economy's limitations. The relative importance of these two forms of economy – minor or major – depends on unknowable future events.

The feasibility of the new economic pathways requires that they cover an extensive "bandwidth" in terms of its theoretical explanations. They must include both Productivity and Health – such as we discuss above for the ADC theory. Such discussions have indeed been successfully tested in a large stakeholder conference (A Feasible [Sustainable] New Economy of Innovative and Healthy Work (Karasek and LeRouge 2016). The "solutions" addressed current Western economy challenges

such as a new job generation – for youth – and reduction in the stress-disease and lost work capability – for older workers.

### Future Scenarios for Integrating the Psychosocial Work Environment and Society

These extended social well-being combinations were actually already the “new message” of the DC model in the late 1970s and the JCQ from the mid-1980s, but now have evolved to an almost unavoidable set of social choices. Already 30 years ago Chapter 10 of Karasek and Theorell (1990) sketched two scenarios – one each for the Future of Good Jobs and the Future of Bad Jobs – in which the broad social-economic context of both reflected and amplified the job content itself. But we could not predict then what we would see in our world today.

First, let us take the optimistic view of our long-term future: we can observe (Conference Keynote Resources, Karasek and LeRouge 2016) that the Conducive Economy described above could *coexist* with the current free-market Commodity Economy (Capitalism) – which has evolved out of Locke’s Bargain #1.

The true potential complementarity of this co-existence can be seen here in Fig. 3. Seen from the view of the “consumer” (Fig. 3 right side), the conventional material

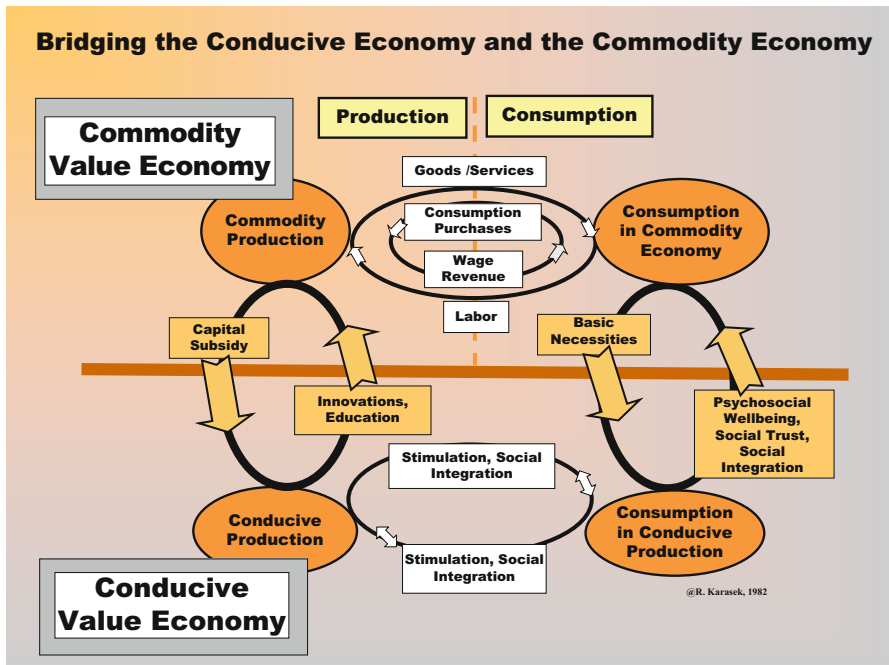


Fig. 3 Bridging the conducive economy and the commodity economy



(Commodity-based) Economy contributes the basic material necessities of food and shelter for consumers, while the Conducive Economy produces psychosocial wellbeing and social integration for healthy work that is otherwise missing in our market economy. On the organization-of-production side of the economy (Fig. 3; left side), the conventional material (Commodity) Economy can provide the physical infrastructures of roads, power grids, and factories – while the new Conducive Economy contributes new ideas and innovation and provides the new skills and training that are needed for future youth jobs in social policies for innovative economic development.

Taking a more pessimistic long-term view, we can also see substantial current evidence for the “bad outcome,” where the Future of Bad Jobs scenario above has come to dominate, via its dominant materialist logic and economies of scale. Psychosocial wellbeing factors are relegated to a secondary status. This is ironic from a Conducive Economy perspective, because much of the nonmaterial, skill-focused production it advocates is already here, with many of the very largest and most valuable international corporations involve information and software based on intellectual, not physical, capital. However, they have also brought great economic power concentration, via the Internet, which was not in our original Conducive Economy prediction (but see Barabasi 2002).

So this is a time of transition: the reality of production experience has indeed changed radically over the last several decades, but the socio-political dialogue has not yet “caught up.” No value transitioning from a past Stage 3, to a new Stage 1 (as discussed above), had broadly occurred at a political level, in spite of myriads of microlevel skill-enhancing examples.

Notwithstanding the “waiting time” implied for a transition to Bargain 2, we can now see Bargain 1, that was originally popular for its wide appeal in Locke’s time, is now rapidly deteriorating in appeal. It is failing to advance the fortunes of the vast majority of middle and lower wage workers. This original bargain has in modern times been based on mass-production of material goods and unregulated, Internet-leveraged global trade, production processes which have “under-delivered” on the decisively advantageous health and creativity benefits of Bargain #2. But obviously also the failure of Bargain #1 is the result of an “internal” logical malfunction. The “democratic processes” and egalitarian material well-being distribution that were to be its cornerstone advantages for the majority of society have instead only accrued unequally to a very few persons – a now accelerating problem (Piketty 2014).

## **Perspectives of a Multiple-Value Social Economy in a Time of Transition –Potentials**

The developments above have left a vacuum of legitimacy for all of the Western social institutions that had followed the Bargain #1 pathway away from the theocratic absolutism of centuries ago with unchallenged success – at least until the present time.

Fortunately, we are actually not caught in an intellectual dead-end with no alternatives. We do have dramatically new alternatives, and the need to fill this void makes a strong case for Bargain #2 – modified as above: the Good Jobs of the Conducive Economy, combined with the Commodity Economy.

Our current time of transition involves three value systems (from the above discussion) currently actively competing in Western society:

1. Capitalism itself (and its welfare-state modifications) – commodity-based
2. Steps forward toward a new economic pathway of creative and psychosocially healthy work such as Conducive Economy
3. Religious absolutism as a seemingly secure step backwards

Assessments of benefits and risks of these alternatives may differ significantly for different groups within Western societies, and even more for those outside its boundaries. For example, the advantages of steps forward, such as Conducive Economy, are especially tempting for members of Western society with secure basic material wellbeing, young with strong educations: a relative “elite.” Significantly such a “new elite” has potentially entirely different “values” from the traditional economic upper-class at the top of the material income distribution: a source of conflict. This discrepancy is consistent with the above noted feature of the early Demand/Control research finding of a second: Psychosocial Class Structure (see Introduction D/C model). There is a greater concentration of such conducive work in urban areas (Florida’s Creative Class 2005) leading to urban/rural value differentiation.

But this transition period also brings with it the threat of societal movement “backwards”: backward development for Western societies – toward a seemingly more stable past with social structures of the “secure” religious absolutism that Locke’s original Capitalist Bargain #1 replaced. This is an especially problematic risk for groups with low education attainment in the context of increasing income inequality.

## **Summary: Historic Challenges**

The socio-political challenges sketched are of course far beyond the scope of this present manuscript, but have consequences closely related to workplace policy. Disagreement on “valid communication” could certainly disrupt possibilities at the microscale for our suggested Associationalist-based progress, since communication is so central to effective creative coordination in work life. The ADC required communication must be broad in “bandwidth”: it must encompass health and productivity.

Furthermore, ADC communication must also provide social reciprocity. In past times this has been the natural result of the relative isolation or decentralization of “local” social structures, but these are disappearing.

In the current and future world of ever more tightly integrated communication networks and vastly unequal power distributions this decentralization must be actively “constructed.” New forms of democratic participation at work could possibly come via our newly suggested mid-level structures, for example, Platforms of Dynamic Stability in an organizational context.

Since the time of the original DC model and the JCQ development, just a few decades ago we have now a much more complex world of work organization to assess. We hope the ADC theory can at least contribute an outline analytic format, or provide a new vocabulary, to fill the “vacuum” of socio-economic policy in the early twenty-first century relating to the design of work and workplace-related social economic policy: life’s central macro institutional sphere.

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# Regeneration and Anabolism: The Good Perspective

# 30

Tores Theorell

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## Abstract

In most textbooks and handbooks on stress, considerable attention has been directed to the mechanisms of energy mobilization and the dangers associated with long-lasting energy mobilization without periods of recuperation. There is less emphasis on how regenerative forces in the body may stimulate repair and replacement of worn-out cells. In interventions, a distinction should always be made between improvement of “good” forces and reduction of “evil” forces. Here the physiological counterparts of “good” (regeneration) forces are presented.

## Keywords

Keywords Stressors · Coping strategies · Stress · DHEA-s · Oxytocin · Energy mobilization · Regeneration · Epigenetics

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_26](https://doi.org/10.1007/978-3-030-31438-5_26)

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## Introduction

There is an interplay between structural and individual factors in workplace stress reactions. Looking at it from a practice perspective, there are three levels. On the first level, we find environmental conditions; on the second, individual strategies; and on the third, the reactions themselves. In energy mobilization terminology, these three levels are *stressors*, *coping strategies for energy mobilization*, and *stress reactions*. Their three counterparts in regeneration terminology are *environmental assets (anti-stressors)*, *coping strategies for regeneration*, and *regeneration processes (repair)*. There is a floating border between these opposites on each level of the model. This means that stressors could become anti-stressors and vice versa, that energy mobilizing patterns of coping could turn into patterns for regeneration, and that stress reactions could turn into regeneration and vice versa. In some circumstances both levels could operate simultaneously.

What this model adds to previously published similar models is that it combines the positive and the negative aspects.

Work organization is a very important prerequisite for the working individual's stressors but also for his/her positive reactions to the job situation. Most of the literature on work organization interventions is devoted to the reduction of negative stressors. The worksite also has responsibility, however, for creating a positive atmosphere that stimulates creativity and social support. Anti-stressors are likely to stimulate what is perceived as "healing" and health promotive processes in the employees. This pertains to both psychological and bodily processes, from being positive to being negative and vice versa.

The individual's coping program is shaped by a continuous interaction between genetic and environmental factors. The individual's coping strategy, however, is subjected to continuous change. New experiences throughout life influence coping strategies in old as well as young subjects.

The "interpretation" of the stressors and the subsequent handling of them (coping) is a result of genetic makeup and previous experiences. According to CATS (cognitive activation theory of stress) formulated by Ursin and Eriksen (2004), the coping pattern is to a great extent formed by the expectancies that the individual has on the consequences of his/her actions. A positive expectancy of outcome is likely to be associated with an active coping pattern. According to this terminology, negative expectancies could be labelled either helplessness (actions will not help) or – even worse – hopelessness (actions will make things worse). The experiences that the individual may have had from similar situations in the past will partly determine how the interplay between stressor and coping will develop and how the physiological and psychological reactions manifest. There is clearly a socioeconomic perspective in this. Individuals who grow up with limited resources and whose work careers are characterized by small possibilities to exert control are less likely to have positive expectations in demanding situations than others.

## The Stress Reaction and Its Positive Counterpart Regeneration

One of the central parts of the stress reaction is the hypothalamo-pituitary-adrenocortical (HPA) axis extending from the hypothalamus to the adrenal cortex. If the organism interprets the situation as energy demanding, a chain of reactions starts resulting in raised blood concentration of corticosteroids. In a number of ways, these corticosteroids help the organism sustain its fight in a stressful situation. In the acute situation, this is purposeful since the release of energy is facilitated by mobilization of fuel for energy requiring actions (carbohydrates and free fatty acids), and there is retention of salt and fluid which may otherwise get lost in an uncontrollable way in a physically demanding situation. There is also a temporary inhibition of acute inflammatory reactions. However, if the stressor is long-lasting (for instance, lasting for weeks or months), those same effects may be damaging to health. There are other components in the immediate stress reaction some of which occur more immediately (within seconds or parts of seconds) than the reactions of the HPA system (which take place within minutes). This is, for instance, the case with those taking place in the sympatho-adrenergic nervous system (noradrenalin) and in the sympatho-medullary system (adrenalin).

The “good” counterbalancing system – an anti-stress system which protects from adverse effects of long-lasting stress – is labelled the HPG (hypothalamo-pituitary-gonadal) axis with the same levels as the HPA axis ranging from the hypothalamus to the gonadal glands (Theorell 2009). The male testes and the female ovaries are the end organs of the HPG axis. They represent the extreme of the formation of new cells, namely, reproduction. “Building a new human individual” is of course the most pronounced “anabolic/regenerative activity” that the body can be involved in. Building new cells and repairing worn-out tissues are closely related to this, however. Some of the production of anabolic corticosteroids takes place in the adrenal cortex. Accordingly, some of the release of these regenerative hormones takes place in the adrenal cortex (for instance, testosterone in women) together with the corticosteroids that are important for energy mobilization. This means that the HPA and HPG axes do not represent an anatomical reality but, rather, a theoretical construct. Cells producing some hormones that are mainly active in regeneration are located in the adrenal cortex which is also mainly producing and releasing hormones that are active in energy mobilization. The two forces “energy mobilization” and “regeneration” are balancing one another on all levels of the HPA and HPG axes.

In all bodily organs, cells are being worn out and have to be repaired or replaced. In some cell systems, this is a rapid process (days or weeks, such as in mucosa, skin, and white blood cells), whereas in other systems it is slow (months, such as in the skeleton). Of particular interest in the discussion regarding effects of long-lasting stress is the fact that connective tissues and muscles depend on regeneration, without which there will be increasing fragility in muscles and tendons. Similarly, white blood cells have to be replaced when they are worn out. If not, increased vulnerability to infections may arise. A third example is the brain with its own support system, the glia cells. These cells are constructed like connective tissue cells, and

they also depend on sufficient regenerative activity. If this is not sustained, the glial cells will be dysfunctional. This affects the brain function, possibly resulting, for instance, in deteriorating short memory function. Testosterone and estrogen as well as their precursor DHEA-s (dehydroepiandrosterone sulfate) are examples of corticosteroids with mainly anabolic/regenerative function. Also other hormones participate in this, such as the pituitary growth hormone. There is a balance between the HPA axis and the HPG axis. This means that the HPG axis tends to lower its activity when the HPA axis has maximal activity (in stressful situations). But it also means that damaging effects of long-lasting stress can be dampened by a high activity in the HPG axis. There are also situations when both the HPA and the HPG axis may show high activity at the same time, for instance, in flow experienced during music making or playing games (see de Manzano et al. 2010; Harmat et al. 2015; Ullén et al. 2010)

According to epigenetic theory (Kader et al. 2018) input from the environment can trigger methylation of genes. This is one of the mechanisms through which the environment can actually influence the sensitivity of a gene that is involved in stress regulation. To grow up in poor socioeconomic conditions, for instance, which is related to an increased risk of being exposed to threats, is associated with changes in the methylation pattern in the genome (Szyf 2012). This is relevant (Baker et al. 2017), for instance, for one of the genes, SLC6A4, involved in serotonin regulation which is of fundamental importance for the development of depression. Epigenetic processes are also of importance for genes that regulate energy mobilization, for instance, NR3C1 which is a glucocorticoid receptor which helps the cell to use glucose for energy production. These are examples of genes that increase psychological sensitivity.

The general epigenetic reasoning is also, however, relevant for regenerative processes, the counterforce against adverse effects of stress. Examples are brain-derived neurotrophic factor (BDNF), which stimulates nerve cell growth and oxytocin receptors (OXTR) regulating oxytocin release which is associated with feelings of togetherness in a group (De Dreu and Kret 2016; Engert et al. 2016). Such group processes are amplified by specific activities such as singing (Grape et al. 2003; Kreutz 2014). Increased oxytocin secretion is associated with increased activity in the parasympathetic system (Lancaster et al. 2018). An additional example is NPY (Neuropeptide Y), which protects the brain (see Feder et al. 2009). With regard to NPY, it has been shown in animal experiments that injections of this factor into the amygdala promote resilient responses to stress in the form of reduced anxiety-like behaviors in response to acute restraint (quoted from Feder et al. 2009).

The balance between HPA and HPG activity is an important principle in health promotion. We are constructed for a life that swings between the two. We need challenges and periods with energy mobilization in order to “train” all our biological systems, but periods of energy focus have to be interspersed with periods of regeneration and recuperation.

There is a growing literature showing that the hormones DHEA-s (water-soluble form) and DHEA (lipid-soluble form) have an important role in regeneration. For many years it has been believed that this hormone is only a precursor of the sex hormones with well-known anabolic effects, testosterone, and estrogen. However

more recent research has shown that DHEA-s has anabolic effects of its own. For instance, it has been shown that DHEA-s is closely coupled to the saliva concentration of the nerve growth factor (NGF) – with increasing DHEA-s NGF (Taylor et al. 2014). This is important since in the absence of NGF sympathetic and sensory nerves undergo apoptosis (cell death). A strong healthy DHEA-s response during stress brings about a strong NGF response.

When energy mobilization functions the way it should, there is an increase in cortisol excretion from the adrenal cortex. However, at the same time, DHEA-s is also released. It has been shown that this healthy DHEA-s part of the adrenocortical response is attenuated when subjects suffer from long-term stress (Lennartsson et al. 2013a) and also that the average plasma concentration of DHEA-s is lowered during long-term stress (Lennartsson et al. 2013b).

That some kinds of individual stress management can reverse the decreased capacity to produce DHEA and DHEA-s when subjects have been exposed to long-term stress has been shown. For instance, a kind of yoga was practiced (8 weekly 90-min sessions) by soldiers who suffered from combat-related post-traumatic stress disorder. This was associated with an increase in the plasma concentration of DHEA-s (McCarthy et al. 2017). Another example was a study of depression which has been associated with low DHEA-s levels, and it is also known that low DHEA-s levels predict development of depression. DHEA-s levels were assessed in 55 patients with depression before and after 8 weeks of antidepressive medication (a selective serotonin reuptake inhibitor). After treatment the patients exhibited significantly increased DHEA-s levels.

Factors that increase energy mobilization in employees are, for instance, excessive demands (both physical and psychological), repeated frequent reorganizations, lack of support from superiors and co-workers, lack of possibilities to exert control, lack of reward, negative feedback, and bullying. With good reorganization these factors could be turned into their opposites, reasonable challenges adapted to the resources in terms of number of employees and knowledge in the organization; well-planned reorganizations rooted in the needs of the worksite activity; a good organizational structure for employee influence; social, psychological, and material reward for hard work; good emotional and instrumental support from superiors and co-workers; and good emotional climate preventing bullying. All of these positive factors could (1) reduce the number of negative factors (stressors), (2) strengthen the ability of the individuals and the organization to handle the stressors, and (3) turn some of the negative biological reactions into positive ones. In addition, all of them could be influenced by organizational work. Such organizational work has been described by several researchers, for instance, Semmer (2006), and Roskam (2009).

I will present two examples from my own experience in which reorganizations resulted in significantly reduced activity in the HPA axis and increased activity in the HPG axis, respectively.

Although it is always preferable to work with the whole organization, it could sometimes be feasible to work with the managers in the organization – in order to convince them that they need to take psychosocial factors into account when the work organization is designed. Financial arguments are often important in such

discussions. It has been shown that organizations that produce ill health in employees lose large amounts of money, much more than managers mostly realize, in the form of indirect costs (see Jauregui and Schnall 2009).

### **Employee Health Effects of Manager Education in a Troubled Swedish Insurance Company**

This evaluation study (Theorell et al. 2001) was planned during the spring of 1998 which was in Sweden the final part of a financial crisis that started in 1990. During the late 1990s, the economy had started to recuperate, and unemployment rates had decreased. The crisis had started a new era in Swedish working life however, with a high pressure for reorganization of worksites, privatization of several parts of the public sector, increased competition, and lively discussions about management models. The insurance company in the study had had a monopoly for a specific kind of insurance, but politicians were now demanding more competition. During the study period, no pronounced change in the company's market conditions took place, but there was a constant discussion about such a change for the company, and this created organizational anxiety. The leaders of the company argued that psychosocial education for the managers could be of benefit. For instance, one argument was that managers who have psychosocial knowledge would be more able to handle employee anxiety and accordingly be able to prevent dysfunction in the organization during the turmoil. A consulting agency was contacted, and at the same time, a team of researchers was contacted taking responsibility for evaluation.

The manager education that was launched was founded in organizational research and had the following structure:

It was mandatory for all managers in the organization (13% of the employees) to participate. There were meetings every second week during two semesters (fall 1998 and spring 1999) lasting 2 h each time. The meetings consisted of a half-hour lecture followed by group discussions with seven participants in each group. An expert from the external consulting group participated in all group discussions. The gatherings took place in the workplace during work hours. An important aspect of the design of this intervention was that all managers in this part of the organization took part in the meetings. This means that they could support one another during the intervention year. They could discuss with one another about themes that had been discussed during the meetings. Another important aspect was that they could use the 2 weeks between the meetings for practical applications of what they had been discussing. There were four themes, each one occupying one fourth of the period, namely, individual stress, group stress, organizational stress, and ways for instituting and maintaining beneficial change.

A condition for a meaningful evaluation was that there was a control group. This was a similar part of the same insurance company. The control group had similar numbers of employees and similar work tasks. Both groups were geographically located in the central part of Stockholm. The evaluation was a quantitative one with emphasis on work environment and employee health. Standardized questionnaires were distributed, and morning blood samples (for the measurement of cortisol and liver enzymes as well as lipids in serum) collected before start, as well as after 1 year.

There was no qualitative evaluation of the intervention program. The researchers even deliberately avoided extensive qualitative interviewing since it was felt that this could influence the course of the psychosocial process.

The results from the questionnaires showed that there was a significantly more favorable development of reported decision authority in the experimental group than in the control group during the intervention year. In the control group, decision authority deteriorated, whereas in the intervention group it improved. This significant difference in development was observed both in the managers themselves and in their respective subordinates.

In the examination of 260 employees in the blood sample collection (130 in each group), morning serum cortisol remained unchanged during the study year in the control group and decreased in the experimental group (with a significant group\*time interaction effect). Similarly, gamma-glutamyl transferase (a liver enzyme sensitive to excessive alcohol consumption but also to long-lasting negative stress) developed significantly more favorably in the experimental group. This latter finding did not correspond to any difference in development of alcohol consumption in the two groups, and the interpretation was therefore that both these changes (not only the decreased cortisol concentration) were related to decreased stress levels in the experimental group's employees.

There was a significant decrease in serum cholesterol in both groups, a likely consequence of the feedback based upon blood analysis results in both groups. This information helped the employees focus on diet and healthy lifestyle more than before the study.

The results of one single intervention study do not prove anything, and more studies with similar design are needed. Important characteristics in the design and interpretation were the following:

1. The initiative came from management, not from employees or union. Although the target of the intervention was the manager group, one of the specific aims of the program was to increase managers' awareness of the employees' psychosocial needs. This means that although the design could imply a top-down perspective, the contents of several lectures and group discussions aimed at an increase in bottom-up processes. Interestingly, analyses of changes in decision authority showed a favorable development in the experimental group both in the managers themselves and in employees. Improved decision authority has been shown to be an important mediator of improved employee health in successful psychosocial job site interventions. Our results could be interpreted to mean that increased power sharing could be perceived at the same time in both managers and employees during a successful psychosocial intervention.
2. Stress reduction was visible after a whole year of the intervention, not before that (data not published) – no significant difference was observed after half a year. This is logical since psychosocial processes may take a long time, and in this case there had to be effects first on the attitudes and knowledge of the managers and subsequently on the whole employee group.

3. The educational principles in the intervention program for the managers followed contemporary theory.

There were both preventive (eliminating stressors by improving the work organization and improving the managers' knowledge of psychosocial factors) and promoting (stimulating anti-stressors by improving the working climate) components – see above – in the intervention program. There was no effect on workload or work tempo. The significant psychosocial effect that was observed was a more favorable development of decision authority in the intervention group than in the other group during the study year. This was associated with a reduced morning cortisol concentration – which in this relatively healthy working population is an indication of reduced energy mobilization – the most likely interpretation is that the intervention program has reduced the stressors by improved influence over decisions and thereby decreased their level of energy mobilization.

### **“Artistic Manager Education”: An Effort to Strengthen Anti-stressors**

The second evaluation study (Romanowska et al. 2011, see ► [Chap. 25, “Using Arts to Support Leadership Development”](#) by Romanowska and Theorell in this book) was based upon a different educational principle than the first one. In this intervention, the framework was different since the managers participating in the study did not represent whole organizations. They came more or less randomly from many companies/agencies and represented themselves as individuals only.

The evaluation was performed on the participating managers as well as on a group of subordinates (four for each manager) – 136 subjects. The results from the subordinates showed that the cortisol concentration changes did not differ significantly between the groups. There was a tendency (similar to the results in the first intervention study, see above) for the cortisol concentration in the nonartistic group subordinates to decrease compared to the corresponding other group after 1 year. This was an expected finding although it failed to reach statistical significance, and this tendency disappeared during the follow-up period. A positive finding was that the concentration of the anabolic hormone DHEA – which is a precursor of both male and female sex hormones and which has anabolic effects on its own – had developed significantly more favorably after 18 months in the subordinates whose managers had participated in the Schibbolet intervention than in the corresponding control group of subordinates – a positive “anabolic effect.”

The development of psychosocial work environment – according to standardized questionnaires – did not differ between the two employee groups. The development of mental health in the subordinates on the other hand had developed significantly more favorably in the Schibbolet subordinates up to the end of the study 18 months after start. Accordingly, there was a more favorable development in the Schibbolet subordinate group with regard to a total mental health score (including emotional exhaustion, sleep disturbance, and depressive symptoms), covert coping (tendency not to deal with problems arising in relation to workmates and superiors), and performance-based self-esteem. This combination of findings could indicate a

climate increasingly allowing employees to talk about problems and solving them jointly, not only with increased individual effort.

In summary, the analysis of this study shows that the artistically flavored manager intervention may have had a positive influence in the direction of health promotion rather than on a reduction of stressors (strengthening HPG rather dampening HPA influence, see above). The results also confirm that it may take more than a year before differences are observable. Intervention programs of this kind have to be carefully tailored to the organization, however. The findings on beneficial effects on the HPG axis have to be repeated in other studies.

### **Spontaneous Fluctuations in Work Environment and HPG Activity**

In the symphony, orchestra colleagues depend on one another to an extreme degree. If a member plays the wrong notes or shows adverse behavior, all the other members of the orchestra are affected. This was clearly shown in a study (Theorell et al. 2007) of two symphony orchestras that were followed every 6 months for 2 years. The results of this study also showed that severe disturbance of the behavior in one orchestra member could have strong effects on biological markers of the HPG axis activity in other members. The psychosocial work environment was examined by means of standardized questionnaires, and physiological assessments of the musicians were made by means of saliva specimens (six tests on every test day on five occasions during the 2-year period) and 24-h ECG recordings. In one of the orchestras, the atmosphere was seriously disturbed by the fact that one of the wind blowers became unconscious during two concerts in front of the audience. He also fainted during two rehearsals during this period. This resulted in a reduced sense of social support, and the mean concentration of testosterone (regenerative hormone, see above) was very low in the musicians during this period. However, the fainting musician was treated medically. As a consequence, his fainting stopped. In addition, group therapy was arranged for the musicians. The psychosocial atmosphere improved, and the saliva testosterone levels became normalized after half a year. Similar findings were made in the ECG analyses (indicating normalization of parasympathetic activity). These results show that a destroyed feeling of control and support may lower the regenerative activity (HPG) but also that a normalization can occur relatively rapidly if collective action is taken.

Morning serum testosterone concentration was studied repeatedly in another study of spontaneous variations in job strain – the combination of high psychological demands (PD) and low decision latitude (DL). In that particular study (Theorell et al. 1990), the ratio between PD and DL was computed for each subject (44 men in 6 different service occupations) during 4-work days scattered throughout a working year (every third month).

The serum testosterone levels – representing the general level of anabolic activity – on the two occasions with the worst strain (ratio between demands and decision latitude) were compared with the serum testosterone levels on the two occasions with the least strain. The results indicated that total serum testosterone levels increased when strain diminished (and working conditions accordingly improved). This finding was confined to participants in sedentary (white-collar workers) but not in physically



demanding work (blue-collar workers). That physical work has an effect of its own on testosterone excretion may explain why these relationships were stronger in white than in blue-collar workers.

### **Individual Stress Management**

Individual stress management refers to a number of techniques which aim at improved coping with stress. An increasing number of controlled evaluation studies of the effects of individual stress management programs have been published. One of the few studies of this kind that I have been part of myself is a study of 303 white-collar workers in 22 units in 4 information technology and 2 media companies who were randomized into an intervention and a control group (Hasson et al. 2005). Web-based tools for health promotion and stress management were introduced. These were developed for this intervention and were building upon principles established in web-based intervention research and in cognitive behavioral therapy. All participants (in intervention and comparison groups) received a short web-based questionnaire for repeated monitoring of current health and stress status, a diary, and information about stress and health. In addition, the participants in the intervention group were offered web-based exercises aimed at decreasing unwanted stress. These exercises included techniques for relaxation, time management, cognitive reframing, and a chat. For the evaluation a structured questionnaire with 100 mostly questions (most of them based upon visual analogue scales) was delivered before start and 6 months later. Venous blood samples were collected from all participants during these data collection periods in both groups. The drop-out rate was small and very similar in the two groups. At the end of the 6-month intervention period, the means in the intervention group had developed significantly better than the comparison group with regard to “ability to manage stress,” “sleep quality,” “mental energy,” “concentration ability,” “social support,” and “competence usage at work.” Correspondingly, the intervention group’s means had developed significantly better with regard to the hormone DHEA-s, Neuropeptide Y, and TNF alpha (a marker of immune activity). These results were very encouraging since they pointed at beneficial effects of the intervention in the form of both reduced HPA and increased HPG activity (see above).

However, when the participants were followed for an additional 6 months, all of the significant differences between intervention and comparison group participants – including the activation of DHEA-s – had disappeared (see Hasson et al. 2006). This illustrates the difficulty that is encountered in several evaluations of individual stress management programs: that the effects of these programs depend on continuous use of them for long periods of time and that individuals may tend to use them initially and then abandon them. Motivation is the key concept: individuals must have motivation to continue. Increased motivation can be facilitated if individuals themselves see that program participation continues to be meaningful. This is only one part of the equation, however. If only a small proportion of employees have participated in the stress management program, the surrounding employees will

not have a good tolerance for the activities and may even try to prevent their colleagues from participating. On the other hand, if the majority of employees have participated and therefore have developed an accepting tolerance, this may increase the likelihood that structures facilitating participation will arise. Individual stress management represents interventions focused on individual coping. If an intervention program is entirely individually focused and no attention is paid to work organization (stressors and anti-stressors), there may be no lasting effects. A poor work organization may in itself create obstacles for participation. Conversely, it could be argued that an intervention that is entirely organization-focused may lack components that motivate individuals to participate. Monitoring of the individuals' health and their work environment raises the interest in organizational conditions. Semmer (2006), in a review of job stress interventions summarizing evaluations of interventions, has concluded that "a combination of person-focused and organisation-focused approaches is the most promising."

There is a growing literature showing that the hormones DHEA-s (water-soluble form) and DHEA (lipid-soluble form) have an important role in regeneration. For many years it has been believed that this hormone is only a precursor of the sex hormones with well-known anabolic effects, testosterone, and estrogen. However, more recent research has shown that DHEA-s has anabolic effects of its own. For instance, it has been shown that DHEA-s is closely coupled to the saliva concentration of the nerve growth factor (NGF) – with increasing DHEA-s NGF (Taylor et al. 2014). This is important since in the absence of NGF sympathetic and sensory nerves undergo apoptosis (cell death). A strong healthy DHEA-s response during stress brings about a strong NGF response.

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## Conclusion

The regenerative processes are important in the body's handling of stress. There is new knowledge from rapidly growing basic research which specifies some of the hormones that are of particular importance and also shows that these hormones interact with specific genes which could be influenced by the environment in long-term regulation (epi-genetics). In this chapter, some examples are presented which show that psychosocial job interventions can beneficially affect both energy mobilization (stress) and regeneration processes.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [The Associationalist Demand–Control \(ADC\) Theory](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [Work Stress and Autonomic Nervous System Activity](#)
- ▶ [Work Stress, Immune, and Inflammatory Markers](#)

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# Work Stress and Autonomic Nervous System Activity

# 31

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## Abstract

Psychological stress in the workplace is particularly common and has been the topic of numerous studies. In this chapter we update our prior systematic review (Jarczok MN, Jarczok M, Mauss D, Koenig J, Li J, Herr RM, Thayer JF, *Neurosci Biobehav Rev* 37:1810–1823, 2013) and elucidate the current knowledge about work stress and autonomic nervous system activity. A systematic search was conducted, and 18 studies published between the year 2013 and March 2019 were included reporting data from the years 2007–2016. Overall, 7 out of 17 studies

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*, Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_27](https://doi.org/10.1007/978-3-030-31438-5_27)

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reported a negative and significant association between vagally mediated HRV and measures of stress at work. The remaining ten studies report small negative or positive but nonsignificant associations to work stress measures. Some of the mixed findings might be traced back to small sample sizes, or other measurement issues. A comprehensive meta-analysis was not possible due to very heterogeneous data collection and measurement procedures and also due to insufficient data reporting. Based on this chapter, one can tentatively conclude that work stress is associated with autonomic nervous system imbalance which has been shown to be a risk factor for increased morbidity and mortality. Future high-quality studies are needed to explicate the relationship between stress at work and health.

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**Keywords**

Work stress · Stress response · Cardiac autonomic activity · Neurovisceral integration model

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**Introduction**

Stress (defined here as the activation of the neurophysiological stress response) is encountered during the life course in a number of situations. Psychological stress in the workplace is particularly common and has been the topic of numerous studies. These studies identify multiple aspects of the work environment that can be perceived as stressful and being able to elicit the physiological stress response. These aspects include time pressure, repetitive and monotonous work, having little control over job tasks, little input into decision-making, or a sense that daily interactions and decisions at work lack fairness (Duijts et al. 2007; Harter et al. 2002). Previous work has suggested that psychosocial features of the workplace determine employees health (Elovainio et al. 2006; Herr et al. 2012; Karasek 1979; Siegrist 1996b) through multiple mechanisms that include alterations in the central autonomic network in the brain, changes in communication pathways to the periphery (the autonomic nervous system (ANS), endocrine mechanisms (e.g., HPA-axis), or immune functions (e.g., elevated pro-inflammatory cytokines) (Jarczok et al. 2013; Lane et al. 2009). In particular, psychological stress has been associated with the development of cardiovascular disease (CVD) (Eddy et al. 2017; Kivimäki et al. 2006), the pathogenesis of essential hypertension (Huo Yung Kai et al. 2018), and the metabolic syndrome (Tamashiro 2011).

However, work stress is also reported to change employees behavior and work performance such as increases in absenteeism and worker turnover (Duijts et al. 2007), as well as decreases in productivity (Harter et al. 2002) and job satisfaction. These can have substantial economic consequences for the employer (Kirsten 2010). In turn, a comprehensive stress management program showed improvement not only in emotional well-being but also in organizational data showing less absenteeism and improved productivity in intervention work units (Munz et al. 2001). Additionally, a

multicomponent health workplace health promotion program produces sizable changes in health risks including lifestyle factors or stress. Moreover, a positive return on investment (ROI) was reported to be as high as 6:1 (meaning for every invested Pound the return was 6 Pounds) for combined absenteeism reduction and productivity increase (Mills et al. 2007) showing additional benefits for the employer. Thus, negative somatic, psychosocial, and economic consequences of work stress can be reversed, at least partly.

In this chapter we will update our prior systematic review (Jarczok et al. 2013) and will elucidate the current knowledge about work stress and autonomic nervous system activity. Thus, the delineation of the term *stress* will be followed by a closer look specifically on the brain-heart interaction in response to (potential) stressful situations, with an emphasis on the parasympathetic (vagal) inactivation.

## Instruments to Assess (Work) Stress

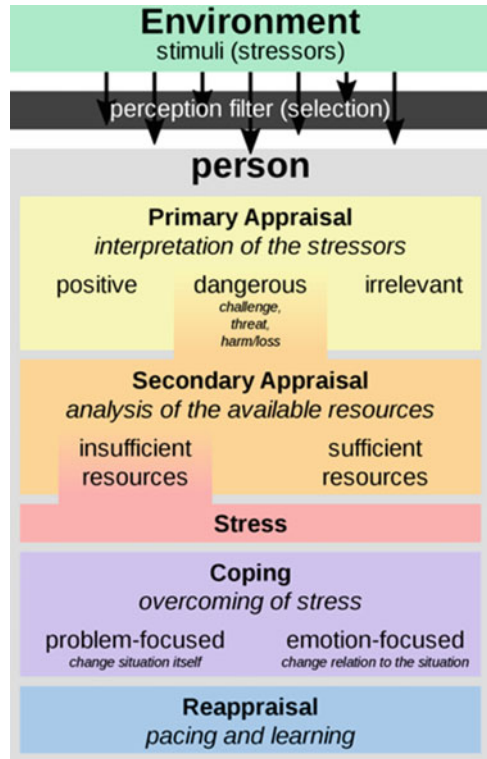
The term *stress* itself is a broad and ambiguous concept. The lack of consensus on the exact meaning and operationalization of the concept of stress makes it difficult for researchers and clinicians, e.g., to identify biomarkers in this area. The authors of a recent *Nature* review on this topic defined stress as a reaction that “helps organisms to cope with situations that challenge their survival, and promotes adaptation in response to threats to homeostasis” (Sandi and Haller 2015, p. 290). Yet, in terms of workplace stressors, this definition is not very practical, as work stress usually does not challenge employee’s survival but can still have tremendous adverse health consequences in the long run.

The concept of adaption has been put forward in most stress definitions. The business professor, Leon C. Megginson, summarized Charles Darwin’s “Origin of Species” with an apt summary, when he pointed out that “. . .it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is best able to adapt and adjust to the changing environment in which it finds itself” (Megginson 1963, p. 4). A detailed review on the flexibility of adaption and the derived neurovisceral integration model is beyond the scope of the current chapter but has been described elsewhere (Thayer et al. 2012; Thayer and Lane 2009). In brief, the three key aspects of this model are as follows: First, there are direct and indirect pathways between the heart and the brain that are involved to orchestrate the complex mix of physiological, behavioral, emotional, and cognitive processes implicated in self-regulation and adaptability. Second, these processes appear to have a common basis such that indices of heart rate variability (HRV) would be associated with all of these various forms of regulation. And third, the model proposes that the default response to uncertainty is the threat response also described as the stress response. In an approach to get more consensus into stress definitions, Koolhaas et al. identify three underlying dimensions being pivotal in the concept of psychological stress (Koolhaas et al. 2011): first, the extent of *controllability* and *predictability* over environmental demands where uncontrollability and unpredictability are the toxic elements; second

the *frequency* of a stressor, where chronicity is the toxic element; and third the *intensity*, ranging from relatively safe to life threatening. Yet, in the modern western (work) society, life-threatening situations are rather rare, as mentioned previously, threats to one's social self are more common conditions. These conditions usually elicit psychological, physiological, and behavioral changes to coordinate an appropriate response to the situation (Dickerson et al. 2004). Hence, the social evaluation threat is a core feature implicated in the public speech task of the Trier social stress test (TSST). This makes it such a powerful tool in laboratory stress research, although a variety of protocols exist (Campbell and Ehlerst 2012). Unfortunately for stress researchers, habituation usually appears when individuals are exposed to similar stressors (Grissom and Bhatnagar 2009; Herman 2013). Thus, an additional, time-dependent dimension needs to be considered when stressors are investigated. Let's label this dimension *experiences and knowledge*. For example, a physician having his or her very first night shift with full responsibilities for the ward may rate this experience as an 8 on a distress thermometer ranging from 0 (not stressful at all) to 10 (most stressful). After 1 year he or she is well experienced and therefore may rate it as a 4. This learning component is implemented in the process model of appraisal in the last stage of reappraisal (Lazarus 1991) and also is an integral part in the neurovisceral integration model (Thayer and Lane 2009). The neurovisceral integration model holds that the conscious experience of emotion requires the transmission of subcortical affective information to the cerebral cortex and that top-down inhibitory influences have a modulatory effect on the subcortical centers that shapes the nature of subjective experience. However, another physician at the same career stage may rate the first nightshift as 5 and after 1 year still a 5. With the appraisal model, it is possible to explain interindividual differences in stress ratings of an objectively similar situation (e.g., night shift) as well as intraindividual differences (e.g., first vs. 50th night shift). Another important determinant is how people perceive and evaluate stress. For example, students anticipating a stressful next day have an amplified cortisol awakening rise compared to days where lower levels of stress were anticipated (Kramer et al. 2019; Neubauer et al. 2018; Thayer et al. 2012). This underlines the ability to anticipate and prepare physiology not only for the next couple of moments or hours but also days, sometimes weeks ahead. Students may have experienced sleepless nights, wet hands, dry mouth, and higher levels of arousal due to an upcoming, important exam, e.g., finals. However, the perception of a single future event is not the only factor of importance, as the overall mindset of a person (what they think about stress) also needs to be considered. For example, a set of studies showed evidence of moderated cortisol reactivity when participants were told "stress-is-enhancing" vs. "stress-is-debilitating" (Crum et al. 2013). Yet, this effect is not only related to the field of stress, as Pavlov's conditioning experiments have demonstrated (Pavlov 1926). Here, ringing a bell started salivation even in the absence of the original stimulus (food). Similarly, a within-person difference on physiological satiation as measured by the gut peptide ghrelin was demonstrated by Crum et al. when serving participants a supposedly high vs. low caloric milkshake (Crum et al. 2011) (Fig. 1).



**Fig. 1** The process model of reappraisal. Graph by Philipp Guttman under CC BY-SA 4.0 from: <https://commons.wikimedia.org/w/index.php?curid=45616588>



Most conceptual work stress models capitalize on at least one of the aforementioned dimensions to analyze potential pathways between psychosocial work stress, health, and disease. These include work stress measurement tools based on the job demand-control model (Karasek 1979), the effort-reward imbalance model (Siegrist 1996b), the concept of organizational (in)justice (Elovainio et al. 2006; Herr et al. 2012), and the perceived stress scale (Cohen et al. 1983). Systematic reviews on workplace stressors identify these four as being the most applied questionnaires or concepts (see section work stress review).

In brief, the effort-reward imbalance model (ERI) is based on social reciprocity, a core principle element of social action. Applied to the work context, people trade their labor (the effort scale) for payment, appraisal, and career advancement (gratification, the reward scale). When employees feel that this reciprocity is violated, the model proposes the experience of work stress (indicated by a ratio larger than one (Siegrist 1996a)). The effort-reward imbalance model was also extended by taking work-related commitment and a high need for approval into account (Siegrist et al. 2004). Here, high effort, high overcommitment, and low reward put the most stress at work on employees. The homepage of the Department of Medical Sociology, School of Medicine, and Heinrich Heine University Düsseldorf, Germany, provides

many resources on the theoretical background, psychometric properties, and scoring instructions.

The job demand-control model (JDC) conceptualizes work stress as being apparent if high demands (often appearing in the form of time pressure or work load) and low control (often in combination with monotony) also labeled decision latitude are present (R. A. Karasek 1979). Here, four different kinds of jobs are prototypically characterized with varying intensity of work stress exposure: high demand, low control (high strain jobs); low demand, high control (low strain jobs); high demand, high control (active jobs); and low demand, low control (passive jobs). In a later version, this model was extended by the aspect of social support. Here, socially isolated jobs, with high demands and low control, are expected to put the most strain on employees (Karasek et al. 1998).

The model of organizational justice (OJ) operationalizes a different dimension of stress at work: the perception of being treated fairly in the workplace (Moorman 1991). In a meta-analysis, four components were revealed: the distributive, procedural, interpersonal, and informational justice components (Colquitt et al. 2001). However, two components explain most of the variance in many investigations (Herr et al. 2012). The procedural component indicates whether decision-making procedures have included input from affected parties, have suppressed bias, and are accurate, correctable, ethical, and applied consistently. The relational component, also labeled as interactional justice, refers to polite and considerate treatment of individuals by supervisors (Elovainio et al. 2006). Here, unequal treatment or inconsistently applied rules and impolite, disrespectful management put the most distress on people.

The perceived stress scale (PSS) is not a work stress instrument per se but is frequently applied also in the work context. It is conceptionally based on Lazarus transaction model (individual's subjective interpretation of a stressor) and captures global stress exposure using a ten- or four-item questionnaire (Cohen et al. 1983).

## Measuring Autonomic Nervous System Activity

The autonomic nervous system plays an important role in the process of adaption and homeostasis. Particularly, in situations where a fast adaptation is necessary, the vagus nerve has a prominent role. This nerve is a primary, fast, and bidirectional route conveying physiological states to the brain (sensory fibers), as well as shaping and coordinating somatic responses to adapt to environmental challenges (motor fibers) (Bernard 1867; Shaffer and Ginsberg 2017; Thayer et al. 2012; Thayer and Lane 2000; Wulsin et al. 2018). The central-peripheral brain-heart integration can be indexed noninvasively and inexpensively by measures of cardiac autonomic activity. These can be obtained using continuous recordings of either the timing between successive heartbeats (e.g., Polar<sup>®</sup> or Suunto<sup>®</sup> heart rate monitors) or better, a one-channel electrocardiograph (ECG) with a preferable 1000 Hz resolution (e.g., Bittium Faros<sup>®</sup> or movisens EcgMove<sup>®</sup>). The time distance between successive R spikes (interbeat interval, heart period) is calculated with non-normal beats being

purged. This is an important step to ensure that variability measures are based on normal-to-normal (NN) intervals. Otherwise, recordings containing ectopic beats may result in biased heart rate variability measures, challenging the comparability between studies. In addition, measures of HRV are sensitive to contextual factors including methodological aspects of measurement. A practical guide to enhance comparability between studies is provided by Laborde et al. (2017).

In the past decade, relatively cheaply, commercial interbeat interval (IBI) recorders became available. Several large studies made the compromise to record IBIs as opposed to one-channel ECGs and therefore have limited artifact correction options. Also, these HR monitors rely on the capabilities of the “on-demand” QRS detection with limited computing power, where the exact algorithm that translates and deals with odd QRS-sequences is a proprietary and not open to the scientific public. Today, cheap devices are available that record the complete one-channel ECG and allow artifact detection and correction on personal computers. The visual inspection of the ECG signal for spurious automatically detected R spikes is still the gold standard and highly recommended. Researchers should not rely on automatic artifact correction procedures (see Laborde et al. (2017) for more detailed discussion).

Several studies have shown the reliability of pulse monitors as near equivalent to ECG recorders, but these are often conducted in controlled environments in healthy, young adults (Weippert et al. 2010). However, with increasing age and in non-laboratory settings, the pure number of ectopic beats or other complications increase (e.g., muscle artifacts from movement) and challenge the comparability between IBI recorders and full ECG recordings. Photoplethysmography is sufficient to detect heartbeats but only in specific environments to detect its variability (in controlled laboratory, resting situations), as measures of this method represent a mixture of pulse transit time and IBIs (Laborde et al. 2017). Unfortunately, a number of studies did not archive the raw ECG data. Instead simple statistics were stored, challenging reanalysis of these data if more powerful algorithms or software become available. Therefore, it is highly recommended to preserve the raw data and attain institutional ethics approval for anonymous uploads to scientific repositories for later reanalysis (also see the open science principles). A precursor for that is to choose devices/sensors with an open data format warranting long-term storage.

Like many organs in the body, the heart is dually innervated by sympathetic and parasympathetic fibers. Autonomic influences on cardiac function can be further distinguished by effector tissues, e.g., at the sinoatrial node and the atrioventricular node. For example, within the first 1.5 seconds of a frightening moment, most people not only feel that their heart rate sharply increase (positive chronotropic effect) but also feel their heart much beating stronger (positive inotropic effect). When vagal activity increases (decreases), it has negative (positive) chronotropic effects on the sinoatrial node (SA) node; it has negative (positive) inotropic effects on the atrioventricular (AV) node. In addition, Jose and Collison were able to demonstrate a tonic inhibition of the intrinsic heart rate by applying pharmacological blockade of both sympathetic and parasympathetic inputs to the heart (Jose and Collison 1970). In other words, they described normal resting heart rate in humans aged 20–30 is between 60 and 80 BPM, while intrinsic heart rate ranges from 90 to 120 BPM

(though age-dependent, Opthof 2000). Actually, the vast majority of everyday situations are usually characterized by heart rate below intrinsic heart rate levels.

Another experiment by Warner and Cox demonstrated differences in the timing of effects on heart rate by autonomic nervous system branch (Warner and Cox 1962). They electrically stimulated sympathetic or parasympathetic (vagal) nerve fibers of mongrel dogs. While sympathetic stimulation effects on heart rate had a 1–2 second delay in onset and a slow but steady increase in heart rate, parasympathetic effects were immediate (within milliseconds) to the full level. Similarly, when electrical stimulation was terminated, sympathetic effects were delayed in onset of HR deceleration (plateau of 2–3 seconds, then slow decrease), while termination of parasympathetic stimulation led to immediate heart rate increase back to the initial (pre-stimulation) level within milliseconds. In terms of a fight or flight response, this leads to an interesting conclusion about the importance of the autonomic nervous system branch involved in immediate adaptive (heart rate) responses. Again, in a frightening moment, the initial change in heart rate (first 1–2 seconds) is an immediate vagal activity withdrawal leading to instant heart rate increase (a heart jump). These differences in timing highlight a distinction between vagally mediated measures of HRV (fast heart rate changes on a time scale of milliseconds) and mixed measures of HRV (on a time scale of seconds). Moreover, these measures allow an index of the functioning of the source of vagal withdrawal – namely, the central autonomic network (CAN) (Thayer and Lane 2009). In other words, HRV measures provide a window to the central autonomic system, and the working level of the central autonomic system reflects the capacity of the body to adapt to environmental challenges (Thayer et al. 2012). This will be further elucidated in the next section. Table 1 describes the commonly used measures of HRV. For a more in-depth overview of HRV metrics and norms, see Shaffer and Ginsberg (2017).

### **A Matter of Time**

Another important aspect that should be considered when exploring the work stress and autonomic nervous system activity association is the total recording duration and the analyzed epochs. As demonstrated in the systematic review section below, total recording length ranges from 5 minutes up to 48 h. Usually, short-term measurement encompasses a 5-minute resting baseline (seated or supine with paced or unpaced breathing) that is analyzed as a single epoch. It is important to note that differences in posture and pacing of breath result in differences in HRV values and should therefore be reported (Laborde et al. 2017). Shorter lengths put more emphasis to fast fluctuations (i.e., short term), while longer recordings also comprise more periods of complete oscillations in slow-wave rhythms (i.e., circadian or ultradian from 24-hour recordings). Long-term recordings better represent the cardiovascular system's response to a broader range of environment stimuli. While in experimental work a resting 5-minute baseline is compared to, e.g., the intervention session preferable of same length, in work stress studies, many have utilized short-term recording,

**Table 1** Frequently used HRV measures

Name	Description	Unit	ANS branch
HR	Simple heart rate in beats per minute	BPM	
IBI	Raw time of R-wave to R-wave intervals in milliseconds time	ms	Mixed

**Time-domain measures**

*Based on the interbeat intervals (IBI) directly or on differences between successive IBI. In addition, there are both short-term and long-term indices*

NN	Normal-to-normal intervals	ms	Mixed
SDNN	Standard deviation of all NN intervals, similar to TP in the frequency domain	ms	Mixed
SDANN	Standard deviation of the average of NN intervals for each 5-minute period over 24 h (i.e., across all segments), similar to ULF power	ms	Mixed
SDNNi	Mean of standard deviations of all NN intervals for all segments of recording, similar to averaged TP of the according segments (SDNNindex)	ms	Mixed
pNN50	Percentage of adjacent cycles that are greater than 50 ms apart, similar to HF power	%	Primarily vagally mediated
RMSSD	Root mean sum of squares of successive differences in milliseconds. This index uses what the econometrics literature calls first-differencing and acts like a high-pass filter, thus removing long-term trends and slower-frequency variability from the signal. Because of the frequency characteristics of the autonomic influences on the heart such that vagal influences cover the full frequency range and sympathetic influences are primarily restricted to the lower frequencies, RMSSD reflects primarily vagal influences (Saul 1990), similar to HF power	ms	Primarily vagally mediated

**Frequency domain measures**

*Frequency domain analysis yields information about the amount of variance or power in the heart rate or heart period time series explained by periodic oscillations at various frequencies. Power spectral analysis of the time series provides basic information on the amount of variance or power as a function of frequency (“heart rate variability: Standards of measurement, physiological interpretation, and clinical use. Task force of the European Society of Cardiology and the north American Society of Pacing and Electrophysiology.,” 1996).*

HF	High frequency (0.15–0.4 Hz)	ms <sup>2</sup>	Primarily vagally mediated
LF	Low frequency (0.04–0.15 Hz)	ms <sup>2</sup>	Mixed
VLF	Very low frequency (0.003–0.04 Hz)	ms <sup>2</sup>	Mixed
ULF	Ultra-low frequency (<0.003 Hz)	ms <sup>2</sup>	Mixed
TP	Total power represents the variance of the measured signal about its mean value exactly equal to the time-	ms <sup>2</sup>	Mixed

(continued)

**Table 1** (continued)

Name	Description	Unit	ANS branch
	domain variance of the HR time series It is the sum of all frequency bands		
Normalization (relative power)	The so-called normalized scores represent the relative value of each power component in portion to the total power. In addition, the VLF or DC component is often subtracted from the total power in calculating the normalized values. The DC component is defined as the spectral components with a frequency less than 0.03 Hz (Pagani et al. 1986). The LF-to-HF ratio (LF/HF) has been proposed to reflect the sympathovagal balance (but see next)	–	–
Percentage %	Relative power in one particular band based on total power (i.e., percentage of total power)		
LF/HF	LF-to-HF ratio may provide some insight into the relative relationship among autonomic influences under	–	Mixed

sometimes even spread across the entire working day. However, as with many other biomarkers, measures of cardiac autonomic activity exhibit a pattern of circadian variation. The circadian timing system regulates daily modulation of synchronized physiological activity in order to conserve energy expenditure and the use of internal resources, thereby optimizing functioning at the ideal time of day including the coordination of physiological functions and behavior (Astiz et al. 2019; Deboer 2018). Also, while short-term measures (i.e., 5-minute resting baselines) are subject to situation-specific variations, long-term measures may overcome this disadvantage and additionally provide salient information from the recorded temporal structure of the biological variable under study. The detection of periodic components can provide very valuable information inherent in a 24-hour signal (i.e., diurnal variation), as demonstrated by improved diagnosis of vascular variability disorders using circadian amplitude and phase derived from 24-hour blood pressure monitoring (Okutucu et al. 2011). Furthermore, the situation-related adaptability of an individual can be visualized by long-term measurements of HRV in combination with a diary (e.g., of a client or patient). In consultation settings, a comprehensive spectral graph can easily be combined with this diary information, exemplifying the impact of a particular exposure (work) to the client. For example, a difficult talk with a co-worker reduces the power spectrum and can be explained to a client. For more details, see Jarczok et al. (2019). An analysis of circadian parameters has not been performed in any of the reviewed studies with long-term recordings (see below).

Technological advances in wearables and ambulatory monitoring have made the continuous recording of real-time data highly accessible for health researchers, clinicians, and the individual. The next challenge will be to improve the links between data collection with pattern classification and identification. Some available sensors (including ECGs) can be paired with smartphone-based ecological

momentary assessment applications, allowing for sensor-triggered experience sampling (rather than time intervals).

### **The (Un)Specificity of Autonomic Nervous System Activity**

In clinical settings, specific and simple to measure biomarkers are favored that, for example, detect dysregulation by abnormally high or low values compared to a given clinical (usually age-adjusted) reference or population distribution (percentile). In laboratory studies, changes of HRV measures have been directly linked to various influences including stress exposure or pain induction. Yet, measures of HRV have also been associated with non-modifiable factors (e.g., age, sex, and genetic factors); modifiable lifestyle factors such as physical activity, smoking, drinking, and other drugs or medications and diseases and syndromes such as obesity, metabolic syndrome, and type 2 diabetes; and personal factors such as Type-D, negative affective states and depressive symptoms, and other conditions related to measurements such as chronobiological factors (circadian variation, ultradian influences, i.e., menstrual cycle), breathing, and posture to name just a few (and of course self-reported measures of stress). From a prevention perspective, this lack of specificity might be an advantage, as measures of HRV may represent an integrative marker for changes in mental and somatic health over the course of time.

## **Work Stress and Autonomic Nervous System Activity: A Summary of Current Literature**

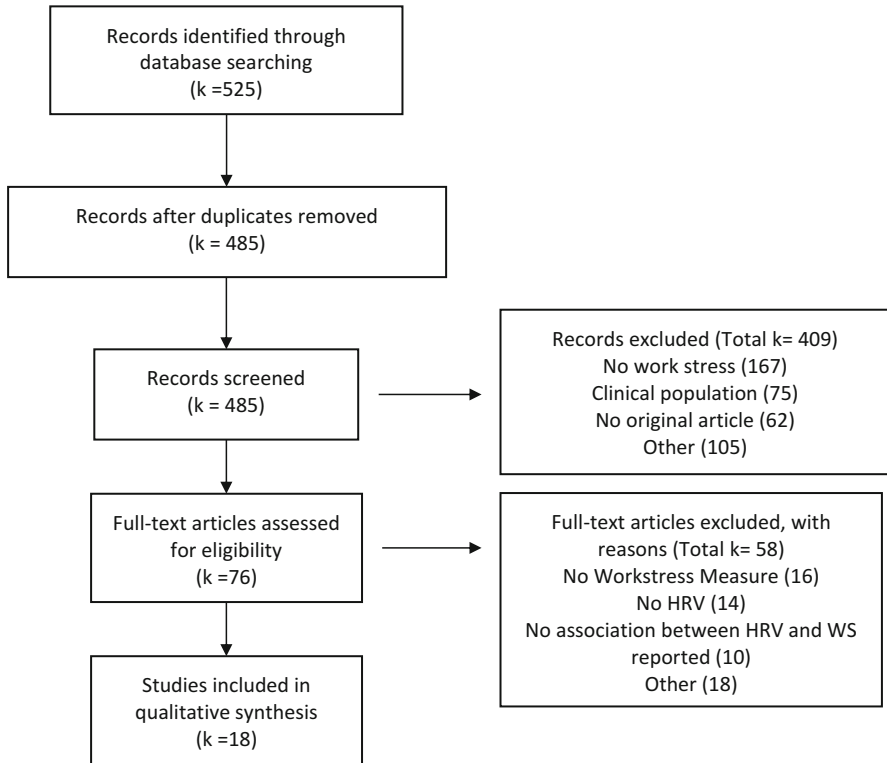
### **Literature Search and Screening Criteria**

A systematic search of the literature was employed and is displayed in Fig. 2. In general, a similar search strategy to our earlier work in this area (Jarczok et al. 2013) was conducted, with identical search terms. A total of three databases (*MEDLINE*, *Embase*, and *PsycINFO*) were screened for studies reporting associations between work stress and autonomic nervous system activity measured by means of HRV. Medical Subject Heading (MeSH) or a comparable method was used to identify search terms (see Appendix A, for detailed search strategy by database).

The search was conducted in March 2019 by the authors MNJ and MJ. All empirical studies published between May 2013 and March 2019 were considered. Database searches yielded 525 records. After removing duplicates that were found through more than one database, 485 records remained.

### **Study Selection and Reporting**

Inclusion criteria were as follows: (1) original research (excluding dissertations, reviews, editorials, book chapters); (2) autonomic activity is reported as the time- or frequency-domain indices of HRV; (3) article language is German or English; (4) the study was employed in human adults (>18 years of age); and (5) the study was comprised of a nonclinical population. Studies were included



**Fig. 2** Flow chart of included manuscripts

if at least one distinguishable subsample was reported that met the inclusion criteria. By applying the inclusion criteria to the information contained in the title and abstract, the pool of records was reduced to  $k=76$ . After reviewing the full text, a total of  $k=18$  publications remained. Abstract screening and selection were carried out independently by the authors MNJ and MJ in March 2019. Potential conflicts were resolved, and the inter-rater agreement was 89% in abstract screening and 94% in full-text screening. In case of any missing or inconclusive information in the full text, the corresponding author of the publication in question was searched electronically to retrieve their current e-mail address and then contacted.

Data were collected from each study on sample characteristics and size, instrument used to measure the work stress exposure, study design, and type of association reported. Associations were coded as “positive” (greater reports of stress at work were associated with increase in HRV parameter) or “negative” (greater reports of stress at work were associated with decrease in HRV parameter), and any statistical insignificance is indicated by “n.s.” using a threshold  $p$ -value of 0.05 or above. When HRV was measured during more than one period, we report results for all periods in this chapter (Table 2).



**Table 2** Results

First Author, year	Period	Vagal tone indicators										Associations/conclusion (quote from original article)	
		RMSSD	pNN50	HF	RR	SDNN	LF	VLF	TP	LF/HF			
Borchimi et al. 2015	Workday	– (n.s.)	– (n.s.)	n.r.	n.r.	–	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	The results of our study suggest that persistent job strain lowers HRV time-domain parameters, supporting the hypothesis that the autonomic nervous system disorders may play an intermediate role in the relationship between work stress and CVD
	Resting day	– (n.s.)	– (n.s.)	n.r.	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	Only prolonged perceived high work stress (i.e., lasting at least 1 year) is associated with consistent reductions of both HF and LF powers. Moreover, under persistent stressful working conditions, recovery to higher HF and LF values during not-working and resting periods is reduced or even absent
Borchimi et al. 2018	Work period	n.r.	n.r.	–	n.r.	n.r.	n.r.	n.r.	n.r.	–	+/– (n.s.)	+/– (n.s.)	
	Nonwork period	n.r.	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	–	– (n.s.)	– (n.s.)	
	Night (workday)	n.r.	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	– (n.s.)	– (n.s.)	– (n.s.)	
	Resting day morning	n.r.	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	–	– (n.s.)	– (n.s.)	
	Resting day night	n.r.	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	– (n.s.)	+/– (n.s.)	+/– (n.s.)	
Chang et al. 2017	Morning (08:00 AM–12:00 noon)	+ (n.s.)	n.r.	+ (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	+ (n.s.)	+	+	The present results provide initial evidence that the studied functional 5-HT2A promoter polymorphism (rs6311) modulates resting parasympathetic vagal tone, an index of stress vulnerability, among people with sustained high levels of perceived stress
da Silva et al. 2015	Morning (8:00 to 11:30)	– (n.s.)	– (n.s.)	– (n.s.)	n.r.	– (n.s.)	n.r.	– (n.s.)	n.r.	–	– (n.s.)	– (n.s.)	Increase in perceived stress in healthy subjects was correlated to decrease in LF (ms2) without correlation to sympathovagal balance, suggesting an association between increase in perceived stress and decreased heart rate variability

(continued)

Table 2 (continued)

First Author, year	Period	Vagal tone indicators						Associations/conclusion (quote from original article)					
		RMSSD	pNN50	HF	RR	SDNN	LF		VLF	TP	LF/HF		
Garza 2015	Either morning or afternoon main effect	– (n.s.)	n.r.	– (n.s.)	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	+	The results indicate that participants exposed to high levels of ERI and overcommitment exhibited a more adverse cardiovascular response (a greater decrease in HRV throughout the 2-h measurement period) compared to their colleagues with lower levels of these factors
	Either morning or afternoon interaction with time	–	n.r.	–	n.r.	–	n.r.	n.r.	n.r.	n.r.	n.r.	+	
Gnam et al. 2018	Rest vs. stress condition	–	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	All subjects showed significant physiological stress responses and a moderate cognitive stress appraisal during the exam. Subjects with different physical activity and physical fitness levels did not differ significantly in their physiological stress responses. Cognitive stress appraisal seemed not to be influenced by physical fitness but by physical
Hernandez-Gaytan et al. (2013)	24 h	– (n.s.)	n.r.	– (n.s.)	n.r.	– (n.s.)	–	n.r.	n.r.	n.r.	n.r.	–	Medical residents in their first academic year report- ing low demand, low control (passive) and high demand, low control (high strain) jobs had some lower parameters of heart rate variability, as compared with their colleagues reporting low demand, high control (low strain) jobs, over a 24- working hour period

Herr et al. 2015	24 h blue collar	– (n.s.)	n.r.	– (n.s.)	n.r.	– (n.s.)	n.r.	n.r.	n.r.	n.r.	Both dimensions of organizational injustice were associated with lowered HRV among white-collar workers. The impact of justice and possibly its association with health seems to differ by occupational groups
	24 h white collar	+ (n.s.)	n.r.	+ (n.s.)	n.r.	+	n.r.	n.r.	n.r.	n.r.	
Herr et al. 2019	24 h organizational justice	+ (n.s.)	+	+ (n.s.)	n.r.	+ (n.s.)	n.r.	n.r.	n.r.	n.r.	The combination of low perceived justice and trust to supervisor appears substantial to the physiological stress threat of employees. Promoting fairness at the workplace might reduce stress; if not possible, trust to supervisor should be enhanced
	24 h trust to supervisor	+	+	+ (n.s.)	n.r.	+ (n.s.)	n.r.	n.r.	n.r.	n.r.	
Jarczok et al. 2016	24 h	–	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	In the present paper, we investigated to what extent the association between work stress, as indicated by the effort-reward imbalance and glyceemic status, is mediated through primarily vagally mediated HRV, as indicated by RMSSD. We found that the indirect effect of work stress on glyceemic status accounts for approximately one quarter of the total effect. We consistently found a significant indirect effect of work stress on glyceemic status via vagally mediated HRV
Lampert 2016	Total cumulative stress (total CAI)	n.r.	n.r.	– (n.s.)	n.r.	–	n.r.	n.r.	n.r.	n.r.	In this study of healthy volunteers, HRV was modestly, but significantly, associated with higher levels of cumulative stress and chronic stress as measured by those respective scales
	Cumulative adverse life events (CALE)	n.r.	n.r.	– (n.s.)	n.r.	–	n.r.	n.r.	n.r.	n.r.	
	Chronic stress	n.r.	n.r.	– (n.s.)	n.r.	–	n.r.	n.r.	n.r.	n.r.	

(continued)



Petrovski et al. 2019	Air day	- (n.s.)	n.r.	n.r.	n.r.	+ (n.s.)	n.r.	n.r.	n.r.	- (n.s.)	EPs of HEMS have an increase in hormonal reactivity in the morning and a lack of recovery of the ANS. It can be concluded that— With respect to the psychobiological stress model by McEwen and Lasley – Work-related stressors persist too long or the stress response is exaggerated (allostatic load) due to chronic stress induction and lack of recovery
	Clinical day	+ (n.s.)	n.r.	n.r.	n.r.	- (n.s.)	n.r.	n.r.	n.r.	- (n.s.)	
Rieger et al. 2014	Night-time period (stressed vs. nonstressed)	- (n.s.)	- (n.s.)	- (n.s.)	- (n.s.)	- (n.s.)	-	-	-	n.r.	Our results reveal that higher perceived stress in the operating room is associated with increased intraoperative HR and decreased HRV at night. Nonstressed surgeons show greater relaxation during sleep compared to their stressed colleagues
Shin et al. 2016	n.r. (total score = low vs. high)	- (n.s.)	n.r.	- (n.s.)	n.r.	- (n.s.)	n.r.	n.r.	n.r.	- (n.s.)	Occupational climate and organizational system are associated with reduction of heart rate variability. Preventive medical care plans for cardiovascular disease of firefighters through the analysis and evaluation of job stress factors are needed
	n.r. (lack of reward = low vs. high)	-	n.r.	-	n.r.	- (n.s.)	n.r.	n.r.	n.r.	-	
	n.r. (job demand = low vs. high)	-	n.r.	- (n.s.)	n.r.	- (n.s.)	n.r.	n.r.	n.r.	- (n.s.)	
von Haaren et al. 2016	Day periods	-	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	+ (n.s.)	Using a randomized controlled trial and a real-life stressor, we could show that exercise appears to be a useful preventive strategy to buffer the effects of stress on the autonomic nervous system, which might result into detrimental health outcomes
	Night periods	- (n.s.)	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	+ (n.s.)	

n.s. not significant, n.r. not reported

## Results

Eighteen studies published between the year 2013 and May 2019 were included reporting data from the years 2007–2016. Sample sizes of these studies ranged from 20 to 12,477 with a median of 54 and a mean of 1612 participants and a total of 29,024 (Table 3). The weighted population age is 40.3 (SD = 10.5) for those studies indicating a mean and standard deviation. Six studies included male employees only, and the other 12 studies included both male and female employees (Table 3). Male participants represent a clear majority in 14 studies. The studies offer a variety of occupations but emphasizing high-stress occupations like firefighters (Gnam et al. 2018; Shin et al. 2016), medical staff (Borchini et al. 2015, 2018; Hernández-Gaytan et al. 2013; Petrowski et al. 2019; Rieger et al. 2014), and industrial employees (Herr et al. 2015; Herr et al. 2019; Jarczok et al. 2016; Mauss et al. 2015; Mauss et al. 2016). Two studies report no details on the type of occupations (Chang et al. 2017; da Silva et al. 2015). Regarding the geographical distribution of the studies, a major focus on work stress and HRV is in Europe (11 studies) and especially in Germany (8 studies). A blind spot is Africa with zero studies. But also, less is known about the Asian region as the only two studies are from Taiwan and Korea, although this might be a result of language restrictions to this systematic review. Western measurement instruments of work stress have been successfully adapted to other languages and cultures, such as the effort-reward imbalance questionnaire in China (Li et al. 2006), but associations between HRV and work stress measures have not been reported. However, transcultural comparisons could add valuable knowledge to the understanding of these associations. Comparing the nations included here and in the previous review (Jarczok et al. 2013) provides a similar picture. Most of the studies were from northern Europe: the Netherlands (four studies), Finland (four studies), and Denmark (two studies). Only a single study was conducted in Germany. Among the former studies, more office workers were analyzed.

The most common study design is cross-sectional; only two studies in the last 7 years applied a longitudinal design (Landolt et al. 2017; von Haaren et al. 2016) and four studies in the former review (Chandola et al. 2008; Eller et al. 2011a, b; Riese et al. 2004). However, giving that in the context of work stress, not a single event but rather continued stress exposure and how it is dealt with it is the toxic element endangering health, longitudinal studies with several repeated measures are needed to elucidate within-person change to stress exposure and HRV measures. Distance between measurement points is also crucial. In an ongoing study (DRKS00012473) that evaluates the effects of psychosomatic consultation at the workplace (PSIB; an early, low barrier access to psychological consultation; see Rothermund et al. (Rothermund et al. 2012) for PSIB details), preliminary analysis shows circadian parameters of HRV measures to be relatively stable across a 3-month time interval, although behavioral change of the consulted individual is documented. These behavioral changes include aspects of work hygiene such as working without restorative breaks, accumulation of overtime and/or working in late, answering emails in bed, etc. On the other hand, if a 5- or 10-year history of workplace stress exposure with maladaptive coping strategies is apparent, it is unrealistic to expect an immediate “reset” to normal circadian HRV patterns after

**Table 3** Descriptives on study population

First Author, year	Country	Year of data collection	Analysis population (m/f or total)	Occupation	Ag of analysis sample (range or mean & (SD))
Borchini et al. 2015	Italy	2010	6/30	Nurses and nurse assistants working for at least 1 year in medical and surgical wards	38.9 (16.5)
Borchini et al. 2018	Italy	2010	See Borchini et al. 2015	See Borchini et al. 2015	See Borchini et al. 2015
Chang et al. 2017	Taiwan	n.r.	552/586	Undefined	38.7 (10.9)
da Silva et al. 2015	Brazil	n.r.	6/29	Undefined	19–29
Garza et al. 2015	The Netherlands	n.r.	26/65	Office workers	44 (24–64)
Gnam et al. 2018	Germany	n.r.	48/0	Firefighters	28.7 (7.3)
Hernandez-Gaytan et al. (2013)	Mexico	2007–2008	36/18	First-year resident physicians	23–36
Herr et al. 2015	Germany	2007	401/0	Employees of a large aircraft manufacturer	45.2 (9.4)
Herr et al. 2019	Germany	2016	39/0	Middle managers	40.7 (6.4)
Jarczok et al. 2016	Germany	2010–2012	8129/1808	Industrial employees	41.2 (10.6)
Lampert et al. 2016	USA	n.r.	87/70	Community sample	29 (1)
Landolt et al. 2017	Australia	n.r.	14/18	Jockeys	19.1 (2)
Mauss et al. 2015	Germany	2009–2011	3012/785	Industrial employees	41 (11.4)
Mauss et al. 2016	Germany	2009–2013	10,031/2446	Industrial employees	42 (10.9)
Petrowski et al. 2019	Germany	n.r.	17/3	Emergency physicians	45 (4.8)
Rieger et al. 2014	Germany	2013	20/0	Surgeons	27–55
Shin et al. 2016	Korea	2012	645/0	Firefighters	20–59
von Haaren et al. 2016	n.r.	2011–2013	61/0	Electrical engineering students	21.4 (1.8)

n.r.: not reported

3 months. Yet, it is unclear how long altered behavioral patterns need to be maintained before discernible changes in autonomic activity manifest. It is to be assumed that the extent (dose) and duration of work strain as well as the coping strategies determine patterns of circadian variation of HRV.

Stress was measured as real-life stressor in two studies, an exam situation (Gnam et al. 2018) and the race period among jockeys (Landolt et al. 2017). Other studies applied standardized questionnaires like the effort-reward imbalance (four studies), the job content questionnaire (three studies), organizational justice (two studies), and the perceived stress scale (two studies). Instruments applied by single studies included the short form of State-Trait Anxiety Inventory (STAI) to assess aspects of stress experience, the Korean occupational stress scale (KOSS), and the primary appraisal and secondary appraisal (PASA) scale.

Most reports adjust for potential confounding variables such as age, BMI, or sex and lifestyle factors such as smoking, alcohol consumption, or physical activity. Some account for additional job characteristics. Yet, in some cases, only bivariate correlations or unadjusted group means were available.

## **The Interplay of Work Stress and Autonomic Nervous Activity**

Overall, 7 out of 17 studies reported a negative and significant association between vagally mediated HRV and measures of stress at work. The remaining ten studies report small negative or positive but nonsignificant associations to work stress measures. One study did not report any numbers on a vagally mediated HRV measure (but did report the LF/HF ratio) (Landolt et al. 2017). Of those, four found the association with effort-reward imbalance and one with the Job Control Questionnaire, real-life stressor, or occupational stress scale, respectively. Seven studies report an LF/HF ratio with two studies reporting a significant negative and one reporting a significant positive association. Ten studies report SDNN with five studies reporting a significant negative and one reporting a significant positive association. Of those nine studies reporting significant association to any mixed measure, two found an association with the job content questionnaire and one with the effort-reward imbalance, the content stress interview, perceived stress scale, organizational justice, or the State-Trait Anxiety Inventory, respectively.

In most publications, various indicators of work stress (e.g., questionnaire or comparing high vs. low strain days) were negatively associated with measures of vagally mediated and mixed HRV indicators, although several studies could not report significant associations. Some of the mixed findings might be traced back to small sample sizes, or other measurement issues. A comprehensive meta-analysis was not possible due to very heterogenic data collection and measurement procedures and also due to insufficient data report.

However, none of the included studies report an intervention effect, and the vast majority provides observational evidence only on selected measures of HRV and



does seldom report the artifact correction procedure. More advanced types of studies are needed that also report on the various measures of HRV: first, studies that look closer at the physiological changes due to challenging situations on a moment to moment basis across the day (e.g., linking sensor-derived physiology events to ecological momentary assessments); second, interventional studies designed to determine the ANS change, e.g., pre to post stress interventions; third, advanced analysis techniques overcoming the oversimplification of 24-hour means or day/night epochs and taking advantage of chronobiological information inherent in these time series; and fourth, when evaluating the potential effect of vagal-excitatory activities on a day-to-day basis such as physical activity or paced breathing, the dose-response relationship remains unclear. Furthermore, when considering long- vs. short-term effects, some interventions may show vagal-inhibitory features in short term but beneficial ones in the long run (like physical activity), while breathing techniques show vagal-excitatory effects in short- and long-term periods, hunger/starving promotes vagal activity in short term but probably not long term, and smoking has both short- and long-term vagal-inhibitory effects (Table 4 and 5).

## Outlook

The current chapter points to several avenues for further investigation. Future high-quality studies with large sample sizes are needed to more fully understand the physiological consequences of stress at work. In addition, a growing literature on burnout, which was beyond the scope of the present chapter, points to exhaustion being associated with low vagally mediated HRV both cross-sectionally and longitudinally (Kanthak et al. 2017; Wekenborg et al. 2019). However, burnout remains a poorly defined construct with limited assessment instruments. Furthermore, it has high comorbidity with other constructs such as depression further clouding its unique contribution to poor health. Thus, future research on burnout and exhaustion in particular may help to explicate the physiological basis of work stress. Another avenue for future research is to more fully explore the effect of work stress on circadian autonomic activity. Previous studies have suggested that the effects of work stress may be more evident in leisure and night-time autonomic activity particularly in older workers (Loerbroeks et al. 2010). Given that these times are ostensibly associated with rest and recuperation, autonomic imbalance or low vagally mediated HRV during these times may suggest an overactive stress response (cf. Brosschot et al. 2018).

In conclusion, work stress has a major impact on the health and productivity of workers. The autonomic nervous system, as an important mediator of prolonged and pathogenic chronic stress responses, is implicated in the ill effects of work stress. Future research is needed to more fully understand the antecedents, resilience factors, and consequences of stress at work.

**Table 4** Methods and statistical models of included studies

First author, year	Study design (C/L)	Excluded subjects	Controlled variables	Applied model
Borchini et al. 2015	C	Affected hypertension, diabetes, neurological or endocrinal disorders, or due to drug treatments with antihypertensive, antiarrhythmic, neuroleptic, and antidepressant medications	Age, smoking	Differences in HRV geometric means among strain categories
Borchini et al. 2018	C	See Borchini et al. 2015	See Borchini et al. 2015	Differences in HRV geometric means among strain categories between workdays and resting days
Chang et al. 2017	C	Taking any medication for at least 1 month prior to the start of the study or those with a personal history of medical diseases, psychiatric illnesses, illegal substance dependence, or pregnancy was excluded	None	MNJ applied a two-sample T-test on HRV parameters of low vs. high PSS group (median PSS score of 21)
da Silva et al. 2015	C	Inclusion criteria comprised being older than 18 years; no prior history or diagnosis of chronic or psychiatric disease; absence of an active systemic disease; no hospitalization within a period of 3 months; no prior history or diagnosis of cardiac disease or use of drugs that would interfere with HRV; not currently using any electronic	None	Spearman's nonparametric rank correlation

(continued)

**Table 4** (continued)

First author, year	Study design (C/L)	Excluded subjects	Controlled variables	Applied model
		medical equipment (contraindication for bioelectrical impedance)		
Garza et al. 2015	C	If “very strong” artifact correction was required for a participant, then that participant was eliminated from the analysis because this correction caused significant differences in the output compared to the less strong corrections	Age, sex, exercise, and job title	Mixed effects linear regression models with participant ID as a random effect
Gnam et al. 2018	C	None: Exclusion criteria for participation in this study were cardiovascular diseases, mental health problems, and treatment with antihypertensives and glucocorticoids due to their impact on measures of interest	Age, BMI, physical activity (MET minutes-week)	Linear regression models
Hernandez-Gaytan et al. (2013)	C	None	Age, sex, IMC, job title	Mixed linear model
Herr et al. 2015	C	None: Temporary workers and trainees were excluded	Age, education, job position, shift work, smoking status, alcohol consumption, physical exercise, BMI, sleep quality	Partial correlation (upon request by authors)
Herr et al. 2019	C	None	Age, job position, height and weight (BMI), and smoking behavior (yes/no) were assessed by questionnaire. Job	Partial correlation (upon request by authors)

(continued)

**Table 4** (continued)

First author, year	Study design (C/L)	Excluded subjects	Controlled variables	Applied model
			position was classified as segment leader vs. other positions	
Jarczok et al. 2016	C	None	Age, sex, occupational status (blue vs. white collar)	Mediation model using SEM
Lampert et al. 2016	C	Dependence for any drug other than nicotine, any cardiovascular, renal, endocrine, neurologic, and immune medical disorders, any psychiatric disorder by history, mood, or anxiety disorder	Age, smoking, education, race, BMI, days in past month, drinks	Linear hierarchical regression analyses
Landolt et al. 2017	L	None	None	Paired T-test
Mauss et al. 2015	C	None	None	Bivariate correlation
Mauss et al. 2016	C	None	None	Bivariate correlation
Petrowski et al. 2019	C	None	None	Pearson's correlation
Rieger et al. 2014		None	None	Wilcoxon signed-ranks test
Shin et al. 2016	C	Hypertension or diabetes mellitus, myocardial infarction, angina, and other ischemic heart disease	Age, department, shift work, smoking, alcohol, marital status, exercise (times/week), BMI	Independent T-test
von Haaren et al. 2016	L	None	PA, group, baseline HRV VO2max	Multilevel modeling

**Table 5** Details on instruments of included studies

First author, year	Total duration/ analyzed segments/ algorithm for frequency domain	Recorder type	Stress measurement	Effect/ association investigated (dependent variable)
Borchini et al. 2015	24 h/24 h assumed/on workday and resting day	Mortara H scribe 12	Job content questionnaire defining 3 groups: SLS, stable low strain; RHS, recently high strain; PHS, prolonged high strain (effort-reward imbalance also available)	Differences in HRV geometric means among strain categories
Borchini et al. 2018	24 h/work period and nonwork period; night and resting morning period; night period/FFT	Mortara H scribe 12 Mortara software for HRV analysis	See Borchini et al. 2015	Differences in HRV geometric means among strain categories between workdays and resting days
Chang et al. 2017	Resting supine position for 5 min/% min/FFT	SA-3000P <sup>®</sup> ; Medcore co., Ltd., Seoul, Korea, with SA-3000P <sup>®</sup> MEDICORE software	Perceived stress scale (PSS)	HRV differences between high and low PSS group
da Silva et al. 2015	Resting supine position/ 5 min/ 5 min/FFT	RS800CX (Polar electro Inc., USA)	Perceived stress scale (PSS)	Correlation
Garza et al. 2015	2 h/5 min/FFT	Polar heart rate monitor (Polar, Lake success, NY, USA)	Effort-reward imbalance questionnaire (ERI)	The interaction term, which describes the change in HRV as the psychosocial variables and time increase
Gnam et al. 2018	10min/5min/ n.r.	Polar RS 800 (Polar electro Inc., USA)	Real-life stressor (exam)	HRV differences between high- and low-stress condition

(continued)

**Table 5** (continued)

First author, year	Total duration/ analyzed segments/ algorithm for frequency domain	Recorder type	Stress measurement	Effect/ association investigated (dependent variable)
Hernandez-Gaytan et al. (2013)	24h/1h/FFT	Holter plus III software version 3.06	Job content questionnaire (Karasek) (JCQ)	JCQ group predicts lower HRV parameters
Herr et al. 2015	24h/5min/FFT	CardioScout electrocardiographic recording, research version, ( PicoMed, Überlingen, Germany)	Organizational justice (OJ)	Correlation of OJ with HRV
Herr et al. 2019	24 h/n.r./n.r.	Faros 180 (Bittium Corp. Oulu, Finland)	Organizational justice and trust to supervisor (OJ)	Correlation of OJ and trust with HRV
Jarczok et al. 2016	24 h/5/FFT	SUUNTO memory belt (Vantaa, Finland)	Effort-reward imbalance questionnaire (ERI)	Mediating role of HRV in the ERI-glucose association using structural equation models
Lampert et al. 2016	24 h/n.r./FFT	GE seer and seer lite recorders	Cumulative stress/ adversity interview “total cumulativestress (TotalCAI)” and “cumulative adverse life events (CALE)” and “chronic stress”	The impact of chronic stress on autonomic function
Landolt et al. 2017	1 h/5min/FFT	AR12plus Medilog Schiller AG Switzerland	Real-life stressor (race period)	Association between ERI and HRV in stress vs. no stress periods
Mauss et al. 2015	24 h/5min/FFT	Suunto memory belt (Vaanta, Finland)	Effort-reward imbalance questionnaire (ERI)	Association between ERI and HRV
Mauss et al. 2016	24 h/5min/FFT	Suunto memory belt (Vaanta, Finland)	Effort-reward imbalance questionnaire (ERI)	Association between ERI and HRV

(continued)

**Table 5** (continued)

First author, year	Total duration/ analyzed segments/ algorithm for frequency domain	Recorder type	Stress measurement	Effect/ association investigated (dependent variable)
Petrowski et al. 2019	n.r./n.r./n.r.	BioHarness 3.0 (Zephyr Technology, USA)	Primary appraisal and secondary appraisal (PASA) (clinical vs. air day)	Pearson's correlations (r) between derived HRV parameters and psychological assessment PASA
Rieger et al. 2014	24 h/5min/n.r.	Equival sensor system EQ-01 (Hidalgo Ltd., Cambridge)	State-trait anxiety inventory (STAI)	Differences in HRV between (A) the two measurements surgery and (B) during night were assessed
Shin et al. 2016	5min/5min/n.r.	SA-3000P (Medicore, 2012)	Korean occupational stress scale (KOSS)	Association between KOSS and HRV parameters
von Haaren et al. 2016	48 h/1h /FFT	EcgMove (movisens GmbH, Karlsruhe, Germany)	Single question of perceived stress administrated between 10 a.m. and 10 p.m. every 2 h	Buffering role of physical activity during stress vs. no stress condition indicated by HRV measures

## Cross-References

- ▶ [Occupational Noise: A Determinant of Social Inequalities in Health](#)
- ▶ [Organizational Justice and Health](#)
- ▶ [Psychosocial Safety Climate and Occupational Health](#)
- ▶ [Sexual Harassment and Bullying at Work](#)
- ▶ [Shift Work and Occupational Hazards](#)
- ▶ [Work–Life Balance: Definitions, Causes, and Consequences](#)

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# Work Stress, Immune, and Inflammatory Markers

# 32

Bradley James Wright, Pennie J. Eddy, and Stephen Kent

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## Abstract

The links between workplace stress and ensuing ill-health have been well researched, but less study has focussed on the underlying mechanisms responsible for this association. Despite this, it is timely to synthesize what data are available on the association between workplace stress and dysregulated inflammatory and immune responses, which are likely implicated in several of the disease

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© Springer Nature Switzerland AG 2020

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T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,  
[https://doi.org/10.1007/978-3-030-31438-5\\_28](https://doi.org/10.1007/978-3-030-31438-5_28)

“endpoints” of workplace stress. We focussed our review on the main biomarkers and workplace stress theories in this field and considered collectively workplace stress as measured by the job-demand control, effort-reward imbalance, and organizational justice models that appear to be most related to the biomarkers CRP, NKCC, and sIgA. The limitations of research in this field and the possible pathways of improvement of such research are considered. The aim of this chapter is to provide the reader with an appreciation of the key confounds in this research area and to discuss what research is required to move this field of enquiry forward.

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**Keywords**

Occupational stress · Immunity · Inflammation · Health

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**Introduction**

In this chapter we review the relationship between workplace stress and markers of immunity and inflammation. Specifically, the effort-reward imbalance (ERI; Siegrist 1996), job demand control (JDC; Karasek 1979), job demand-resources (JD-R; Bakker and Demerouti 2007), and organizational justice (OJ; Elovainio et al. 2002) workplace stress models have dominated the small literature examining the relationship between workplace stress and immunity and will be the focus of this review. While there are other studies that have assessed the association of workplace stress with immune and inflammatory markers (see Nakata 2012, for a review), the disparate constructs and measures used in these studies to measure workplace stress compromise the ability to adequately synthesize the literature.

The immune response involves multiple biological systems, and there are several arms to the immune response, each with very specific functions. This review will focus on the most prominently studied immune measures within the workplace stress literature: cytokines, leukocytes and lymphocytes, and immunoglobulins/antibodies. We will start with a brief overview of the workplace stress models before providing the reader with some background on the various roles and functions of these markers of inflammation and immunity. The ensuing sections of the chapter will synthesize and critique the literature with an aim of answering the questions:

1. Is workplace stress related to inflammation and/or reduced immunity?
2. Which models of workplace stress are associated with these markers?
3. What are the complications or limitations within this research?
4. What research is required to move this field of enquiry forward?

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**Workplace Stress Models**

Full descriptions of the workplace stress models are found earlier in this book. However, for those reading this chapter in isolation, we provide a brief overview to assist in the interpretation of the findings presented throughout the chapter.

The ERI model has its foundations in theories of social reciprocity. That is, employees expect to get as much out of their work as they put in, and when they perceive this exchange as unfair, such as when efforts exceed rewards, the individual experiences stress. The specific hypotheses of the ERI model are that each of efforts, rewards (e.g., salary, esteem, job security), and the dispositional/cognitive style “overcommitment” are related to poor health. Further, the interaction of efforts and rewards, or the ERI ratio, contributes a greater explanation to the incidence of poor health than any of the three constructs in isolation. Finally, the overcommitment hypothesis posits that those high in this disposition, which involves an over-investment in work and an inability to “turn off” from work, further amplify the experience of stress.

The JDC model has been tested in a variety of ways, but the main assumption is that job control buffers the impact of job demands on the experience of stress. Others have also looked to segment the model into quadrants of high and low control and high and low demand to assess which quadrants were most associated with poor health. The term “job strain” applies to persons higher in the JDC ratio or in the high stress/low control quadrant. The JDR model differs from the JDC in that the focus moves from control/autonomy to job and personal resources as potential buffers of job demands. The JDR model posits that high job resources are linked with positive or motivational outcomes including improved employee engagement whereas job demands are related with health impairment. This review will focus on the health impairment process.

The OJ model is less researched than the other models presented thus far, but it bears some resemblance to the ERI model given the underlying theme of “fairness” in the workplace. The OJ model focuses on procedural or distributive justice, and these are said to reflect organization- and person-level outcomes, respectively (Elovainio et al. 2002). The outcomes for those who believe their workplace is not “just” include changes in attitude, drops in productivity (Terzioglu et al. 2016), and an increased risk of ill health (Ndjaboué et al. 2012; Robbins et al. 2012).

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## Indicators of Immunity and Inflammation

Studies of workplace stress have used a variety of molecules housed within blood, mucous, and saliva to identify markers of immunity. In this section we focus our attention on indicators of immune and inflammatory activity and function, namely, lymphocytes and leukocytes, immunoglobulins, and cytokines.

### Lymphocytes and Leukocytes

The lymphatic system consists of the thymus, spleen, lymph nodes, and bone marrow. This system is responsible for producing and storing both lymphocytes (B and T cells), which are small white blood cells, and leukocytes which are white blood cells that identify and eliminate pathogens (bacteria, virus, or microorganism that can cause disease). B cells make antibodies that attack toxins and bacteria, whereas T cells can help destroy cancerous or infected cells. Natural killer cells

(NKC) are activated by cytokines known as interferons and act in response to tumor identification or persistent infection (3 days or more). Decreases in helper T cells (CD4+), and suppressor/cytotoxic T cells (CD8+), and an increase in the CD4+:CD8 + ratio have been associated with increased chronic stress (Kawakami et al. 1997). Helper-inducer (CD4 + CD29+) and suppressor-inducer (CD4+ CD45RA+) cells have also been considered in response to workplace stress. Some suggest that an increased proportion of CD8+ T lymphocytes with an effector-memory phenotype (CD27-CD28-) and a low CD4:CD8 ratio are features of an aging immune system and are key elements of the immune risk phenotype (Bosch et al. 2009).

Generally, in response to chronic stress, the number of circulating lymphocytes and leukocytes is expected to decrease, possibly in response to a depleted hypothalamic-pituitary-adrenal (HPA) axis response (Webster et al. 2002). Most researchers assessing the relationship of chronic stress with the number of circulating lymphocytes and leukocytes have hypothesized a negative relationship, with increased chronic stress suppressing this arm of the immune system and compromising the ability to protect the organism from invading pathogens and cancerous or infected cells.

## Immunoglobulins

Immunoglobulins or antibodies as they are otherwise referred are produced by B cells and perform very specific actions to destroy antigens. The five main immunoglobulins are IgA, IgD, IgE, IgG, and IgM. IgA and IgG are further classified as IgA1 and IgA2 and IgG1, IgG2, IgG3, and IgG4. Immunoglobulins differ in their structure, features, targets, and distribution. Similar to lymphocytes and leukocytes, the expectation is that in response to chronic stress, the numbers of circulating immunoglobulins are reduced, leaving individuals at an increased risk of infection. Differences in the way the immunoglobulins respond to chronic stressors have been suggested, with IgG having a high “turnover rate” suggesting that a long-lasting stressor would not have a measurable impact on IgG levels until several days or weeks after exposure. Unlike IgG, sIgA has been used frequently in studies of acute stress and is known for its relatively quick response in circulating concentrations post-stressor.

## Inflammatory Factors

Cytokines are proteins, specifically peptides, that are important in the communication and coordination of cell actions. Cytokines are important “immunomodulators”; they can both amplify and suppress immune and inflammatory responses and modulate the balance between humoral and cell-based immune responses to protect and repair the organism. Cytokines are synthesized by numerous cell types including B and T lymphocytes, macrophages, and endothelial cells; any given cytokine typically originates from more than one cell type.



Some debate exists about the classifications of cytokines as pro- or anti-inflammatory. While several cytokines such as interleukin (IL)-4 and IL-10 are involved in dampening inflammatory responses and tumor necrotic factor (TNF)- $\alpha$  and IL-6 are viewed as pro-inflammatory, there exists a wide spectrum of functions for most, if not all cytokines. To illustrate this point, most anti-inflammatory cytokines have some pro-inflammatory properties as well. Chronic stress has been linked to both increases and decreases in pro-inflammatory cytokines. For instance, several studies (see Tian et al. 2014, for a review) highlight the relationship of chronic stress with downregulation of pro-inflammatory cytokines in response to increases in markers of increased circulation counts of glucocorticoids, catecholamine, adrenocorticotrophic hormone, and corticotropic-releasing hormone. In apparent contrast, a review of 330 studies assessing the relationship of various forms of chronic stress with pro-inflammatory cytokines reported an increase in these circulating cytokines compared to lower-stressed controls (Hänsel et al. 2010).

Potentially, these apparently divergent findings may be explained by the level or stage of chronicity of the stress experienced (Tian et al. 2014). That is, in the early stages of chronic stress, we see a downregulation of pro-inflammatory cytokines in line with an increase in HPA axis and sympathetic adrenomedullary system response, and then if the chronic exposure continues, we move to “HPA axis fatigue” where pro-inflammatory cytokines are increased due to the reduction in circulating glucocorticoids, catecholamines, adrenocorticotrophic hormone, and corticotropic-releasing hormone.

The role of cytokines in the human immune system is both complex and specialized. The role of cytokines as a “communicator” is further highlighted with the upregulation of C-reactive protein (CRP), a marker of inflammation, in response to signals from pro-inflammatory cytokines including TNF- $\alpha$ , IL-6, and IL-1.

Our brief description above is provided to give the reader a basic understanding of key principles to aid interpretation of the findings presented later in this chapter. Those interested in a more extensive review of cytokines are directed to McInnes (2017) and Tian et al. (2014). The review of the relationship of *workplace stress* with cytokines is less extensive than those provided by studies of *chronic stress*, but an advantage of narrowing the focus to employees is that employees represent a potentially more homogenous sample of somewhat healthy individuals given that they are actively employed.

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## Workplace Stress and Inflammatory Factors

In our review of the literature of workplace stress with cytokines and CRP, we identified seven papers using the ERI model, six papers using the JDC model, one paper using the JD-R model, and two papers using the OJ model (Table 1).

We located papers that used ten different markers of inflammation including ratios of pro-inflammatory to anti-inflammatory ratios, but most of the cytokines were only captured in one or two papers. The exception to this were the inflammatory markers CRP (12 papers), IL-6 (7 papers), and TNF- $\alpha$  (3 papers). The CRP

**Table 1** Workplace stress and markers of inflammation

Marker	Stress model	Study	Effect size/findings
CRP	ERI	Bellingrath et al. 2009 104 females	ERI $r = 0.24$
		Mauss et al. 2015 $N = 3797$ (79.3% males)	ERI $r = -0.02$
		Almadi et al. 2013 204 males	ERI $r = -0.29^*$
		Hamer et al. 2006 92 males	ERI not associated with CRP levels at baseline
		Izawa et al. 2016 142 males	Higher effort related with higher CRP in young group only*
	JDC	Emeny et al. 2013 $N = 1027$ (68% males)	Job strain $r = 0.11$ (CVD group) Job strain $r = 0.08$ (non-CVD group)* Demands $r = 0.19$ (CVD group)* Demands $r = 0.03$ (non-CVD group) Control $r = 0.04$ (CVD group) Control $r = -0.10$ (non-CVD group)*
		Hemingway et al. 2003 $N = 283$ (59% males)	High versus low demands did not differ High versus low control did not differ
		Emeny et al. 2012	Job strain $r = 0.09^*$
		(P) Shirom et al. 2008 $N = 1121$ (66% males)	Job strain not prospectively related with CRP
		Tsai et al. 2014 825 males	High strain related to higher CRP in the under 35 age group only (odds ratio = 2.71)*
		Schnorpfeil et al. 2003 $N = 324$ (84% males)	Demands positively associated with CRP* Control negatively associated with CRP*
	OJ	(P) Elovainio et al. 2010 $N = 4409$ (73% male)	Lower perceived justice related with higher CRP prospectively in men* Perceived justice not related with CRP prospectively in women
		Herr et al. 2015 353 males	Low and high justice groups did not differ
	IL-6	ERI	Bellingrath et al. 2010 $N = 55$ (62% female)
Bellingrath et al. 2013 $N = 46$ (63% females)			High ERI group higher IL-6 than low ERI group at baseline*. No difference in OC groups
JDC		Emeny et al. 2013 $N = 1027$ (68% males)	Job strain $r = 0.04$ (CVD group) Job strain $r = 0.01$ (non-CVD group) Demands $r = 0.13$ (CVD group) Demands $r = -0.02$ (non-CVD group) Control $r = 0.10$ (CVD group) Control $r = -0.01$ (non-CVD group)
		Hemingway et al. 2003 $N = 283$ (59% males)	High versus low demands did not differ High versus low control did not differ
		Emeny et al. 2012	Job strain $r = 0.01$
JDR		Falco et al. 2017 $N = 119$ (71% females)	Emotional demands $r = 0.19^*$ Control $r = -0.15$ Support $r = -0.03$
OJ		(P) Elovainio et al. 2010 $N = 4409$ (73% male)	Lower perceived justice related with higher IL-6 prospectively in men*

(continued)

**Table 1** (continued)

Marker	Stress model	Study	Effect size/findings
			Perceived justice not related with IL-6 prospectively in women
IL-10	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.30^*$ Overcommitment $r = 0.21$
IL-2	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.01$ Overcommitment $r = 0.09$
IL-4	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.13$ Overcommitment $r = 0.07$
	JDC	Miyazaki et al. 2005 241 males	Higher work social support related to lower IL-4* Demands not associated
IL-8	JDC	Emeny et al. 2013 <i>N</i> = 1027 (68% males)	Job strain $r = 0.05$ (CVD group) Job strain $r = -0.04$ (non-CVD group) Demands $r = 0.10$ (CVD group) Demands $r = -0.01$ (non-CVD group) Control $r = 0.02$ (CVD group) Control $r = 0.03$ (non-CVD group)
		Emeny et al. 2012 <i>N</i> = 951 (66% males)	Job strain $r = -0.03$
IL-18	JDC	Emeny et al. 2013 <i>N</i> = 1027 (68% males)	Job strain $r = 0.08$ (CVD group) Job strain $r = -0.05$ (non-CVD group) Demands $r = 0.12$ (CVD group) Demands $r = 0.01$ (non-CVD group) Control $r = 0.04$ (CVD group) Control $r = 0.09$ (non-CVD group)
		Emeny et al. 2012 <i>N</i> = 951 (66% males)	Job strain $r = -0.03$
TNF	ERI	Bellingrath et al. 2009 104 females	ERI $r = 0.05$
		Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.11$ Overcommitment $r = 0.08$
	JDC	Schnorpfeil et al. 2003 <i>N</i> = 324 (84% males)	Control negatively associated with TNF*
INF- $\gamma$	JDC	Miyazaki et al. 2005 241 males	Not associated with social support Demands not associated
INF- $\gamma$ : I-L4	JDC	Miyazaki et al. 2005 241 males	Positively associated with social support* Demands not associated
TNF: IL-10	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.05$ Overcommitment $r = 0.08$
IL6: IL-10	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = 0.21^*$ Overcommitment $r = 0.08$

Note. \*significant finding, (P) prospective design,  $r$  values for Bellingrath et al. 2009, 2010, 2013; Almadi et al. 2013; Mauss et al. 2015 were retrieved from the Eddy et al. (2016) meta-analysis where they had been transformed from the original measure of effect size

findings are evenly balanced with 10 of the 20 associations significant and suggest a positive association between increased workplace stress and circulating levels of CRP, especially when workplace stress is measured using the JDC model (7/11 significant associations). The exception is the Almadi et al. (2013) paper, which has the largest effect size, but suggests a negative relationship between ERI and CRP. It

is noteworthy that the large ( $N = 4409$ ) prospective study reported that lower perceived justice was related to higher CRP and IL-6 in men, but not women (Elovainio et al. 2010).

The studies that assessed IL-6 include 2 significant associations out of the 17 comparisons with workplace stress, with the significant findings suggesting higher workplace stress is related with higher IL-6. Similarly, the relationship between workplace stress with TNF- $\alpha$  was weak with only one of the three papers reporting a positive association between variables.

While the findings suggest that most associations are weak and nonsignificant, the Eddy et al. (2016) meta-analysis of the relationship between ERI with cytokines and inflammatory markers suggests that when considered together, the result may be different. Specifically, the meta  $r$  from Eddy et al. (2016) was 0.08,  $p = 0.04$ , for these markers, suggesting that while the effect is small and only 2 out of the 13 individual associations rejected the null, when considered collectively, the association is significant.

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## Workplace Stress, Lymphocytes, and Leukocytes

In this review we located ten papers that assessed the relationship of workplace stress with leukocytes and lymphocytes (Table 2). Of the 18 markers used in these studies, most were studied on at least 2 occasions, with the exceptions being CD4%, CD8%, CD4 + CD45RA + %, lymphocytes%WBC, neutrophils%WBCC, and neutrophils/lymphocytes. Of these 82 associations, 19 were significant. Of the components of the workplace models, ERI was most likely to be associated with the lymphocyte and leukocyte markers with 5/16 (38%) negative associations. Next was job strain with 5/17 (30%) negative associations and then control 4/13 (30%), overcommitment 2/9 (22%), support 2/15 (13%), and, finally, demands 1/11 (9%).

Considered collectively, there are substantially more null than statistically significant associations, and these are generally small effects. The most promising associations between workplace stress and leukocytes and lymphocytes would appear to be natural killer cell cytotoxicity with four out of seven associations with components of the JDC and ERI models across two studies. The Bosch et al. (2009) study is the only study to concurrently assess more than one job stress model with measures of inflammation or immunity. The findings highlight that the way in which workplace stress is assessed impacts whether associations are significant or not, with demands and control not associated and with ERI and support positively and negatively associated, respectively, with CD27-CD28-%. Similarly, the CD4:CD8 data is negatively related with ERI and control but with support positively associated with the CD4:CD8 ratio.

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## Workplace Stress and Immunoglobulins

In this review we located eight papers that assessed the relationship between workplace stress and immunoglobulins (Table 3). Of the three markers used in these papers, only sIgA and IgG were studied on two occasions. The relationship

**Table 2** Workplace stress, lymphocytes, and leukocytes

Marker	Stress model	Study	Effect size /findings
CD4 + (helper T cells)	ERI	Bellingrath et al. 2010 <i>N</i> = 55 (62% female)	ERI $r = -0.04$ Overcommitment $r = -0.11$
	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.03$ Control $r = 0.15$ Job strain $r = -0.07$ Supervisor support $r = -0.16$
	JDC	Nakata et al. 2000 116 males	Lower in high strain group*
CD4 + %	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.11$ Control $r = 0.05$ Job strain $r = -0.05$ Supervisor support $r = -0.01$
CD8 + (suppressor/cytotoxic T cells)	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.00$ Control $r = 0.16$ Job strain $r = -0.13$ Supervisor support $r = -0.20$
	JDC	Nakata et al. 2000 116 males	No difference between high and low strain groups
CD + 8%	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.00$ Control $r = 0.16$ Job strain $r = -0.13$ Supervisor support $r = -0.20$
CD4 + CD45RA+ (suppressor-inducer T cells)	JDC	Kawakami et al. 1997 65 males	Demands $r = 0.04$ Control $r = 0.01$ Job strain $r = 0.03$ Supervisor support $r = -0.22$
	JDC	Nakata et al. 2000 116 males	Lower in high strain group*
CD4 + CD45RA + %	JDC	Kawakami et al. 1997 65 males	Demands $r = 0.01$ Control $r = -0.05$ Job strain $r = 0.06$ Supervisor support $r = -0.14$
CD4 + CD29+ (helper-inducer T cells)	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.21$ Control $r = 0.31^*$ Job strain $r = -0.04$ Supervisor support $r = 0.14$
CD4 + CD29+ %	JDC	Kawakami et al. 1997 65 males	Demands $r = 0.13$ Control $r = 0.29^*$ Job strain $r = -0.27^*$ Supervisor support $r = 0.15$
NKC	ERI	Bellingrath et al. 2010	ERI $r = -0.05$ Overcommitment $r = -0.16$

(continued)

**Table 2** (continued)

Marker	Stress model	Study	Effect size /findings
		<i>N</i> = 55 (62% female)	
		Nakata et al. 2011 <i>N</i> = 1747 (89% females)	ERI $r = -0.22^*$ (males) ERI $r = -0.11$ (females) Overcommitment $r = -0.15^*$ (males) Overcommitment $r = -0.02$ (females)
	JDC	Nakata et al. 2000 116 males	No difference between high and low strain groups
	JDC	Miyazaki et al. 2005 142 males	Demands not associated Support not associated
NKCC	ERI	Nakata et al. 2011 <i>N</i> = 1747 (89% females)	ERI $r = -0.12^*$ (males) ERI $r = -0.16^*$ (females) Overcommitment $r = -0.01^*$ (males) Overcommitment $r = -0.04$ (females)
	JDC	Nakata et al. 2000 116 males	Job strain $r = 0.173$ Demands $r = 0.25^{**}$ Social support $r = 0.18$
B cells	ERI	Nakata et al. 2011 <i>N</i> = 1747 (89% females)	ERI $r = -0.02$ (males) ERI $r = 0.02$ (females) Overcommitment $r = -0.02$ (males) Overcommitment $r = 0.11$ (females)
	JDC	Nakata et al. 2000 116 males	No difference between high and low strain groups
T cells	ERI	Nakata et al. 2011 <i>N</i> = 1747 (89% females)	ERI $r = -0.09$ (males) ERI $r = -0.12$ (females) Overcommitment $r = -0.01$ (males) Overcommitment $r = -0.03$ (females)
	JDC	Nakata et al. 2000 116 males	Lower in high strain group*
	JDC	Miyazaki et al. 2005 142 males	Demands not associated Support not associated
WBCC	ERI	Mauss et al. 2015 <i>N</i> = 3797 (79.3% males)	ERI $r = 0.02$

(continued)

**Table 2** (continued)

Marker	Stress model	Study	Effect size /findings
	JDC	(P) Shirom et al. 2008 <i>N</i> = 1121 (66% males)	Demands not prospectively related with WBCC Control negatively related for males* Control not related in women Social support not related with WBCC
		Nakata et al. 2000 116 males	Lower in high strain group*
CD4:CD8	ERI	Bosch et al. 2009 <i>N</i> = 537 (90% males)	ERI negatively associated*
	JDC	Bosch et al. 2009 <i>N</i> = 537 (90% males)	Demands not associated Control negatively associated* Support positively associated*
	JDC	Kawakami et al. 1997 65 males	Demands $r = -0.05$ Control $r = 0.00$ Job strain $r = 0.03$ Supervisor support $r = 0.02$
CD27-CD28-%	ERI	Bosch et al. 2009 <i>N</i> = 537 (90% males)	ERI positively associated*
	JDC	Bosch et al. 2009 <i>N</i> = 537 (90% males)	Demands not associated Control not associated Support negatively associated*
Lymphocytes % WBCC	OJ	Herr et al. 2015 353 males	No difference between high and low justice groups
Neutrophils % WBCC	OJ	Herr et al. 2015 353 males	No difference between high and low justice groups
Neutrophils/lymphocytes	OJ	Herr et al. 2015 353 males	No difference between high and low justice groups

\* $p < 0.05$ 

of various factors within the ERI, JDC, and OJ models was compared with immunoglobulins on 18 occasions. In seven instances these associations were significant and highlight that while the research in this area is sparse when compared with workplace stress and leukocytes, lymphocytes, and markers of inflammation, the results are more consistent. The most researched immunoglobulin was sIgA, with six studies assessing the marker of mucosal immunity. Four of these studies used the ERI model, while the other two used the JDC model. ERI was related with lower

sIgA in two investigations with the other two investigations reporting no association. Likewise, the findings from the two investigations that used the JDC framework were mixed; only one study suggested higher workplace control was related with *reduced* sIgA.

Investigations of the relationship of job strain with IgG concentration report both increased (Nakata et al. 2000) and reduced (Theorell et al. 1990) concentrations. This is not unusual; however, Nakata et al. (2000) cited several studies that have reported increases, decrease, and no association of various immunoglobulins in response to increased chronic stress. Potentially, the findings may be moderated by the chronicity of the stressor.

## Considerations

Before embarking on a discussion of how best to interpret the evidence we have collated, some key points need to be considered. The following points not only will assist in interpreting the research that has been collected in the area to date but will also be used by those who seek to investigate the association of workplace stress with immunity and inflammation in the future.

**Table 3** Workplace stress and immunoglobulins

Marker	Stress model	Study	Effect size/findings
sIgA	ERI	Bathman et al. 2013 66 males	ERI $r = -0.47^*$ Overcommitment $r = -0.27^*$
		Wright 2011 $N = 98$ (56% females)	ERI $r = -0.22^*$ Overcommitment $r = -0.04$
		Eddy et al. 2018 74 males	ERI $r = 0.01$ Overcommitment $r = 0.01$
		Yu et al. 2008 50 males	ERI not related Overcommitment not related
	JDC	Wright 2008 $N = 98$ (56% females)	Demands $r = -0.17$ Control $r = 0.24^*$
		Yu et al. 2008 50 males	Demands not related Control not related Support not related
IgG	JDC	Theorell et al. 1990 $N = 50$ , 78% males)	Job strain $r = -0.23$ Adequacy of social support $r = -0.54^*$ Availability of social support $r = -0.24$
		Nakata et al. 2000 116 males	Job strain $r = 0.20^*$
IgM	JDC	Nakata et al. 2000 116 males	Job strain $r = 0.18^*$

\* $p < 0.05$



## Does Affect Carry the Effect?

Studies of the association between depression (Howren et al. 2009) and anxiety (Vogelzangs et al. 2013) with markers of immunity and inflammation also suggest associations between these constructs. The stress and coping model (Lazarus and Folkman 1984) suggests that it is not the stressor per se but rather the negative affect induced by the stressor that is responsible for ensuing ill-health. The consideration therefore is how, if at all, do negative affective states including depression and anxiety influence the relationship between chronic workplace stress and adverse physiological reactivity? Does it mediate the relationship as posited by the stress and coping model or is it that the relationship is moderated (amplified) in the subgroup of persons who report higher levels of negative affect? Unfortunately, the answers to these questions are not able to be answered at this point in time, but hopefully as researchers begin to assess these constructs both concurrently and prospectively, the underlying pathways from workplace stress to ill-health will be better understood.

## Does “Level of Chronicity” Impact Findings?

As mentioned earlier in this chapter, there is good reason to suspect that the temporal location of when the physiological sample is taken from the period of chronic stress exposure may help explain the disparity that exists in the findings reported thus far. Specifically, the impact of HPA axis upregulation at the beginning of stress exposure results in downregulation of the immune and inflammatory response, but with HPA axis “exhaustion,” we would expect an upregulation of the immune and inflammatory response. In short, those with chronic stress profiles are likely to have different immune and inflammatory profiles to those experiencing burnout. When these subgroups are not accounted for however, it is possible that a negative correlation for one subgroup may “cancel” the positive association of the other subgroup resulting in a false conclusion of no association between self-reported stress and physiological indices of immunity.

Much of the research has been cross-sectional in nature, and without consideration of the potential moderating impact of the duration or “chronicity” of the workplace stress, consequently it is difficult to tease apart these profiles. Considering both the self-reported and physiological indices of stress in combination may help to better identify subgroups of non-stressed, chronically stressed, and burned-out employees.

## Functional Changes?

Although an association between high workplace stress with low concentrations (or counts) of the various immune and inflammatory markers may be statistically significant, in isolation, this information does not suggest that chronic workplace stress lowers immunity. Someone with the lowest or highest counts or concentration of a particular marker may not necessarily be outside the normal range for

that marker. In fact, even those that fall beyond these normal ranges (usually those in the top or bottom 2.5% in large normative data sets) may not represent an abnormal finding; after all, the entire sample was originally deemed “normal” and healthy.

It is also important to note that cell counts alone are not evidence of immune function. T-cell counts may be high in an individual, but the *functional* immune response may be dampened. For instance, in laboratory tests of functional immunity, T-cell function is measured by observing the response of the T cells to stimuli such as mitogens and antigens. These studies quantify T-cell proliferation and whether they produce cytokines. There are also a variety of other laboratory-based tests that assess the functionality of the immune and inflammatory markers described in this chapter, and interested readers are referred to Albert et al. (2018).

The final point in this section is that the cross-sectional approach used in most studies of the association of workplace stress with immunity does not allow for consideration of the *causal* association between workplace stress and lowered immunity. To infer a causal connection between A and B variables (i.e., A causes B), we need for A to occur before B, the dose of A to impact the magnitude of change in B (cross-sectional studies can't do this), and, finally, A to cause changes in B after controlling for other rival explanations.

## Rival Explanations

Musculoskeletal injuries or infections may compromise the interpretation of the stress-immune/inflammation relationship. Traumatic injuries induce microcirculatory changes that involve the emigration of leukocytes and excessive amounts of pro-inflammatory mediators to the site. We have discussed earlier how the immune and inflammatory response is triggered by infection. Consequently, it's critical that researchers exclude participants who are unwell or injured. The problem, however, is that in the early stages of infection, for example, it is not always apparent to the individual that they are unwell. The same can be said for musculoskeletal injuries, with individual variations in what an individual would define as an “injury.” In addition to exclusion, the researcher may also opt to statistically control for “health” based on self-reports from participants.

While both exclusion and statistical control of self-reports of health are useful, there is still likely to be some “noise” in the data, and this noise is amplified when research teams use disparate measures to account for health and injury. The different approaches to this problem impact the ability to synthesize the literature as the effect sizes are adjusted or not adjusted by covariates and exclusions. Moving forward, researchers should be prepared to give detailed information to participants on what constitutes exclusion, alongside clear definitions of injury and illness. It may also be prudent to follow up with participants at a short period post-collection to assess if they still fulfil inclusion criteria. In order to better articulate synthesis of findings across studies, researchers are also encouraged to report effect sizes for the associations they assess both with and without covariates.

## Hits and Misses

There are various methods available to the researcher when seeking to identify measures of inflammation and immunity from the samples they collect. Traditionally enzyme-linked immunosorbent assay (ELISA) techniques have been used, and while this approach is still appropriate, new testing technology such as the SIMOA platform (Quanterix, Lexington, MA, USA) provides a higher level of precision for the detection of specific molecules (Rivnak et al. 2015). In essence, some markers of inflammation and immunity are harder to detect in blood than others and may be at an increased risk of imprecise reporting when using older technology. As newer testing methods become more viable and affordable, transitioning from ELISA to SIMOA testing may provide greater clarity on the underlying mechanisms between the association of workplace stress and lowered immunity. This argument is compelling given that the SIMOA technology has a 1000-fold greater sensitivity of detection of blood-based molecules compared with traditional assays (Fischer et al. 2015).

## Cytokine Imbalance

Of the 15 studies that assessed the association of workplace stress with measures of inflammation, only 1 assessed cytokine imbalance. Cytokine imbalance refers to the ratio of pro-inflammatory to anti-inflammatory expression. A potential issue with assessing the pro- or anti-inflammatory markers in isolation may be best understood by the following example: When compared to the group, an individual is ranked high on both pro- and anti-inflammatory markers and is consequently categorized most “at risk.” When the ratio is computed however, this individual is not “at risk”; it is more likely that those with lower or higher ratios are more at risk. Due to a dearth of data, there is little evidence to support this premise in the workplace stress literature. However, investigations of depression and cytokine expression are accumulating evidence in support of this prediction (Kim et al. 2007). Bellingrath et al. (2010) reported significant relationships between ERI and both anti-inflammatory (IL-6,  $r = 0.30$ ) and pro-inflammatory (IL-10,  $r = 0.30$ ) cytokines, but given the statements above, perhaps the most important finding was the relationship of ERI with the measure of cytokine imbalance (IL-6:IL-10,  $r = 0.21$ ). Given these promising findings, future researchers are encouraged to compute measures of cytokine imbalance alongside standard measure of pro- and anti-inflammatory markers.

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## Conclusions

The aim of this chapter was to answer some key questions about whether workplace stress was related with markers of inflammation and immunity and, additionally, which specific workplace stress models were most associated with these markers. The results of the review reveal that inflammatory markers were most assessed (16 papers, 10 markers of inflammation), followed by leucocyte and lymphocyte

numbers (8 papers, 18 markers) and immunoglobulins (8 papers, 3 immunoglobulins). The JDC (ten papers,  $N = 7028$ ), ERI (eight papers,  $N = 4977$ ), and OJ (two papers,  $N = 4744$ ) models were generally used to assess workplace stress followed by the JD-R model (one paper,  $N = 119$ ).

The findings suggest that for the measures of inflammation, CRP was positively associated with workplace stress, especially when workplace stress was assessed using the JDC and OJ models. Other important findings in this section include the significant positive relationship between IL-6 and IL-10 with ERI.

The association of workplace stress with leukocytes and lymphocytes was quite diverse. While many markers of this branch of the immune system were collected, the overall  $N$  for each association was relatively modest as a majority of these associations were only assessed by  $\leq 2$  studies. Most of the findings suggested no association between variables, with the most promising markers being NKCC and CD4:CD8.

The immunoglobulins were the least researched markers of immunity, but each of sIgA, IgG, and IgM shared associations with workplace stress. sIgA was the most assessed and was associated with elements from both the JDC and ERI models. The small  $N$  precludes definitive conclusions on these associations, but given the large effect sizes and consistency of findings, these immunoglobulins appear to represent promising options for workplace stress researchers.

Considered collectively, workplace stress as measured by the JDC, ERI, and OJ models appears to be most related to CRP, NKCC, and sIgA. For the reasons outlined earlier, more research, preferably prospective in design, on the relationship of ERI with cytokine imbalance may also prove useful in understanding the pathways from workplace stress to ill-health.

In short, the understanding of the relationship between workplace stress with altered immune and inflammation factors is compromised by a literature largely cross-sectional in nature. Further factors inhibiting definitive conclusions include the disparate ways that workplace stress has been measured alongside the impact of injury, illness, and the duration of chronic stress upon markers of immunity and inflammation. A coordinated international effort coupled with more sophisticated research design will help to resolve many of these problems and assist in understanding if and how altered immune and inflammatory responses are associated with workplace stress and ill-health.

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# Work Stress and Adverse Health Behaviors **33**

Katriina Heikkilä

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## Abstract

This chapter summarizes the evidence for the relationship of work-related psychosocial stress and adverse health behaviors, including tobacco smoking, drinking alcohol, and the low level of physical activity. There are several ways to measure and operationalize work-related psychosocial stress in research studies, and the measures commonly examined in relation to adverse health behaviors are job strain, effort-reward imbalance, job insecurity, and long working hours. The evidence summarized in this chapter suggests that work-related psychosocial stress co-occurs with smoking, excessive alcohol drinking, obesity, and low levels of physical activity. Longitudinal relationships between some indicators of work-related stress and some adverse health behaviors have also been observed. However, many studies in this area have had heterogeneous findings,

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© Springer Nature Switzerland AG 2020

T. Theorell (ed.), *Handbook of Socioeconomic Determinants of Occupational Health*,  
Handbook Series in Occupational Health Sciences,

[https://doi.org/10.1007/978-3-030-31438-5\\_29](https://doi.org/10.1007/978-3-030-31438-5_29)

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and the interpretation of the available evidence is limited by the non-longitudinal study designs and the focus of the research effort in high-income countries.

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**Keywords**

Psychosocial stress · Work · Occupational health · Health behavior · Smoking · Alcohol intake · Obesity · Body mass index · BMI · Physical activity · Sedentary lifestyle · Observational studies · Epidemiology · Occupational epidemiology

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**Overview**

The relationship between work-related psychosocial stress and adverse health behaviors, such as tobacco smoking, excessive alcohol consumption, or sedentary lifestyle, has received considerable research attention since the 1960s, when occupational health physicians, psychologists, and psychiatrists became interested in the psychosocial characteristics of work and their influence on workers' health (Fingret 2000). Several measures of work-related psychosocial stress exist. Apart from asking people the direct question "Is your work stressful?," several operationalizations of work-related psychosocial stress have been devised for research and assessment purposes. These are typically based on self-reported data collected by validated questionnaires. Commonly used operationalizations are job strain, effort-reward imbalance (ERI), job insecurity, long working hours, and organizational justice. All of these measures have been examined in research studies in relation to adverse health behaviors. This chapter summarizes the evidence on the relationship of work-related stress and adverse health behaviors and the clustering of such behaviors.

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**Measuring Work-Related Psychosocial Stress**

Several measures and operationalizations of work-related psychosocial stress have been devised for research and assessment purposes. Most of these are based on self-reporting questionnaires, which have been validated to ensure they measure work stress appropriately. Some indicators of work-related stress, for instance, long working hours, can also be measured from sources other than self-report. As it would be unethical not to mention practically challenging to expose people to psychosocial stress at work, the evidence in this area is by necessity based on observational studies.

The most widely used measure of work-related psychosocial stress is job strain, a combination of high demands and low control at work. According to a theory by Karasek and Theorell, this combination is harmful to health (Karasek and Theorell 1990). The job strain questionnaire has been validated and is available in several languages. Although widely used, the job strain measure and the model it is based on have been criticized for being more appropriate for measuring stress associated with

manual, often mechanical work, and less apt for identifying stress associated with non-manual, knowledge-based, or less physical work, which has become increasingly common in high-income countries since the 1980s, with the transition from industrial to knowledge-based economy.

Other measures of psychosocial stress at work, introduced and used in more recent research, include effort-reward imbalance (ERI), job insecurity, and organizational justice. ERI occurs in a situation where the physical and/or psychological effort expended at work exceeds the perceived rewards (financial or psychosocial) received (Siegrist 1996). Job insecurity, for its part, is defined as the possibility or probability of being laid off or having one's employment discontinued (Hartley et al. 1990). Since the 1990s, decreased labor market regulation, restructuring of companies and organizations, workplace downsizing, and increased use of flexible forms of employment have modified patterns of employment in such a way that many jobs are becoming increasingly unstable and insecure (Organisation for Economic Co-operation and Development 2007; Virtanen et al. 2005). In the past two decades, job insecurity has become increasingly common in high-income countries (Cornelissen 2007), and it is a major cause of concern and often stress to many workers (Ferrie et al. 2002). A less often used measure of work-related stress is organizational justice, defined as an employee's perception of fairness of the organization's treatment of individual workers. Organizational justice can be divided into two components, procedural and interactional; the first indicates the extent to which decision-making in the workplace is consistent and free of bias and includes input from affected parties, while the latter refers to the polite and considerate treatment of individuals by supervisors (Greenberg 2004).

Long working hours has been used in many research studies as a proxy measure of work-related stress (Spurgeon et al. 1997). Long working hours is defined as an individual regularly working longer than recommended hours. The specific working time regulations vary by country, but in many cases, they center around a maximum of 48 h per week (Lee et al. 2007), which is also the recommended maximum limit defined in the current European Union Directive (European Commission 2014). Findings from a number of epidemiological studies suggest that  $\geq 55$  h of work per week is harmful to health (Virtanen et al. 2012). As a consequence, typical definitions of long working hours in the studies of the health impact of long working hours vary from 48+ to 60+ h per week.

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## Work-Related Stress and Tobacco Smoking

Psychosocial stress and work and tobacco smoking have been examined in a number of studies, mainly in high-income countries of Europe and North America. Pooled analyses of cross-sectional data from 15 European studies, comprising 166,130 participants and over 4,000 men and women reporting job strain, have shown that current smokers are more likely to report job strain than individuals who have never smoked (age, sex, and socioeconomic position-adjusted fixed effect odds ratio, OR: 1.11, 95% confidence interval, CI: 1.03–1.18) (Heikkilä et al. 2012a). In the same set

of studies, job strain was also associated with a higher smoking intensity: current smokers experiencing job strain smoked, on average, three cigarettes per week more than current smokers without job strain. In the analyses of a subset of six studies with repeated measurements of smoking, however, the researchers found no clear evidence for longitudinal associations between job strain and taking up smoking (OR: 1.03, 95% CI: 0.87–1.21) or quitting this habit (OR: 0.91, 95% CI: 0.79–1.04) (Heikkilä et al. 2012a).

The evidence for stress measures other than job strain in relation to tobacco smoking is inconclusive. A systematic review of studies of long working hours and adverse health behaviors identified only one study of long working hours and smoking, in which no association between these was reported (Bannai and Tamakoshi 2014). One cross-sectional study reported an association between ERI and high smoking intensity in men (Peter et al. 1991). However, longitudinal studies have found no relationship of overall ERI (Ota et al. 2010; Allard et al. 2011), or overcommitment (a component of ERI: defined as individuals working harder or longer when faced with a stressful task or job) with smoking cessation (Ota et al. 2010). Findings from a cross-sectional study of Finnish public sector employees suggest that compared to non-smokers, smokers are more likely to report low levels of organizational justice (Kouvonen et al. 2007).

In summary, job strain appears to be associated with smoking to some extent, with individuals reporting job strain being more likely to smoke and smoke more intensively than those not reporting job strain. However, due to the small number of studies with heterogeneous findings, the associations of ERI, long working hours, and organizational justice with the prevalence or incidence of smoking remain unclear.

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## Work-Related Stress and Alcohol Intake

Psychosocial stress at work could plausibly be associated with excessive alcohol intake if, for example, individuals experiencing stress attempt to use alcohol drinking as a means for stress relief or relaxation. The social requirements of some types of work could also lead to higher alcohol intake among workers. The association between psychosocial work stress and alcohol intake has been the focus on considerable research effort. A large meta-analysis of cross-sectional data from 12 studies from Northern and Western European countries showed that compared to moderate drinkers, non-drinkers (random effects OR: 1.10, 95% CI: 1.05–1.14) and heavy drinkers (>20 drinks/week for women and >27 drinks/week for men; OR: 1.12, 95% CI: 1.00–1.26) had higher odds of job strain. Intermediate drinkers (women: 15–20, men: 22–27 drinks/week), on the other hand, had lower odds of job strain (OR: 0.92, 95% CI: 0.86–0.99) (Heikkilä et al. 2012b). In a subset of longitudinal data from four studies, the researchers found no clear evidence for longitudinal associations between job strain and alcohol intake: OR for taking up excessive drinking in participants with job strain compared to the no strain-group was 0.90 (95% CI: 0.79–1.01), and the corresponding OR for reducing alcohol intake was 1.91 (95% CI: 0.76–1.08) (Heikkilä et al. 2012b).

Similar to job strain, observational evidence suggests that working long hours is linked to excessive alcohol intake. A meta-analysis based on published aggregate data alone provided no clear evidence for an association between long working hours and alcohol intake (Bannai and Tamakoshi 2014). However, in a meta-analysis of 36 published studies and 27 studies with unpublished individual participant data, Virtanen and colleagues found that working more than 48 h during a typical week was linked to increased alcohol use in both cross-sectional and prospective analyses (Virtanen et al. 2015). In the cross-sectional analyses, based on published as well as unpublished data, the adjusted overall OR for the association between working 48+ h and risky alcohol use (>14 drinks/week for women and >21 drinks/week for men) was 1.11 (95% CI 1.05–1.18) (Virtanen et al. 2015). In the analysis of prospective studies, the OR for the onset of risky alcohol use among individuals who had previously not used alcohol excessively was 1.12 (95% CI: 1.04–1.20) (Virtanen et al. 2015). These findings were similar in men and women as well as across different age groups, socioeconomic status categories, and geographical regions.

Evidence for an association of ERI and organizational justice with alcohol intake is based on a small number of studies with a mix of positive and null findings. ERI has been reported in association with heavy alcohol consumption in male public sector employees in the UK (Head et al. 2004) and in female aid workers at an international humanitarian aid agency (Jachens et al. 2016). However, no association between ERI and alcohol consumption was found in studies of public sector employees in Finland (Kouvonen et al. 2005a) or fire fighters in Taiwan (Guo et al. 2006). Longitudinal analyses in the Finnish study did indicate, though, that low organizational justice at baseline predicted heavy drinking at follow-up, independently of age, sex, socioeconomic position, and marital status (OR: 1.23, 95% CI: 1.09–1.40) (Kouvonen et al. 2008).

Taken together, these findings suggest that individuals reporting job strain are more likely to drink excessively than those who do not experience job strain. However, no clear evidence for a longitudinal association between job strain and taking up or quitting drinking exists. The evidence for an association of ERI and organizational justice with alcohol intake is inconclusive. It is possible that the varying study-specific findings reflect the low analytical power of some individual studies, and it may be that some of the reported associations are specific to certain job workplace contexts and as such not generalizable to other countries or work settings.

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## Work-Related Stress and Overweight and Obesity

Overweight and obesity are increasing health concerns worldwide, in low- and high-income countries alike. Work-related stress could be associated with these important health risk factors if, for example, workers experiencing stress eat less healthfully than those who are not stressed at work. Job strain is the most commonly investigated work stress exposure in relation to overweight and obesity. In an analysis of individual-level data from 13 European studies and 161,746 participants, Nyberg and colleagues found a U-shaped cross-sectional association between job strain and

BMI, with increased odds of job strain among participants who were underweight (OR: 1.12, 95% CI: 1.00–1.25], moderately obese (OR: 1.07, 95% CI 1.02–1.12), or severely obese (OR 1.14, 95% CI 1.01–1.28) when compared with normal weight participants (Nyberg et al. 2012). In the longitudinal analyses, based on 42,222 participants from 4 studies (median follow-up, 4 years), it showed that changes in job strain and BMI category tend to co-occur. New exposure to job strain at follow-up was associated with becoming obese at follow-up, independently of age, sex, or socioeconomic position (OR compared to no job strain at baseline or follow-up: 1.18, 95% CI 1.02–1.36) (Nyberg et al. 2012). In a similar vein, becoming obese was associated with increased odds of job strain at follow-up (OR: 1.18, 95% CI 1.02–1.36). However, job strain at baseline alone or at both baseline and follow-up was not associated with obesity at follow-up.

Evidence for the relationship between markers of work-related stress other than job strain and overweight or obesity is not as extensive as it is for job strain. Longitudinal associations of job insecurity with subsequent small average increases in BMI (0.3 units in men, standard error, SE: 0.08; 0.6 units in women, SE: 0.21) have been reported in British white-collar workers (Ferrie et al. 1998). Findings from two British population-based cohort studies supported these observations (Monsivais et al. 2015). Evidence for a relationship between ERI and body weight, however, is heterogeneous. Cross-sectional analyses in industrial and public sector employees in Finland suggest that workers reporting ERI are, on average, heavier than those not reporting ERI (Kivimaki et al. 2002; Kouvonen et al. 2005b). A cross-sectional study of 1,306 Swedish men and women also reported that ERI was associated with higher BMI in men (difference in mean BMI in the high effort/low reward group compared to low effort/high reward: 0.9, 95% CI: 0.1–1.7), independently of age, smoking, education, and occupational status (Soderberg et al. 2012). However, no clear evidence for a corresponding association was observed in women (difference in mean BMI in the high effort/low reward group compared to low effort/high reward: 0.7, 95% CI: –0.2 to 1.5). Furthermore, in the same study, job strain and BMI were unrelated (Soderberg et al. 2012). Also, meta-analyses based on published aggregate data provided no clear evidence for an association between long working hours and obesity or weight gain (Bannai and Tamakoshi 2014; Solovieva et al. 2013).

In summary, individuals reporting work-related psychosocial stress tend to have a higher BMI than those who do not report stress. Work-related psychosocial stress and BMI have also been reported changing together over time. However, the evidence base for the relationship between stress at work and overweight or obesity is heterogeneous, with direction and magnitude of association varying by the operationalization of work-related stress as well as by participant characteristics.

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## Work-Related Stress and Physically Active Lifestyle

Physical activity has many important health benefits, not least in improving cardiovascular health and reducing overweight and obesity. Psychosocial stress at work could be associated with physically active lifestyle if, for instance, workers

experiencing stress undertake less physical activity during their free time than those who are not stressed. It is also possible that individuals who work very long hours have little time to engage in leisure time physical activity. This is particularly of concern among workers whose job entails little or no physical activity, as the sedentary work and sedentary overall lifestyle can have a considerable detrimental effect on an individual's overall health.

Findings from a cross-sectional survey of Japanese workers, who reported on their experience of job strain and leisure time physical activity habits from 2010–2011 to 2014, suggest that job strain and ERI are associated with concurrent inactivity (physical activity level self-reported as “none”) but that the association is at most modest in size. The OR for leisure time physical inactivity in individuals with job strain, compared to those with low strain, was 1.22 (95% CI: 1.03–1.43), and this association was independent of age, sex, educational attainment, working hours, income job type, and data collection wave (Oshio et al. 2016). The correspondingly adjusted OR for leisure time inactivity associated with a combination of high effort and low rewards was 1.28 (95% CI: 1.10–1.50). Authors of this study speculated that the observed association might relate to residual confounding from personality characteristics, if, for example, individuals with low activity levels choose low demands and low control jobs (Oshio et al. 2016). If this was the case, the estimated associations between markers of work-related stress and physical inactivity, in this study and others, would overestimate the true association.

A pooled analysis of individual-level data from 14 European cohort studies and a total of 170,162 employees provided some evidence for an association between job strain and sedentary lifestyle. In cross-sectional analyses, the odds for leisure-time physical inactivity were higher (OR: 1.26, 95% CI: 1.15–1.38) for employees with high-strain jobs as well as for those with passive jobs (OR: 1.21, 95% CI: 1.11–1.31), compared with employees in low-strain jobs (high control/low demands) (Fransson et al. 2012). In prospective analyses restricted to physically active participants, the odds of becoming physically inactive during follow-up were higher for those with high-strain (OR: 1.21, 95% CI: 1.11– 1.32) and passive (OR: 1.20, 95% CI: 1.11–1.30) jobs at baseline (Fransson et al. 2012). These findings suggest that work-related stress may have a spillover effect on leisure time physical activity. In a similar vein, working long hours is linked to physical inactivity (Angrave et al. 2015; Kirk and Rhodes 2011), possibly because individuals feel that they lack time to exercise due to spending extensive time at work (Escoto et al. 2012).

In summary, the currently available evidence suggests that work-related psychosocial stress and physical inactivity are linked and that workers who report stress at work tend to undertake less physical activity during their leisure time. It is of note that the majority of studies have focused on the relationship between work-related stress and leisure time physical activity, and the relationship between work stress and physical activity at work remains unclear. An important limitation that poses a challenge to the interpretation of research findings in this area is that physical activity has been self-reported in many studies: objectively measured physical activity, for instance, by using accelerometers, would provide more accurate estimates of the amount of activity people undertake at work as well as outside of work.

## Work-Related Stress and Co-occurrence of Multiple Adverse Health Behaviors

Adverse health behaviors, such as smoking, excessive alcohol intake, physical inactivity, and unhealthy diet, tend to cluster at population-level (Meader et al. 2016; Noble et al. 2015), and there is evidence that a synergistic effect of multiple, co-occurring adverse health behaviors is more detrimental to health than the sum of their individual effects (Poortinga 2007; French et al. 2008; Berrigan et al. 2003). The causes of health behavior clustering are not fully understood, but many are likely to relate to the workers' socioeconomic circumstances, and they may be associated with working environments. For instance, a systematic review of studies conducted in the UK reported that the strongest predictors of co-occurrence and clustering of multiple risk behaviors were occupational socioeconomic position (with up to fourfold increased odds in lower socioeconomic groups) and level of education (up to fivefold increased odds in those with no qualifications) (Meader et al. 2016). In addition to socioeconomic position, work-related stress is one potentially modifiable risk factor for the co-occurrence of multiple adverse health behaviors.

A multi-cohort analysis of individual-level data from 11 European studies (based on cross-sectional data from 118,701 participants and longitudinal data from 43,971 participants) showed that individuals with job strain were more likely than those with no job strain to have a combination of unhealthy lifestyle factors (being a smoker, being overweight or underweight, physically inactive, and drinking excessive amounts of alcohol; OR: 1.25; 95% CI: 1.12–1.39), independently of age, sex, and socioeconomic position (Heikkilä et al. 2013). Men and women with job strain were also less likely to have the corresponding four healthy lifestyle factors (OR: 0.89; 95% CI: 0.80–0.99). The longitudinal evidence on the relationship between job strain and health behavior clustering is, however, less clear. The odds of adopting a healthy lifestyle during follow-up were lower among individuals with high-strain jobs at baseline than among those with low-strain jobs at baseline (OR: 0.88; 95% CI: 0.81–0.96). When the directions of the associations were explored longitudinally, of the individuals who reported no strain at baseline, those who had a healthy lifestyle at baseline were less likely to have job strain at follow-up (OR: 0.90, 95% CI: 0.83–0.96), but those with job strain at baseline, lifestyle at baseline was not associated with job strain at follow-up.

In a Finnish cross-sectional study of 36,127 public sector employees, the researchers found that after adjustment for age, socioeconomic position, marital status, and type of job contract, women and men with high workplace-level ERI were more likely to have three or more lifestyle risk factors (OR vs. 0 risk factors in women: 1.44, 95% CI: 1.23–1.69; OR in men: 1.39, 95% CI: 1.06–1.74) compared with their counterparts with low ERI (Kouvonen et al. 2006). Findings for individual-level ERI scores were similar, with high ERI being associated with higher odds of having 3+ adverse health behaviors in women (adjusted OR: 1.31, 95% CI: 1.12–1.52) as well as in men (adjusted OR: 1.29, 95% CI: 1.03–1.61) (Kouvonen et al. 2006).

In summary, work-related psychosocial stress appears to be associated with the clustering of multiple adverse health behaviors (unhealthy lifestyles) and, conversely, the absence of stress at work is associated with the clustering of health-promoting behaviors (healthy lifestyles). However, the evidence from longitudinal analyses does not point to a straightforward cause–effect relationship between work-related stress and the clustering of health behaviors.

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## Challenges in the Interpretation of the Evidence

A considerable research effort in examining the relationship of work-related psychosocial stress with adverse health behaviors has focused on one measure of stress, job strain, a combination of high demands and low control over one's work. Evidence on the relationship of ERI, long working hours, organizational justice, and job insecurity with adverse health behaviors also exists, but this evidence base is less extensive. A large majority of studies of work-related stress and health behaviors have been conducted in high-income countries of Northern and Western Europe, as well as in Japan, Australia, and North America. It is therefore possible that the findings from these studies are not directly generalizable to working populations on other continents or in middle- or low-income countries.

Studies of work-related psychosocial stress and health behaviors are by necessity observational, and they typically rely on self-reported measures of stress and health behaviors. Many studies of work-related stress and lifestyle factors have not adequately controlled for individual-level psychological factors in the analyses, and as a consequence, these findings may have been influenced by residual confounding from individual-level factors, including personality, coping styles, or other determinants of stress and health behaviors. As a consequence, the findings from individual studies in this area are heterogeneous, making the synthesis and interpretation of the evidence challenging. Furthermore, many studies have had a non-prospective design, which makes their findings prone to recall bias (if, for instance, smokers are more likely than non-smokers to recall and report past stress exposures) and reverse causality (if, e.g., heavy alcohol intake leads to individuals experiencing and reporting stress at work). It is also possible that publication bias has inflated the pooled estimates reported in literature-based meta-analyses, as positive associations reported in individual studies are more likely to be submitted to scientific journals and more likely to be published, thus ending up in systematic reviews and other research summaries. A useful way to overcome some of the challenges of bias and comparability is to pool individual-participant data from available research studies and harmonize, as far as possible, both the stress and health behavior measures, using a predefined harmonization protocol. This approach has been used in the individual-participant data meta-analyses of working populations (IPD-Work) consortium to investigate the potential impact of work-related stress on individual health behaviors (Heikkilä et al. 2012a, b; Virtanen et al. 2015; Nyberg et al. 2012; Fransson et al. 2012) as well as their clustering (Heikkilä et al. 2013). However, the evidence on the longitudinal relationships between many operationalizations of



work-stress and health behaviors is still relatively scarce, and future studies with repeated measures of these exposures and outcomes would help to quantify the direction and magnitude of the specific temporal associations of work stress and health behaviors.

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## Discussion and Conclusion

This chapter has described the currently available evidence on the relationship between various operationalizations of work-related psychosocial stress and adverse health behaviors. Overall, there is evidence that work-related psychosocial stress co-occurs with many harmful health behaviors. Longitudinal relationships between some indicators of work-related stress and some health behaviors have also been observed. However, the findings of individual studies are heterogeneous, and the interpretation of the available evidence is limited in many cases by the cross-sectional study designs and the focus of the research in high-income countries.

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## Cross-References

- ▶ [Effort-Reward Imbalance and Occupational Health](#)
- ▶ [From National Labor and Social Policies to Individual Work Stressors](#)
- ▶ [Organizational Justice and Health](#)
- ▶ [Social Distribution of Occupational Hazards](#)
- ▶ [The Demand Control Support Work Stress Model](#)
- ▶ [The Paradoxical Health Effects of Occupational Versus Leisure-Time Physical Activity](#)

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