Effort-Reward Imbalance and Occupational Health

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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.

Keywords

Social reciprocity · Employment relations · Psychosocial stress · Coronary heart disease · Depression · Intervention studies

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.

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:

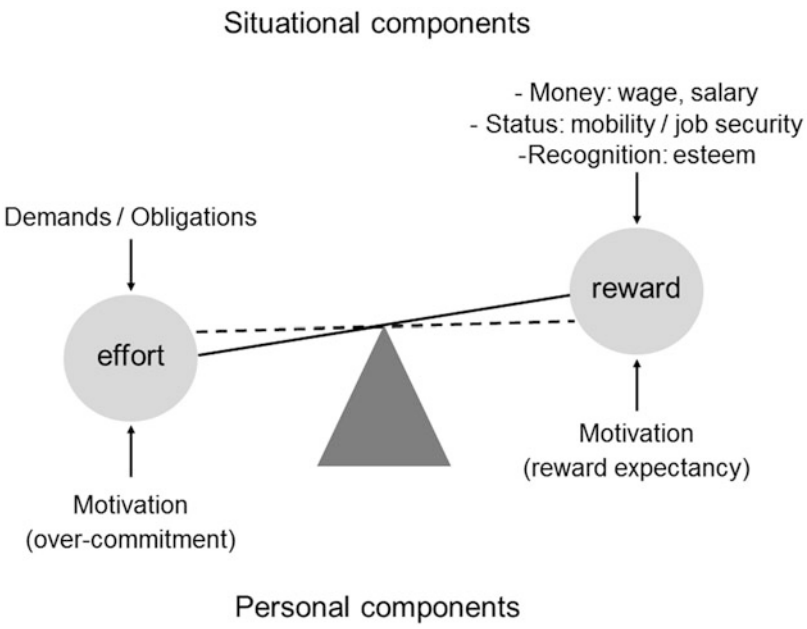

Fig. 1 The model of effort-reward imbalance at work. (Based on Siegrist 2016)

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.

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 cingulated 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 r*elated 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 Kivimaki 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

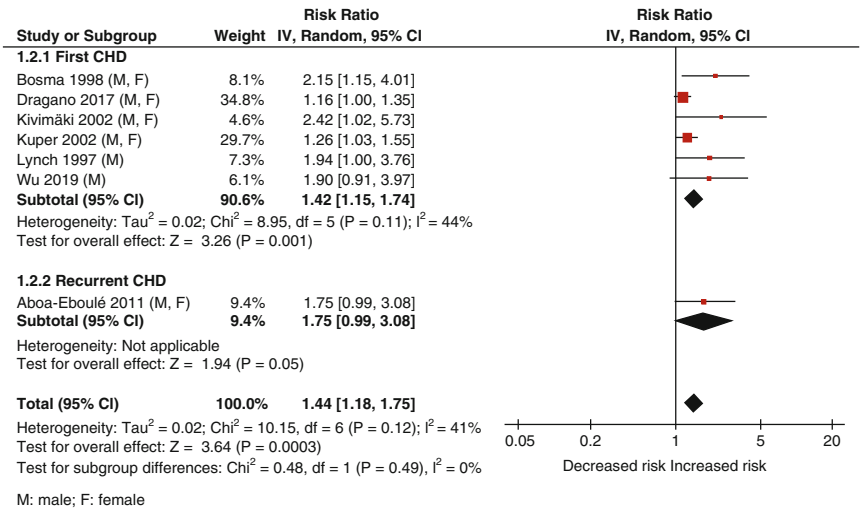

Fig. 2 Meta-analysis of cohort studies on the association of effort-reward imbalance with cardiovascular disease (mainly CHD)

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 multicohort 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

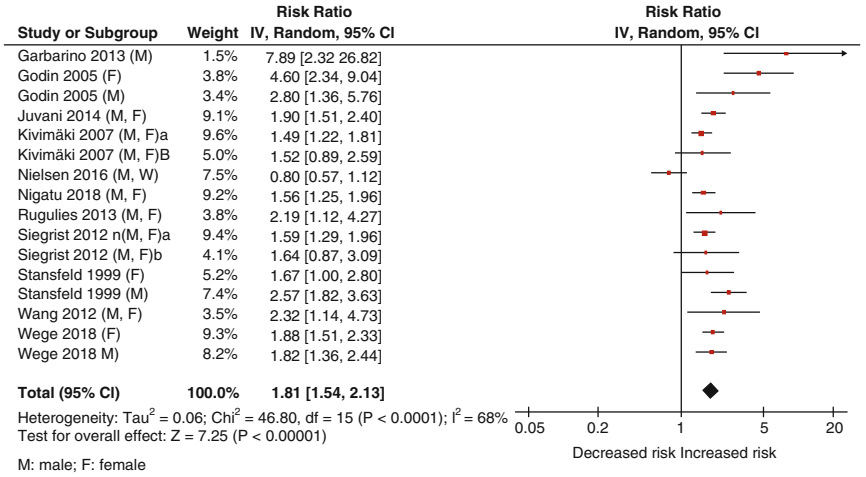

Fig. 3 Meta-analysis of cohort studies on the association of effort-reward imbalance with depression

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.

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; Tetrick 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 α-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; Tetrick 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* ($R2 = 66.5$) (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.

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.

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-conducing 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.

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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