Aligning Perspectives on Health, Safety and Well-Being

Johannes Siegrist
Morten Wahrendorf *Editors*

Work Stress and Health in a Globalized Economy

The Model of Effort-Reward Imbalance

Springer

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Foreword

"*More and better jobs.*". This is a corner-stone in the European Union strategy for sustainable development of living and working conditions for its 508 million inhabitants. My own 60 years of research, teaching, and lobbying in this area, through countless conferences, speeches, publications, and discussions with cabinet ministers and parliamentarians, and my long-term collaboration with several of the United Nations' specialized agencies have taught me that there is a very wide gap between the establishment of scientific knowledge and its translation into political action. And there is an even wider gap between such policies and their actual implementation by central and local government and all levels of management in trade and industry.

At the beginning of my endeavors in the mid-50s, none of the major stress-and-health related theoretical models did exist – neither Karasek's, Theorell's and Johnson's "demand-control-support," Siegrist's "Effort-Reward-Imbalance" nor Marmot's "Social Gradient/Unfairness" models. Today, they do exist, are utilized worldwide, and have been the basis for the production of solid evidence concerning a wide variety of pathogenic (and some salutogenic) situational causes and health effects caused or triggered by our living and working conditions, and our ways to cope with them.

Still, work stress and its direct and indirect pathogenic effects prevail, are endemic and probably even getting worse, as shown in this highly important volume with contributions from leading scientists from all over the world.

Why is this so? The answer can probably be summarized in three quotes:

"*Simplify as much as possible – but not more*!" High-level politicians, managers, and administrators are usually very reluctant to read and digest thick volumes of scientific treatises. They usually prefer one-page memos. But such oversimplifications (cf Albert Einstein) do not fit attempts to solve highly complex societal, occupational and/or health problems, and their interrelationships.

"*It is not enough to know – you also have to apply. It is not enough to wish – you also have to act*." This was said by Johann Wolfgang von Goethe some 150 years ago, and it has remained valid ever since. In addition, our analyses and subsequent actions should not be based on tunnel vision or silo thinking but need to be comprehensive, integrative, and sustainable.

"*If I have seen further than others, it is by standing upon the shoulders of giants.*" Scientific knowledge can never become complete and final, partly because knowledge never stops developing, and partly because the world is changing ever more rapidly. Globalization, urbanization, technological innovations, job instability, intensification of work, female participation in the labor force, the greying of the population, and a rapid increase in expectations – every one of these processes, and particularly any combination of these – create completely new challenges that need to be met.

When discussing the above, we tend to forget that most of the universal human rights are out of reach for the great majority of the world's population. Billions live under conditions of corruption, tax evasion, fraud, and exploitation – and resulting poverty, homelessness, morbidity, and premature mortality, which in turn makes their lives "solitary, poor, brutish, nasty and short," to quote Hobbes' description from 1651.

One contribution to improving their level of living, health, and wellbeing could be to introduce compulsory education of *critical ethical thinking in all higher education*, enable future decision makers to analyze major challenges, conduct multidisciplinary impact assessments, and subsequently base their decisions on the outcome of such analyzes.

Professor Johannes Siegrist and Dr Morten Wahrendorf have achieved a real tour de force in writing and compiling this extremely important book that is mainly focused on "effort-reward imbalance", a theoretical approach with particular significance for work and health in a globalized economy. This book should be compulsory reading not only for occupational and environmental health scientists and practitioners but also for managers and trade union representatives, and for international, national and local political decision makers. It is a treasure chest of highly useful, inspiring and relevant information for enlightened, humane, and cost-effective decision making.

Sigtuna, Sweden Lennart Levi
January, 2016

Preface

Work is a core activity in society with far-reaching impact on people's health and wellbeing. Substantial changes of work and employment in recent past, not least with the advent of economic globalization, prompted scientists to deal with these changes by developing innovative conceptual approaches and by testing them in newly established empirical investigations. This book is devoted to one such innovative approach termed "Effort-Reward Imbalance,", and to the review of scientific evidence on its contribution towards explaining the health effects of stressful experience at work. Research on this theoretical model started more than two decades ago within a small team and has meanwhile attracted the interest of a broad international research community. As the results of this rapidly expanding research are scattered in a variety of scientific journals, we thought it is time to collect a substantial part of them in a volume, even more so as the available evidence continues to inform stakeholders from different parts who are devoted to the development of health-promoting working and employment conditions.

The book is organized in five sets of chapters. The first group of chapters deals with theory, measurement, and two overarching research perspectives. It begins with a chapter by Siegrist describing the effort-reward imbalance (ERI) model and is followed by a critical assessment of the model's measurement, written by Montano, Li, and Siegrist. Wahrendorf and Chandola then explore a major recent research perspective, life course analysis, illustrating how the experience of work stress is embedded in larger employment trajectories. The other overarching research perspective concerns social inequalities in health. Dragano and Wahrendorf demonstrate the importance of work in explaining these inequalities and discuss what the different components of the ERI model contribute to this explanation.

In the second part, three chapters review essential scientific evidence obtained from epidemiological and experimental investigations that were conducted, to a large extent, in European countries. Kivimäki and Siegrist tie together findings from different research streams dealing with work stress and cardiovascular disease. Among others, their chapter documents the usefulness of distinct proxy measures in the absence of original scales measuring the ERI model. The role of work stress in explaining the other major type of stress-related diseases, affective disorders, is analyzed in a scholarly review by Rugulies, Aust, and Madsen. Their conclusion based on prospective cohort studies asserts that reward frustration at work has a significant impact on the development of depressive disorders.

The demonstration of potential psychobiologic pathways linking exposure at work with disease development defines a major scientific challenge in this field. In their chapter, Bellingrath and Kudielka provide a comprehensive, carefully elaborated review of respective research findings related to the ERI model.

As pointed out in the title of this book, stressful work has become a widespread concern in a globalized economy. It is therefore of interest to see to what extent this development is reliably captured by core notions of effort-reward theory. The third set of chapters deals with this task by discussing research findings from four different regions of the world. Tsutsumi, a pioneer of ERI research beyond western societies, discusses relevant respective scientific developments in Japan. Then Owen, Bailey, and Dollard demonstrate how ERI theory can be fruitfully extended using the notion of psychosocial safety climate. Their research is based on extensive data from Australia. China is one of the countries that will essentially shape the world's future. Therefore, research on work stress and health in China, as convincingly reviewed by Li, deserves special attention. Readers may learn that the author himself made significant contributions to this development. The book's part on economic globalization is concluded by a chapter by Gomez Ortiz and Juarez-Garcia who discuss more recent research developments on the topic in Latin America.

In the fourth section, two chapters are devoted to extensions of ERI theory beyond the scope of paid work. According to one line of epistemological reasoning, the quality of a theory is contingent on its capacity to explain a wide range of phenomena by a restricted set of elements. Siegrist and Wahrendorf explore to what extent the notion of failed reciprocity in non-monetary types of costly transactions is useful in explaining reduced health and wellbeing. More specifically, they illustrate the case of volunteering and informal caring. More recently, the model has been applied to school work of young students. A more thoroughly developed extension concerns household and family work. In their chapter, Sperlich and Geyer were the first to analyze these associations with health and summarize the current state knowledge.

The final group of chapters deals with interventions and policy implications of this research. Theorell, one of the founders of modern occupational stress research, explores the significance of three core notions, reward, flow, and control, for human wellbeing as well as their contribution to guide and enrich stress prevention programs at work, and specifically leadership training. A core chapter of this final part is devoted to the translation of scientific knowledge to practice, in particular to the design of health-promoting workplace interventions. The Canadian research team of Brisson, Guilbert-Ouimet, Trudel, and Vézina, who performed path-breaking studies in this field, summarize available evidence and set out recommendations for future intervention research. The last chapter broadens the perspective of analysis by addressing the contribution of national and international labor and social policies to the development of healthy work. Marmot, who has inspired and influenced policy through his scientific distinction more than anyone else in this field, discusses together with Siegrist implications of current work stress research for the development and implementation of globally sustainable improvements of healthy work, with a special focus on the promises of effort-reward theory.

Although this comprehensive account of a theoretical model and its multiple applications in research and policy may give the impression that this work has come to an end, quite the opposite is the case. Each chapter points to open issues and new questions, and there is an urgent need to refine, revise, and update the current state of the art. Thus, this book may be instrumental in supporting researchers in their efforts towards moving the field to next steps of significant scientific progress and practical impact.

Düsseldorf, Germany

Johannes Siegrist
Morten Wahrendorf

Acknowledgments

The development and extensive empirical test of a theoretical model that took more than 25 years is clearly not the work of a single person. Therefore, I (J.S.) am deeply indebted to all my collaborators who made significant contributions to this process. Starting at the University of Marburg, I experienced the wonderful and inspiring cooperation from my initial team, in particular from my wife Karin Siegrist, Klaus Dittmann, Ingbert Weber, Herbert Matschinger, and Daniela Klein to whom I owe so much. I am especially grateful to Richard Peter who joined me when I moved to the University of Düsseldorf and who contributed significantly to the model's measurement. Later on, I was fortunate to collaborate with Olaf von dem Knesebeck, Nico Dragano, Morten Wahrendorf, and Jian Li who enriched the model's development in decisive ways and who became close friends.

Through my participation in a series of international conferences, most importantly those sponsored by the European Commission's Programme on "Breakdown in Human Adaptation to Stress" in the 1980s, I was privileged to extend my intellectual development and to develop personal ties with several eminent scholars and scientific pioneers in their respective field, especially Herbert Weiner (Psychiatry) and James P. Henry (Physiology) from the USA, Michael Marmot (Social Epidemiology) and Andrew Steptoe (Psychobiology) from the United Kingdom, and Lennart Levi (Occupational Stress Research) and Töres Theorell (Cardiovascular Stress Research) from Sweden. Importantly, the Scientific Programme "Social Variations in Health Expectancy in Europe," supported by the European Science Foundation (ESF) from 1999 to 2003, provided unique opportunities of international scientific collaboration. This collaboration was most fruitful and inspiring with two longstanding close colleagues, Michael Marmot and Töres Theorell, to whom I owe my deep gratitude. When the ESF Programme expired, the intensity and productivity of our scientific collaboration motivated us to start, together with Marcel Goldberg, a leading French occupational epidemiologist, the "Four Centre Initiative," an informal network of cooperation between our departments in London, Stockholm, Paris, and Düsseldorf. It is of interest to notice that, among other innovative projects, the so-called IPD network, directed by Mika Kivimäki from the University College of London, evolved from this initiative.

This book reflects these major developments both in the choice of authors who agreed to contribute and in large parts of its scientific substance. Both editors gratefully acknowledge all the authors' excellent performance in producing their chapters, including Lennart Levi's impressive Foreword. We also extend our thanks to the editors of this book series, and specifically to Stavroula Leka at Nottingham University, to five anonymous reviewers, and to Stefan Einarson, Prasad Gurunadham, and their colleagues from Springer Publishing Company. In addition, we thank Simon Götz for his support in formatting the chapters. Finally, I (J.S.) am particularly grateful to the Faculty of Medicine at the University of Düsseldorf and its Dean, Joachim Windolf. By granting me with a Senior Professorship, they provided the necessary support for a successful preparation of this book.

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Johannes Siegrist and Morten Wahrendorf

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About the Editors

Johannes Siegrist is Senior Professor of Work Stress Research at the University of Düsseldorf, Germany. Previously, he was Professor of Medical Sociology and Director of the respective Institute, and additionally Director of the Postgraduate School of Public Health at Düsseldorf University. His long-standing research is devoted to the study of adverse effects of modern working conditions on health, with a particular focus on their contribution to health inequalities. He is the author of one of the internationally acknowledged models of stressful work, "effort-reward imbalance". Among the many papers and books the volume on "Social Inequalities in Health", edited with Michael Marmot in 2006, deserves special attention. Among other distinctions, he is Fellow of Academia Europaea (London) and Corresponding Member of the Heidelberg Academy of Sciences.

Morten Wahrendorf is Senior Researcher at the Centre for Health and Society, University of Düsseldorf, Germany, with substantial expertise in sociology, research methodology, and statistics. He has previously worked at the International Centre for Lifecourse Studies in Society and Health (ICLS) at University College, London. His main research interest are health inequalities in aging populations and underlying pathways, with a particular focus on psychosocial working conditions, patterns of participation in paid employment and social activities in later life, and lifecourse influences.

Part I
Effort-Reward Imbalance: Theory, Measurement and Research Perspectives

Chapter 1
A Theoretical Model in the Context of Economic Globalization

Johannes Siegrist

1.1 Work and Employment in the Era of Economic Globalization

The industrial revolution originating in some European countries in the late eighteenth and early nineteenth century, in combination with radical political and societal changes initiated by the French revolution and the independence of the United States of America, are considered decisive turning points in modern human history (Hobsbawm 1968). Economic growth, technological progress, and a substantial transformation of the workforce were achieved, fuelled by core forces of the market economy. Later on, the development of welfare state policies within emerging democracies, including legislation protecting workers' safety and health, and a broadened access to education and skill development conducive to technological advances contributed to unprecedented productivity, rise in living standards, life expectancy, and societal progress. Yet, trans-national wars and economic crises acted as destructive forces in the development of 'industrialized' societies over the past 100 years. Moreover, during this period significant changes in the nature of work and employment occurred. Mass production was transformed by the advent of automation and, more recently, by pioneering developments of information and communication technology. Service occupations and professions, and administrative jobs continued to expand, shifting the workforce of high income countries from a manufacturing-based industrial towards an information-based economy (Piore and Sabel 1984). Alongside these developments the composition of the labour force became more diverse, with an increase of older workers, working women, and immigrant workers. Employment relations also changed significantly as flexible job

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arrangements largely replaced previously dominating standard contracts with more stability and long-term career prospects.

It is generally agreed that a process termed *'economic (or neo-liberal) globalization'* became visible during the 1970s and 1980s in leading economies of high income countries, impacting progressively the world's remaining economies. Distinct from previous trans-national developments of economic, social and cultural exchange and interdependence contemporary globalization is characterized by the fact that free market principles in conjunction with ground-breaking innovations in information and communication technology spread over the world, stimulating large flows of transnational capital, trade, and workforce. This *flow of capital, trade, and labor force* was, and continues to be, promoted by the creation of international institutions, such as the International Monetary Fund, the World Trade Organization, and the World Bank, as well as by intergovernmental trade liberalization resulting from the deregulation of national financial markets. The deregulation was initiated in an era of economic recession, guided by neo-liberal principles recommending an end to fixed currency exchange rates, a private sector growth at the expense of the public sector, and a weakening of national legislation, welfare state and social policies in conjunction with reduced governmental spending (Labonte 2015).

The expansion of financial markets operating worldwide with risky capital exchanges, and the growing power of transnational corporations originating essentially from the three regions of United States of America, North-Western Europe, and Japan most pervasively characterize the current state of economic globalization. Proponents of this development claim that the creation of new jobs in developing countries and the concomitant global economic growth decrease poverty, improve living conditions including health, and result in strengthening international human rights in less developed parts of the world (Sachs 2005). At the same time, the 'flexible accumulation' of capitalist production alongside a 'spacial restructuring' of work on a global scale promotes large income inequalities between and within countries and results in *significant changes* of *employment relations* and *working conditions* in economically developed parts of the world (Kalleberg 2009). Importantly, a transnational labor market results from the 'spacialization' of production and workforce, aggravated by the entry of millions of working people from China, India, and the former Soviet bloc countries into the global labor pool. With a resulting growth in economic competition and increased pressures for cost-containment, large parts of the workforce in high income countries are experiencing an increase of their workload and work intensity. *High work pressure* often goes along with higher *job instability and insecurity*, with adverse long-term effects on health and wellbeing (Gallie 2013) (see below).

Several determinants of heightened uncertainty of one's job in the context of economic globalization were identified. First, with growing pressure on return on investment employers aimed at reducing labor costs, specifically by implementing distinct *restructuring strategies*. These strategies are known as off-shoring, downsizing, and outsourcing. As a result, layoffs, forced occupational mobility and involuntary part-time employment became more frequent (Cooper et al. 2012). Second, supported by technological advances and economic constraints, job arrangements and employment contracts became more flexible. A *rise in non-standard work arrangements* has been observed, such as temporary agency-based work, part-time work, fixed term contingent work, and independent contracting. As a consequence, "the standard employment relationship, in which workers were assumed to work full-time for a particular employer at the employer's place of work…was eroding… which led to a growth in precarious work and transformations in the nature of the employment relationship" (Kalleberg 2009, p. 3). Although the notion of precarious work includes disadvantaged conditions such as lack of control of one's job environment and task, lack of alternative job opportunities and poor pay, job insecurity is probably its most eminent, most frequent feature. Insecure jobs are now increasingly spreading from the secondary labor market to considerable parts of the primary labor market, where they affect higher qualified employees and some professional groups as well. As a consequence, a growth in perceived job insecurity and of nonstandard flexible work arrangements has been observed among several workforces in advanced societies (Gallie 2013; Quinlan et al. 2001). Third, neoliberal market forces resulted in a *weakening of legal regulations* incorporated in national social and labor policies, thus reducing workers' opportunities of experiencing employment stability and fair retirement benefits. The chances of preventing this risk-enhancing process were critically reduced by a global decline in union membership and a reduced power of workers' collective voice of defending their rights (Moutsatos 2009).

In conclusion, significant changes in the nature of work and employment occurred during the past several decades that can briefly be summarized at three levels. First, with the advent of new technologies and new societal demands employment sectors in high income countries shifted from industrial mass and lean production towards service delivery and information/communication technology-driven jobs. Although physically strenuous work and exposure to main occupational hazards of industrial production continue to pose serious challenges to workers' health and safety, the *threats of a health-adverse psychosocial work environment* are becoming more widespread and more visible with this shift, and they contribute to a growing burden of work-related diseases. Second, as a consequence of different drivers, mainstream employment relations and job trajectories with long-standing continuity and security were increasingly replaced by more flexible arrangements, including mobility, retraining, de-standardization of employment contracts, and growth of job insecurity. In part, these developments were supported by demographic changes in the composition of workforces, in particular by an aging population, an increasing participation of women in the labor market, and a diversification of working people in terms of cultural background and training. Third, with the advent of economic globalization, growing competition between transnational companies and the constraints of financial markets resulted in a sizeable increase of work pressure in many employment sectors in high income countries. At the same time, job stability and promotion prospects decreased – and continue to decrease – not only in the periphery of labor markets, but increasingly in its well-trained central segments.

1.2 The Role of Psychosocial Stress at Work

As was mentioned, the spectrum of occupational exposures with potential impact on health has changed rather markedly during this transformation. While traditional hazards still prevail in certain sectors of the labour market, the majority of employed people are now confronted with a variety of mental and emotional demands, threats or conflicts rather than with toxic substances and environments. There has been a general recognition that the importance of work for health goes beyond traditional occupational diseases. Moreover, the established approach of occupational medicine with its focus on occupational toxicology, noise, temperature and similar conditions needs to be extended to include a wide spectrum of work-related stressors that affect working people's perceptions, cognitions, emotions, and motivations. To this end, theoretical and methodological knowledge from social and behavioural sciences, specifically from psychology and sociology is required that complements the knowledge obtained from basic sciences, such as physics, chemistry, and biology. The *stress paradigm* offers a most promising approach to deal with this major challenge of modern, current occupational health research.

The notion of 'stress' as a scientifically useful term differs from its widespread popular use in everyday language in important ways. Stress defines a reaction to a challenge (stressor) from the external world or from within the organism that interrupts or threatens the usual behaviour and normal functioning of a person and that requires specific efforts to meet the challenge. These efforts are termed *'coping'* and include personal competencies and capabilities as well as interpersonal, socio-environmental support. Stressors can occur in the natural and built environment as well as in the social environments where people live and work, either as acute, unexpected events (e.g. earthquake, fire, terrorist attack) or as chronic, recurrent threats (e.g. drought, starvation, long-term unemployment). In terms of frequency, duration, and impact on health major chronic stressors originating from the social environment deserve primary attention (Weiner 1992). Adverse psychosocial work environments are one such type of chronic social stressors.

A second difference between everyday and scientific notions of stress concerns the distinction of several dimensions of a person's response to a stressor. In scientific terms, the following dimensions are distinguished: the cognitive, the affective or emotional, the physiological, and the behavioural response. At the cognitive level, a challenge is appraised according to its degree of threat or harm. This appraisal is paralleled – or sometimes preceded – by negative or positive affective responses, where the experience of threat goes along with intense negative emotions of anger, irritation, or anxiety. At the physiological level, *stress reactions* activate the autonomic nervous system and the organism's innate stress axes. The primary biological systems activated during stress are the hypothalamic-pituitary- adrenal (HPA) and sympatho-adrenomedullary axes (Steptoe and Kivimäki 2012). The long-term consequences of sustained activation of stress axes, mediated by endocrine, immune, and autonomic nervous system responses, trigger a state of *'allostatic load'* within distinct organ systems, resulting in the development of manifest diseases (McEwen 2007; see Chaps. 5, 6, and 7). At the behavioural level, stress responses in terms of evolutionary old patterns of fight or flight are often prevented in modern societies by mechanisms of social control, thereby intensifying the physiological reactions (Elias 1997).

How can we define those critical aspects of adverse psychosocial work environments that act as chronic social stressors, thereby affecting the working persons' health and wellbeing? Given the complexities and variations of multiple modern work environments and employment conditions there is a need to reduce this complexity by selectively focusing on distinct components that are assumed to produce tangible effects on workers' health. To this end, a *theoretical model* is needed. A theoretical model offers at least three advantages. First, it proposes an analytical focus by identifying a general principle that is expected to explain the associations between stressful aspects of work and the working people's health. Proposing a theoretical model is a creative intellectual activity and, at the same time, a risky endeavour, as an empirical test of its predictions may fail. Once a theoretical model has been measured by a standardised assessment approach, cumulative empirical evidence on its explanatory contributions can be achieved, through recurrent testing in epidemiological and experimental studies. As a third advantage of a theoretical model resulting from this second gain, *successful explanations or predictions* derived from the model can be used to *guide actions* that aim at improving work and employment settings and reducing the burden of work-related disorders.

As mentioned, every theoretical model is inherently limited due its selective analytical focus. Therefore, there may always be a trade-off in applying a model between the limitations resulting from its selective analytical focus and the desire to understand the richness and complexity of the real world. Several decades of research along these lines resulted in the proposition and test of a *variety of theoretical models* of a psychosocial work environment with relevance to health (for review e.g. Cartwright and Cooper 2009). Some of these models received prominence in terms of their diffusion across the research community and in terms of their contribution towards explaining working people's health and wellbeing. Among them, in a historical perspective, the following approaches are noteworthy: 'person-environment fit' (French et al. 1982; Edwards et al. 1998), 'demand-.control' (Karasek 1979; Karasek and Theorell 1990), 'effort-reward imbalance' (Siegrist 1996), 'organizational injustice' (Greenberg and Cohen 1982; Elovainio et al. 2002), and 'job demands-resources' (Demerouti et al. 2001).

While a more detailed description of these models is given below, it is probably accurate to observe that each concept was developed in a specific *socio-cultural and socio-economic context.* For instance, *'person-environment'* addresses the role of individual perceptions and coping efforts in adapting to job environments, with a major interest in achieving optimal correspondence between persons' abilities and environmental demands and supplies. This important extension of previous unidimensional approaches nevertheless puts more weight on individual adaptation to given work environments than on changing environments (Karasek and Theorell 1990, p. 95). This is well understandable given the major scientific input from important psychological advances in personality and organizational behaviour research during that time. As a result, improving recruitment, selection, and training of persons entering the labour market seems to be a primary practical application of this model's insights (Edwards et al. 1998, p. 58). It may be of interest to note that this concept originated in the context of a booming industrial labour market and sustained economic growth in the United States in the 1960s and 1970s, directing attention to workers' job satisfaction, such as qualification, career advancement, or working climate rather than to issues of job insecurity or job loss, forced occupational mobility, or poor salary. To some extent, the same holds true for the concept of *organizational injustice* which places its main emphasis on fair procedures of treating employees, of appropriated leadership behaviour, and of improved flows of information and communication within organizations. Embedded in emerging scientific developments of organizational and occupational psychology and management sciences in the 1970s in the United States and Europe, it disregarded broader labour market developments.

Different from these traditions, the *demand-control* model is rooted in a sociological approach focusing on characteristics of job task structures and features. It gives rise to organizational change in terms of job redesign, and it aims at strengthening workers' control over their job tasks, stimulating job enrichment and skill development. The model has been – and continues to be – important for improving trade unions' efforts towards a democratization of work organization and the management of enterprises, and it has even far-reaching implications of challenging the utilitarian approach towards material production and economic growth (Karasek and Theorell 1990). Despite these merits of representing a broad spectrum of scientific scholarship, including the discussion of personality factors in the work process, the model, in its measurement approach, must be considered a 'black box' concept analysing distinct combinations of features of job tasks and, with respect to the addition of the dimension of social support at work, of its immediate social environment. Importantly, the authors confirm their unique focus on job tasks in their basic critique of Taylor's influential principles of work organization, claiming that "the three major oversights in Taylor's prescription for job design related to psychological demands, control, and social support" (Karasek and Theorell 1990, p. 24). As such, the demand-control-support model still heavily relies on a stage of economic development where industrial production with inherent forms of division of labour plays a core role, and where employees are performing their work in the frame of hierarchically structured organizations.

'Effort-reward imbalance' has been proposed as a complementary model of psychosocial stress at work that addresses more recent economic developments by focussing on the employment contract as the core element of employment relations, rather than on job task features. With the consequences of economic globalization described above, the nature and quality of employment contracts gained renewed prominence, given a growth of insecure and precarious work, short-term contracts, and new forms of flexible employment arrangements. Moreover, with associated developments of information and communication technologies and automation, temporal and spatial constraints of performing work within traditional organizational frames of enterprises were diminished, while the employment contract

continues to be of key importance in new forms of work arrangements, such as home-based or other forms of distant work, independent contracting, and in a variety of service job conditions. The next section describes this model in more detail.

1.3 The Model of Effort-Reward Imbalance at Work

This theoretical concept is concerned with stressful features of the employment or work contract. It was developed by this author and his group with a selective focus on the notion of *social reciprocity in costly transactions* (Siegrist 1996). 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. Exchange expectancy does not implicate full identity of the service in return, but it is essential that this activity meets some agreed-upon standard of equivalence. Failed reciprocity results from situations where service in return is either denied or does not meet the agreed-upon level of equivalence. To secure equivalence of return in crucial types of costly transactions, social contracts have been established as a universal societal institution. The *work contract* (or contract of employment) 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 details, but provide some room of flexibility and adaptation.

The model of effort-reward imbalance at work asserts that *lack of reciprocity* in terms of *high cost* spent and *low gain* received in turn occurs frequently under specific conditions. *'Dependency'* is one such condition, defined by situations where workers have no alternative choice in the labour market. For instance, unskilled or semi-skilled workers, elderly employees, or those with restricted mobility or reduced work ability may be susceptible to unfair contractual transaction as the incentives of paying non-equitable rewards are high for employers, while the risks of rejecting this transaction by employees are low, due to the fact that they have no alternative choice. 'Dependency' is relatively frequent in modern economies with a globalized labour market (see above). While this labour market offers jobs with good quality to better qualified parts of the workforce it confronts less skilled or otherwise disadvantaged parts with job instability or job loss due to mergers, organisational downsizing, rapid technological change, and growing economic competition. In times of economic globalization, forced competition equally occurs among better qualified parts of the work force, and among them, a second condition of failed reciprocity at work, termed *'strategic choice'*, may matter. Here, people accept the experience of 'high cost/low gain' in their employment for a certain time, often without being forced to do so, because they tend to improve their chances of career promotion and related rewards at a later stage. This pattern is frequently observed in early stages of professional careers and in jobs characterized by heavy competition. As anticipatory investments are made on the basis of insecure return expectancy, the risk of failed success after long-lasting efforts is considerable.

The notion of effort at work implies both an extrinsic demand to which the working person responds as well as a subjective motivation to match the demand. In most instances, matching the demands is part of the control structures established in organizations, thus leaving little room for variations of subjective motivation. Yet, demands are likely to be exceeded in situations of strong informal pressure exerted by a competing work team (e.g. group piece work). Similarly, demands are likely to be exceeded if people are characterized by a motivational pattern of excessive work-related *'over-commitment'*. Consciously or unconsciously, they may strive towards continuously high achievement because of their underlying need for approval and esteem at work. This motivation contributes to 'high cost/low gain' experience at work even in the absence of extrinsic pressure.

To summarize, the model of effort-reward imbalance at work maintains that failed contractual reciprocity in terms of high cost and low gain is often experienced by people who have no alternative choice in the labour market, by those exposed to heavy job competition, and by those who are overcommitted to their work. As these conditions are expected to occur across different sectors of employment, in a variety of jobs and in different socio-economic and socio-cultural contexts the model's claim may be relevant for working populations in several parts of the world, but specifically in labour markets in times of a globalized economy.

In a sociological perspective, the model stresses the *core social role of paid work* in adult life, and it considers the powerful effects of socio-structural inequalities on status acquisition and status control as elaborated by the classical work of Robert K. Merton (1968). According to Merton, socio-structural conditions act as external constraints against individual choices where the chances of realizing a desired goal depend on the person's location in the vertical social structure. The vertical social structure distinguishes status positions according to access to core resources, such as authority, power, influence and prestige. Therefore, the social opportunity structure in general, and the opportunity structure of the labour market more specifically, affect people's unequal life chances, including the quality of work and related rewards. 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 wellbeing of working people.

1.3.1 The Model's Hypotheses and Its Stress-Theoretical Basis

A graphical illustration of the model is depicted in Fig. 1.1 (see also Chap. 2). These are the model's *core research hypotheses* linking stressful psychosocial work with adverse health outcomes:

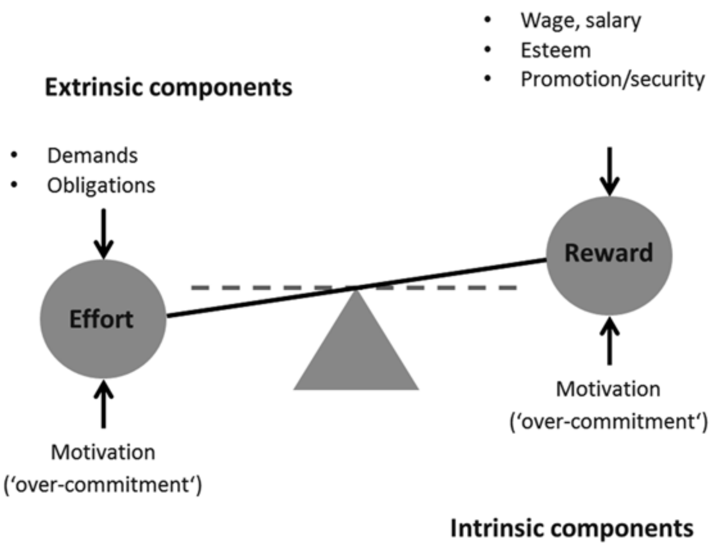

Fig. 1.1 The model of effort-reward imbalance at work

1. Each component of the model, defined by the scales 'effort', 'reward', and 'over-commitment', exerts separate effects on the health outcome under study. In general, these effects reflect 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 exceeds the size of effect on health produced by each single component (e.g. as demonstrated by the individually assessed 'effort/reward ratio').
3. The personal coping pattern 'over-commitment' moderates the effect size of effort-reward imbalance on health (interaction term). Among people scoring high on over-commitment this effect is significantly stronger than among people scoring low on this pattern of coping.

As there are two types of imbalance between effort and reward, high effort with low reward and low effort with high reward, it is crucial to distinguish their different significance in stress-theoretical terms. As explained in more detail below, primacy with regard to impact on health is accorded to the former type of imbalance. Accordingly, an additional hypothesis states that the relative risk of stress-related disorder associated with high effort in combination with low reward at work is always higher than the risk associated with low effort in combination with high reward. A further refined hypothesis of this model maintains that each one of the three reward components depicted in Fig. 1.1 exerts effects of similar strength on health, thus supporting the notion of comparable importance of material and non-material occupational rewards for health and wellbeing.

Turning to the *stress-theoretical basis* of the model it is obvious that experiencing effort-reward imbalance at work is particularly distressing as it frustrates basic expectations of equivalence of return in costly transactions. Most importantly, the recurrent experience of failed reciprocity is expected to afflict the health and well-being of working people by compromising their self-esteem and by eliciting negative emotions and related psychobiological stress responses. As mentioned, continued sustained stress responses exert adverse long-term consequences for stress-related mental and physical disorders (McEwen 2007; see also Henry and Stephens 1977; Weiner 1992).

The experience of effort-reward imbalance at work due to unfair exchange, trust violation, or broken promise is assumed to 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, i.e. neurotransmitters associated with pleasurable emotions and stress-buffering properties. Moreover, activation of the insula is associated with the experience of physical and emotional pain, and with strong visceral and somatic sensations (Baumgartner et al. 2009; Singer et al. 2004). If combined with the occurrence of threats to a person's self or social status, these processes of sustained activation may interfere with inbuilt regulatory systems of the body, driven by extensively aroused stress axes and impaired compensating bodily anti-stress mechanisms, thus triggering the development of stress-related disorders. Importantly, 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). It seems that the brain's reward circuitry is sensitive to the experience of disadvantageous inequality in social exchange (Tricomi et al. 2010). While this recent evidence from neuroscience research is in accordance with basic assumptions of the effort-reward imbalance model, further studies are needed to unravel the links between sustained experience of reward deficiency at work and the development of stress-related disorders, triggered by the described psychobiological processes (see also Chap. 7).

1.3.2 Distinct Approaches Towards Dealing with Inequity

This model has not been conceptualized at a single early stage of my scientific work. Rather, it gradually evolved over time, starting with early collaborative research that explored the psychosocial history preceding the incidence of young men's first myocardial infarction (Siegrist 1984; Siegrist et al. 1986). Before the final conceptualisation and measurement of the model were accomplished, its main hypotheses were tested in the frame of a prospective study of a cohort of blue-collar industrial workers and their risks of experiencing coronary heart disease (Siegrist et al. 1990; see below Chap. 5). In the course of advancing the model, similarities with, and differences from related theoretical notions became evident. Whereas these similarities and differences with the demand-control model are discussed below, those related to different conceptualisations of the core notion of inequity are addressed here. Two such conceptualisations are particularly relevant in this context, Adam's (1965) inequity theory, and the model of organizational injustice (Greenberg 2010).

The principle of social reciprocity, elaborated in a sociological perspective by Gouldner (1960), is central to the effort-reward imbalance model. The overarching significance of this principle is due to the fact that it protects people from stressful, devastating experiences of deprivation, deception or even fraud evolving from its violation. Accordingly, *justice of exchange* in interpersonal transactions is realised to the extent that taking unjustified advantage of other people's investments in exchange can be prevented. In a certain contrast to this argument, an influential social psychological theory of inequity proposed by Adams (1965) distinguishes between two deviations from the principle of reciprocity of exchange, 'over-fitting' and 'under-fitting'. In the first case, the gains received outmatch the invested costs, whereas in the latter case, costs exceed the experienced gains. *Equity theory* posits that both states trigger some kind of inequity aversion that motivates people to reduce these discrepancies by behavioural or cognitive changes. Yet, a stronger motivation of change is expected in case of under-fitting than in case of over-fitting, given the powerful impact of loss experience. As Adams' main interest was to understand adaptive behavioural changes following perceived inequity rather than to explore potential effects on emotion and wellbeing, this latter assumption was not tested in the frame of inequity theory. However, the important role of avoiding 'under-fitting' and related *loss aversion* in guiding economic decision- making and in securing people's emotional wellbeing was demonstrated in the path-breaking experiments of Kahneman and Tversky (1979), and was supported by a broad range of subsequent research including the influential theory of conservation of resources (Hobfoll 1989).

A second notion of Adam's social-psychological inequity theory deserves attention as it has direct relevance to the effort-reward imbalance model, the notion of two types of reference standards (Adams 1965). The first standard, termed 'intrinsic', is weighing the costs of effort against the gains of reward, whereas the second standard, termed 'extrinsic', is weighing one's own gains relative to one's costs with the gains obtained by significant others for similar costs. According to inequity theory, both reference standards are of similar importance in evaluating the equity or fairness of exchange. In contrast, the effort-reward imbalance model accords *primacy to the intrinsic reference standard*, given a prominent role of the 'evolutionary old' principle of social reciprocity (see above). A decisive role of intrinsic reference standards has been demonstrated, for instance, with regard to the evaluation of fair earnings (e.g. Fehr and Fischbacher 2003). To quote just one example: In a large survey, judging one's own earning as unfair (intrinsic reference standard) was strongly associated with poor health even after adjusting for the confounding factor of horizontal social comparison (extrinsic reference standard) (Falk et al. 2011). In summary, inequity theory has contributed to significant progress in understanding the unfairness of social exchange. Yet, as argued here, when applying this approach to the analysis of stressful work, some further specifications are needed.

The concept of 'organizational injustice' that was elaborated in the context of organizational psychology and management sciences in the 1970s and 1980s (Greenberg 2010) is largely based on Adam's inequity theory. It is concerned with the analysis of perceived inequities of people's behaviours within formal organizations, mostly in the frame of work and employment. *Four types of injustice* are usually distinguished. 'Procedural injustice' is defined as the perceived deviance from established rules of decision-making and from applying agreed-upon standards of judging the performance of employees. 'Interactional (or relational) injustice' describes the unequal treatment of persons within organizations in everyday interactions, e.g. with regard to respect and communication. 'Informational injustice' is introduced to describe unequal access to, and share of relevant information within the organization. Finally, 'distributive injustice' is defined as the perceived inequity of an organization's distribution of valuable goods, resources, and services to its members. It is this last type, distributive injustice, which may interfere with the core notion of effort-reward imbalance. However, distributive justice within an organisation is primarily concerned with social comparison processes between its members, and in this regard the extrinsic reference standard dominates the evaluations of fair or unfair shares. Thus, a potential conceptual overlap between the notions of *distributive justice* and *justice of exchange* can be avoided by pointing to the different weight of extrinsic versus intrinsic reference standards in the respective concepts, as explained.

Finally, when discussing distinct concepts of inequity, the differences in setting priorities for policy implications inherent in the models discussed so far need to be emphasized. Inequity theory (Adams 1965), organizational injustice (Greenberg 2010), as well as the related concept of *psychological contract in organizations* (Rousseau and McLean Parks 1992), are ultimately directed towards understanding and improving human relations in organizational settings. By improving leadership, communication and flow of information, by developing more appropriate forms of cooperation and by strengthening the organization's social capital the practical implications of this research are clearly far-reaching. Yet, different from these concepts, 'effort-reward imbalance' addresses tangible aspects of the *opportunity structure of labour markets* (e.g. job security, promotion prospects, adequate earnings), thus pointing to structural aspects of improving work and employment within and beyond the level of organisations (see also Chaps. 15 and 16). Despite this difference, both approaches complement each other and contribute to better health of working people.

1.4 Comparing Complementary Models of Stressful Work

As every theoretical model of stressful psychosocial work is inherently selective research in this field is confronted with two challenges. First, a convincing argument has to be given that each model offers an explanatory approach that is sufficiently distinct from knowledge that is already available. Second, in empirical research, the independent explanatory power of each model needs to be demonstrated, thus confirming its complementary nature. Concerning the first challenge, the main conceptual differences between 'effort-reward imbalance' and *'organisational injustice'* were already discussed. Can similar arguments be given in case of the other theoretical concepts mentioned earlier?

It is not easy to give a succinct summary of *'person-environment'* theory as it has undergone several refinements between the early 1960s and the late 1990s (Edwards et al. 1998). Its fundamental premise claims that stress arises from a misfit between the working person and the environment, and that this misfit is best analysed in terms of objective and subjective representations of the person and environment. According to this theory, subjective misfit matters more for the workers' strain than objective misfit, and this holds true for misfit between extrinsic demands and personal abilities as well as for misfit between supplies and personal needs. Although the theory provides a conceptual framework for understanding the relationships between these two types of misfit and strain it does not specify the content of its core dimensions (Edwards et al. 1998, p. 39). Moreover, at the methodological level, measures of person and environment were often collapsed rather than separated in empirical studies, thus complicating the development of cumulative knowledge. For these reasons, the opportunities of directly comparing 'person-environment fit' with concurrent theoretical approaches are limited.

'Demand-control' is one such concurrent theoretical model that must be considered the most widely used approach towards studying health-adverse psychosocial work environments. It was introduced by sociologist Robert Karasek (1979) and further developed by Karasek and Theorell (1990). It posits that stressful experience at work results from a distinct job task profile defined by two dimensions, the psychological demands put on the working person and the degree of control available to the person to perform the required task. Jobs defined by high demands and low control are stressful because they limit the individual's autonomy and sense of control while generating continued pressure ('high job strain'). Under these conditions, excessive arousal of the autonomic nervous system is expected to occur that is not compensated by a relaxation response following the experience of control and mastery. Low level of control or decision latitude manifests itself in two ways, as lack of decision authority over one's tasks, and as low level of skill utilization, as evidenced by monotonous, repetitive work. A different job task profile '(active job'), defined by high demands in combination with high level of control, exerts more positive effects on the working person. Active jobs enable individuals to experience positive stimulation, success, and self-efficacy. The recurrent experience of control and mastery at work is associated with positive emotions and active learning, thus protecting the working persons from the risk of developing stress-related disorders. Inherent in these categories of job task profiles is some notion of social hierarchy. Obviously, active jobs are more likely to be assigned to better educated people and those in leadership positions, whereas high strain jobs are more prevalent among skilled, semi- or unskilled workers. It is important to recognize that this is a bi-directional model which, in its negative part, is based on the stress- theoretical notion of limited control of challenging demands. In its positive part, it is based on

the notion of active learning and skill development through successful coping with stimulating tasks.

'Demand-control' and 'effort-reward imbalance' differ in important ways. As mentioned, the former's analytical focus is on job task characteristics while contractual employment relations define the latter model's focus. Moreover, 'demand- control' has been developed with the intention of overcoming outdated conceptions of work organisation and economic growth within the frame of industrial societies, whereas. 'effort-reward imbalance' addresses reward deficiencies of people exposed to labour market constraints in a globalized economy. A second difference relates to the role of person characteristics within the two models. While 'demand-control' considers exclusively situational characteristics, 'effort-reward imbalance' integrates person characteristics in terms of the coping pattern of over-commitment in its set of hypotheses. Third, the stress-theoretical basis differs to some extent between the models as threat to control and threat to reward may activate partly different brain circuits implicated in the stress response. Finally, at the level of basic philosophical orientations, 'demand-control' argues in favour of developing a new model of productivity that meets human needs beyond material consumption, unfolding people's capabilities and creativity. By emphasizing the importance of justice of exchange, social recognition and appreciation for health and wellbeing, 'effort-reward imbalance' opens a window of opportunity in favour of an economy that challenges the dominance of egoistic profit by valuing trust and fairness.

More recently, two versions of a further model termed *'job demands-resources'* were proposed in the context of extensive research on burnout (Demerouti et al. 2001; Schaufeli and Bakker 2004). The first version builds on the demand-control-support model as it considers control, support and feedback as job resources, while extending the definition of demands beyond those captured by the former model. In this version, the authors posit that job resources mitigate the negative effect of job demands on exhaustion and burnout. In an updated second version, negative (burnout) and positive (work commitment) psychological states are defined as outcomes of different constellations of job demands and job resources, thus offering a 'pathogenic' as well as a 'salutogenic' perspective (Schaufeli and Taris 2014). Motivational processes act as mediators linking job resources with positive performance outcomes, whereas an imbalance between high demands and low resources triggers burnout and associated health problems. Further specifications of the concept concern the introduction of distinct personal resources and vulnerabilities. In a recent review authors confirm that the 'job demands-resources' model "is heuristic in nature and represents a way of thinking about how job (and recently also personal) characteristics may influence employee health, well-being, and motivation" (Schaufeli and Taris 2014, p. 44). The fact that all sorts of demands, resources, and outcomes can be included in the model can be interpreted as a strength, but equally so as a weakness. In the context of this discussion the model's lack of specificity complicates a direct comparison of similarities with, and differences from 'effort-reward imbalance'.

Having discussed the first challenge I now turn to the second challenge, i.e. the need of demonstrating the *independent explanatory power of each model* in comparative empirical studies. Up to now, with the exception of a few publications focusing on 'organizational injustice' (Kivimäki et al. 2007; Ndjaboué et al. 2012), respective research has been limited to comparisons of the demand-control and the effort-reward imbalance models. In several of the following chapters, respective evidence is presented and discussed. Overall, it can be concluded that either model maintains its strength in explaining health after respective statistical adjustment. Moreover, several reports document additive effects on health resulting from their combination. It is hoped that more comparative research will be conducted along these lines in the near future.

1.5 Concluding Remarks

This chapter has delineated the theoretical background of the effort-reward imbalance model of psychosocial stress at work. The model has been explained in the framework of recent worldwide developments of work and employment directed by the process of economic globalization. Economic globalization offers opportunities of growth and development, but at the same time carries substantial risks that may threaten the health and wellbeing of millions of working people around the globe. It is therefore important to monitor related risks and to develop preventive measures that aim at reducing the burden of work stress-related diseases. Using available scientific evidence and measurement tools based on theoretical models such as effort-reward imbalance can be a useful and promising step towards this end. In addition to an extended interpretation of this conceptual approach the chapter discussed similarities with, and differences from complementary theoretical concepts in this field of research, a strategy that is needed given the selective nature of each model in view of the complexity and diversity of modern work environments. More specifically, major features of 'demand-control', 'person-environment fit', 'organizational injustice', and 'job demands-resources' were elaborated, with an understanding that this selection is far from complete.

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Chapter 2
The Measurement of Effort-Reward Imbalance (ERI) at Work

Diego Montano, Jian Li, and Johannes Siegrist

2.1 Introduction

The measurement process in the social and behavioral sciences is more problematic than in the natural and basic sciences. Major measurement problems associated with social and behavioral phenomena are related to the high complexity of biological systems, the difficulty of defining unequivocal objects of measurement, and the practical cost and time constraints concerning data collection from different sources. Moreover, in many cases, calibrated measurement standards that are required for unequivocal quantification, comparison and replication of data are not available. Despite these limitations remarkable methodological advances were achieved in these sciences, including the assessment of people's personal experiences, attitudes, and behaviors (King et al. 2004).

One such advance concerns the modeling of constructs by means of *latent variables* and their measurement by a set of standardized indicators. There are two main approaches towards assessing these indicators, observational and self-report data collection. Either approach has its strengths and weaknesses. To measure the construct 'effort-reward imbalance' (ERI) in terms of a *systematic observation* of

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the efforts and rewards people experience at work has the advantage of providing information that may be unbiased by subjective interpretations. Yet, distinct components of the model (e.g. esteem reward, over-commitment) are hardly observable, and due to the narrow time window of observation relevant occurrences may be bypassed or interpretation biases of external observers may limit the validity of assessment. Additional problems concern the high costs of application and training, and the limited size of samples to which this technique can be applied (Karasek and Theorell 1990; Rau et al. 2010). *Self-report data* are more easily collected, and there are no limitations of the sample size. However, the validity of this measurement has been repeatedly questioned given several sources of systematic bias, such as the risk of distortion of information, the impact of distinct personality traits and reporting styles, and uncontrolled contextual influences on the assessment process (Kahneman et al. 2004; Sudman et al. 1996). On balance, self-report data have the advantage to reflect personal experience, a crucial prerequisite of human stress research, and they cover long periods of the person's living and working conditions.

Different methods of collecting self-report data have been applied to the measurement of effort-reward imbalance at work. They include non-standardized qualitative interviews (McGillis Hall and Kiesners 2005), event momentary assessment (Johnston et al. 2013; Johnston 2006), standardized computer-assisted personal or telephone interviews that may or may not include psychometrically validated scales (Wege et al. 2008), and questionnaires containing psychometrically validated scales answered either under controlled conditions or via mail or online (Fekete et al. 2014).

The *development and test of ERI indicators* has taken a number of years and underwent several changes. In a first phase, data were collected from healthy workers as well as from distinct groups of people with chronic disease (in particular coronary heart disease), by using semi-structured interviews with descriptive and evaluative questions measuring 'effort' and 'reward', and additionally by applying a pool of dichotomous items assessing 'over-commitment'. It is important to note that descriptive information was validated by contextual data where available (for a detailed description see Siegrist (1996b), for a summary description see the main ERI reference paper Siegrist (1996a)).

In a second phase, based on the results of these early studies, each component of the construct was assessed by a series of *Likert-scaled items* reflecting the questions with highest explanatory power. Items and related scales underwent psychometric analysis according to classical psychological test statistics, including the assessment of internal consistency of scales, of item-scale correlations, and of scale intercorrelations. The *three scales* were finally composed by six items measuring '*effort*' (five items if 'physical workload' was excluded, e.g. in white-collar surveys), 11 items measuring '*reward*' (containing the three sub-scales 'money and career', 'esteem', 'job security'), and six items measuring the personal coping pattern of '*over-commitment*' (Siegrist et al. 2004). Confirmatory factor analysis was performed by comparing alternative configurations of the model structure, where the formal structure reflecting most closely the theoretical assumptions demonstrated the best fit with data (Rödel et al. 2004). This latter finding was replicated in several studies testing the original and the newly developed short version of the questionnaire (see text and Fig. 2.1 below). Later on, the original version of the ERI questionnaire was subject to a change of the answering format of items, and an additional, psychometrically validated short version was developed.

These changes of the ERI questionnaire are described in more detail in the next section. Following this, the main ways of testing the research hypotheses of this

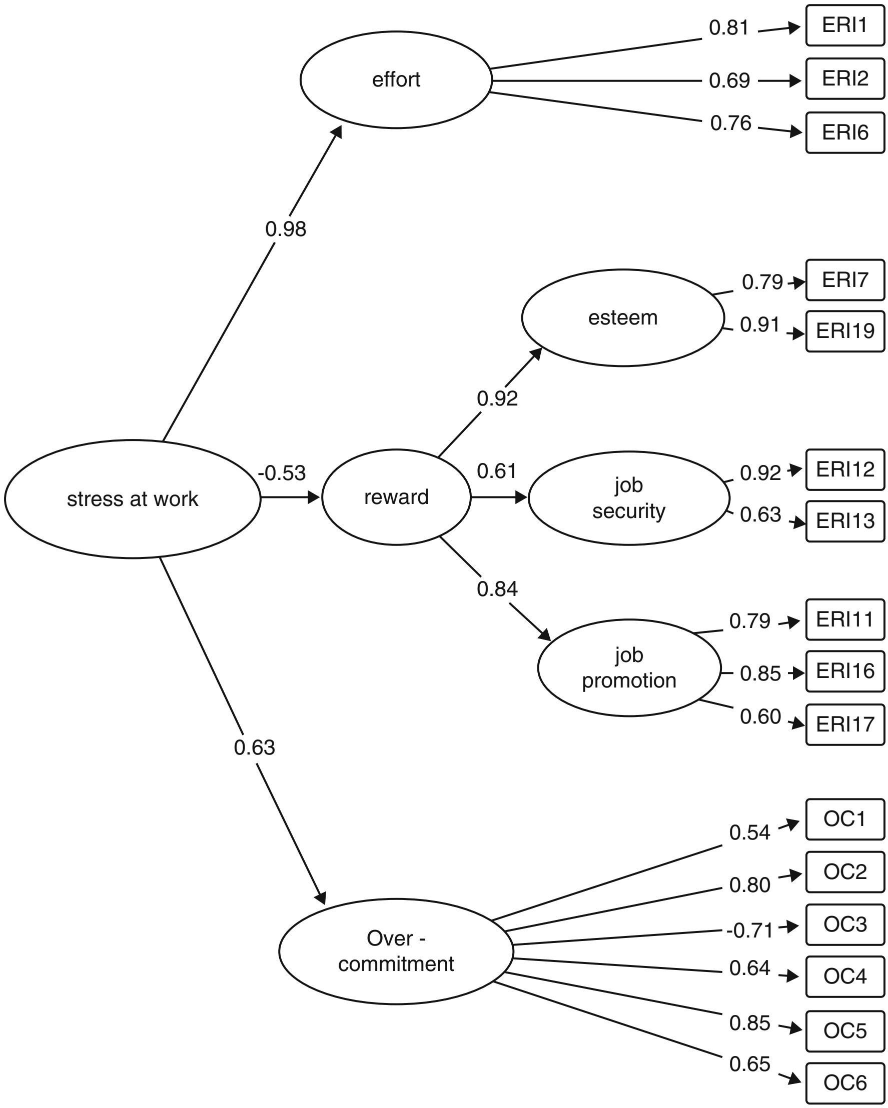

Fig. 2.1 Confirmatory factor analysis testing the ERI-model (short version, source: Leineweber et al. 2010)

model are discussed. In the third section, major critical methodological problems are addressed, and in the final section some future directions of research based on this measurement approach are proposed.

2.2 ERI Scales and Test of the Model's Hypotheses

2.2.1 Towards a One-Step Rating Procedure

When the *original 23 item version* of the ERI questionnaire was developed the prevailing psychological stress theory suggested that cognitive appraisal exerts a decisive impact on the triggering of stress responses (Lazarus and Folkman 1984). According to this assumption a two-step procedure of answering the items was proposed to map the distinction between occurrence of a situation and appraisal of the degree of distress assigned to it. Therefore, first, subjects agree or disagree whether or not the item content describes a typical experience of their work situation. Subsequently, subjects who agree are asked to evaluate to what extent they usually feel distressed by this typical experience (not distressed, somewhat distressed, distressed, very distressed) (Siegrist et al. 2004). As discussed below, this two-step 5-point Likert scale rating procedure turned out to be problematic in psychometric terms, and it produced some difficulties during data collection, especially among low educated people. Therefore, in a further improvement of the ERI questionnaire, a widely used one-step rating procedure was proposed in terms of a 4-point Likert scale where respondents had to indicate to what extent they agree or disagree with the item content (strongly disagree, disagree, agree, strongly agree) (Siegrist et al. 2009). Here, the distinction between occurrence and appraisal was no longer made, and the rating of the degree of stressfulness was replaced by assessing to what extent the item content matches the respondents' typical experience at work. As the item content describes a situation generally appraised as disadvantageous (or advantageous if reverse coding is required) the respondents' answers to the items of each scale are expected to mirror the amount of their *perceived* effort and reward at work.

The new rating procedure was introduced in the context of developing a psychometrically validated *short version of the original questionnaire* (see below). It was also widely used in the short version incorporated in the Survey of Health, Ageing and Retirement in Europe (SHARE) (Siegrist et al. 2007; Wahrendorf and Siegrist 2014). Based on the experience of appropriate psychometric properties of the scales and on the observation that associations with health outcomes were generally well comparable to those derived from the original questionnaire (Fekete et al. 2014; Juvani et al. 2014; Li et al. 2012a, b; Tsutsumi et al. 2008), it was more recently proposed to use this new rating procedure in future applications of the original ERI questionnaire as well (Siegrist et al. 2014). However, one has to take into account that the sum scores of the scales with 4-point answers and those with 5-point answers have to be transformed in order to be comparable.

2.2.2 The Short Version of the Questionnaire

Given increasing demands from research consortia of large-scale cohort studies to provide a short, economic measure of the model, an abbreviated version of the two scales 'effort' and 'reward' was developed in Germany, based on data from the Socioeconomic Panel (Siegrist et al. 2009), and in Sweden, based on data from the Swedish Longitudinal Occupational Survey of Health (Leineweber et al. 2010). The two versions were almost identical, containing ten items (three 'effort' and seven 'reward' items). In either case, a second order model (where reward was represented by the three theoretically defined components; see Fig. 2.1) reached the relatively best level of fit, as indicated by several fit indices. Moreover, the criterion validity was tested by analyzing associations with measures of self-rated health and depressive symptoms. High effort in combination with low reward was strongly and consistently related to poor self-rated health in the cross-sectional study in Germany (Siegrist et al. 2009) and in the longitudinal study in Sweden, where similar associations were additionally observed for depressive symptoms (Leineweber et al. 2010). Importantly, an *identical factorial structure* resulted from the Chinese short version of this questionnaire, and significant associations of effort-reward imbalance with poor physical and mental health were reported in this large community survey in the city of Kunming (Li et al. 2012b). The factorial structure was again confirmed in the short version of the questionnaire applied in a different cohort of German workers (Li et al. 2012a).

In conclusion, based on this evidence, the short ERI questionnaire can be recommended for application in large-scale studies where economic measures are required. However, the original questionnaire covers the model's components in a more comprehensive way and is therefore considered the first choice, in combination with the one-step rating procedure (Siegrist et al. 2014). This conclusion is substantiated by further test-statistical information demonstrating the replication of its factorial structure in different countries (see Table 2.2) and the factorial invariance and stability over time (de Jonge et al. 2008; Rantanen et al. 2012; Törnroos et al. 2014). This latter finding is of course essential for obtaining unbiased estimates of change in indicators of work-related stress (e.g. in intervention studies). Thus, it can be assumed that changes in the parameters of the ERI scales reflect true changes in work characteristics (Törnroos et al. 2014).

2.2.3 Test of the Model's Hypotheses

As described in the previous chapter, the main aim of the ERI model consists in producing new knowledge on associations of stressful working conditions with workers' health outcomes. Considering the model's components three hypotheses were stated. They are visualized in a causal path model in Fig. 2.2 (Siegrist 2002):

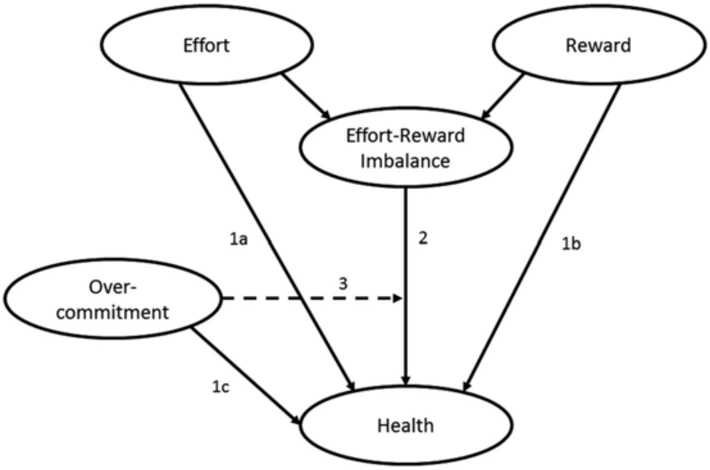

Fig. 2.2 Path diagram representing the causal structure implied by the effort reward imbalance model

1. Each component ('effort', 'reward', 'over-commitment') exerts separate effects on the health outcome under study (paths 1a, 1b, 1c in Fig. 2.2).
2. The size of effect on health produced by a combined measure of high effort and low reward exceeds the size of effect on health produced by each single scale (e.g. as demonstrated by the individually assessed 'effort/reward ratio') (path 2 in Fig. 2.2).
3. The personal coping pattern 'over-commitment' moderates the effect size of effort-reward imbalance on health (interaction term) (path 3 in Fig. 2.2).

It should be stated that two different approaches were proposed towards testing these hypotheses. In the approach established most pervasively in psychology and sociology, estimating the causal structure of latent (or observed) variables, as depicted in Fig. 2.2, requires the identification of main and interaction effects of effort, reward, and over-commitment. Thus, testing a multiplicative term of the scales has been proposed as a way of analyzing the model's hypotheses (van Vegchel et al. 2005).

In epidemiological research the size of effect on health produced by a predictor is estimated in terms of relative risk, hazard ratio, or odds ratio using multivariate regression analysis. In this regard, it is of interest to compare the effect size of the model's single components with the effect size of a *combined measure of effort and reward*, based on an algorithm that *quantifies their imbalance at individual level*. This algorithm is of theoretical interest as well. According to the theory of affective information processing (Ledoux 1989) a potentially unfavorable trade-off between the costs and gains experienced in everyday working life is rarely subject to conscious computational processing. Rather, negative emotions aroused by the recurrent experience of non-reciprocal exchange at work may bypass conscious awareness, as is the case for a substantial part of affective processing in general (Siegrist et al. 2004). An investigator-based algorithm quantifying this mismatch may capture part of respective strain reactions that would be missed if measurement of imbalance were based on the working person's explicit trade-off of cost and gain at work (Siegrist et al. 2004). In fact, a substantial number of epidemiological studies provide empirical support of this theoretical assumption (see several chapters in this book).

2.3 Critical Aspects Concerning the Psychometric Properties of the ERI Scales

Despite extensive psychometric analyses performed with the ERI scales in international research and despite a robust body of empirical evidence that the model's components contribute to the prediction of different stress-related disorders, measures of functioning, and well-being, there remain some critical methodological aspects that need to be discussed. In this section, three such critical aspects are given special attention. First, as mentioned above, the shift from a two-stage response pattern of the items defining the scales to a one-step rating procedure has a serious impact on the distribution of answers and, subsequently, on comparing the results between the two procedures. Second, problems of defining a cut-point or critical threshold in the distribution of sum scores of the scales are discussed. Finally, some challenges of trans-cultural application of the scales are addressed.

2.3.1 Comparability of Different Rating Procedures

Even though the changes mentioned above can be regarded as improvements, they may at the same time compromise the comparability of results across studies insofar as they affect fundamental statistical parameters such as means, variances and covariances. In other words, a direct comparison of distribution parameters and effect sizes across studies requires taking into account the type of rating procedure applied in the studies. In Table 2.1 the two rating procedures are displayed. It should be noted that some studies applying the 1-step rating procedure offer a 5-point Likert scale instead of a 4-point scale (Hintsanen et al. 2007; Kivimäki et al. 2007; Li et al. 2012a; Yokoyama et al. 2014).

Nonetheless, as pointed out by Kurioka et al. (2013), changing the rating procedure may shift the distribution of the effort, reward and *effort-reward ratio* (ER ratio) scores. As a result, applying the two-step or the one-step procedure is likely to have two major side effects: The first one concerns statistical properties of the scales. From a mathematical point of view, the main reason accounting for the

Table 2.1 Common rating procedure formats of the ERI questionnaire

	2-step rating procedure with five categories (original procedure). Respondents are asked whether the item describes a situation encountered at work (does not apply/apply). If the item applies, respondents are then asked to rate on a 4-point Likert scale the extent to which the work situation is experienced as distressful		**1-step rating procedure with four categories (revised procedure).** Respondents are asked to rate on a 4-point Likert scale the extent to which they agree or disagree with the item content	
Construct assessed	Presence or absence of stressful work environment component reflected in item content, and subjective experience of emotional distress		Subjectively perceived stressfulness of item content	
Categories	**Item response formats**	**Score**	**Item response format**	**Score**
Category 1	Disagree/agree	1	Strongly disagree	1
Category 2	Agree, but I am not at all distressed	2	Disagree	2
Category 3	Agree, and I am somewhat distressed	3	Agree	3
Category 4	Agree, and I am distressed	4	Strongly agree	4
Category 5	Agree, and I am very distressed	5		

distribution shifts in all ERI scales is the fact that the frequencies of categories 1 and 2 for all items in the two-step procedure are higher in comparison to the other categories. In contrast, the frequencies of categories 2 and 3 in the one-step procedure are much higher than those of categories 1 and 4. As a consequence, the ratio of effort and reward scores tends to be much lower in the two-step than in the one-step procedure. The second effect relates to the object of measurement. From a psychometric point of view, changing the rating procedure from a two-step to a one-step format implies focusing exclusively on the working persons' perception of the degree of fit between a potentially stressful aspect of the work environment, as illustrated by the item content, and their respective personal experience (see above Sect. 2.2.1).

In order to illustrate how the *different rating procedures* may affect the distribution of ERI scales, we simulated a dummy dataset containing 1000 observations by randomly sampling from the items range (i.e. 1–5 and 1–4, respectively), and evaluated the impact of the rating procedures on the distribution of scales, based on the original version of the scales. We took into account the unequal selection probability of categories in each procedure described by Kurioka et al. (2013), i.e. a larger probability of choosing categories 1 and 2 in the two-step procedure, and a larger probability of choosing categories 2 and 3 in the one-step procedure (see Table 2.1 for details). We simulated the responses to 16 items on a 5-point Likert scale. As depicted in Fig. 2.3, the distribution of the ERI scores in the two-step procedure

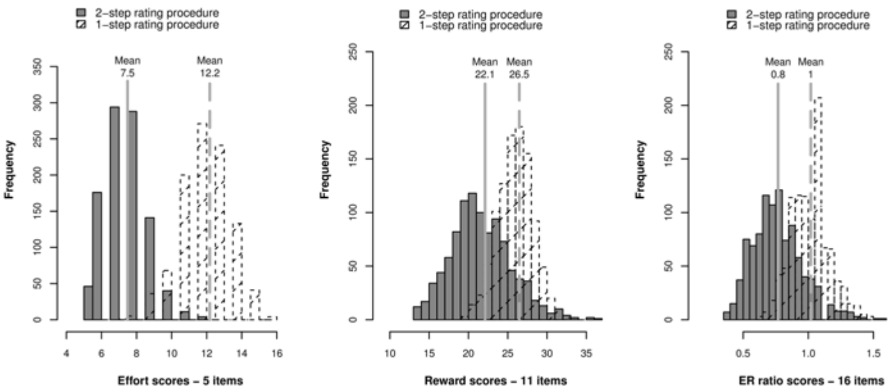

Fig. 2.3 Comparison of the distribution of the ERI scales according to the one- and two-step rating procedures with a simulated dataset containing 1000 observations. Sampling probabilities of categories 1 and 2 for the 2-step procedure, and of categories 2 and 3 for the 1-step procedure are higher (0.9 and 0.7; 0.7 and 0.6, respectively). The *vertical lines* on each histogram indicate the sample mean of the distribution under the two-step procedure (*continuous line*) and the one-step procedure (*dotted line*)

is consistently shifted left to the distribution of scores in the one-step procedure. Notice that this phenomenon was reported by Kurioka et al. (2013) with survey data.

From a statistical perspective, however, the shifting of scales suggests that the one-step procedure may be interpreted as a linear transformation of the scales obtained from the two-step procedure. Since linear transformations of the form $X = aX + b$ do not affect the correlation between two random variables, say between variables X and Y, the inferences obtained from the ERI scales by means of the one- or two-step rating procedure should be to some extent comparable for both long and short versions in spite of the distribution shifts observed in empirical research.

2.3.2 *Critical Thresholds of Scales?*

The ERI scales were conceptualized as a method of assessing stressful work in employed populations and of estimating associated health risks. Therefore, the higher the *sum score of the scales*, including the ratio, within a distinct population group, the higher the probability of occurrence of a stress-related health outcome. The scales were not constructed as a diagnostic tool to assess individual risk. Thus, clinically validated cut-points in terms of classical psychological test theory are not provided. It is nevertheless of interest to explore whether the hypothesis of a *linear relationship* always holds true or whether effect sizes on health vary according to a *distinct threshold*. For instance, sensitivity and specificity of cut-points have been estimated comparing the scores of patient groups and healthy control groups (Lehr et al. 2010). In fact, in earlier publications the authors of the ERI questionnaire proposed to use a cut-point of the effort-reward (ER) ratio, where scores beyond 1.0 are thought to represent a critical condition of high cost/low gain whereas scores below this threshold are assumed to indicate absence of risk (Siegrist et al. 2004). Although this idea is intriguing it turns out to be problematic in terms of measurement theory. This argument is discussed in more depth in the following paragraph. Here, it is important to stress that it is generally recommended to *analyze continuous data of the scales* which then might be re-classified, e.g. as quartiles, for inclusion in logistic regression analysis.

The *assumption of linearity* deserves a further theoretical comment. Distinct from this model, equity theory predicts a curvilinear relationship between equity and strain where high reward in combination with low effort raises negative emotions as well (Adams 1965). However, in keeping with the propositions of prospect theory (Kahneman and Tversky 1979) and of the conservation of resources theory (Hobfoll 1989), the ERI model posits that threat to, or experience of loss following high effort spent matters most for health, due to the intensity of reactions following the violation of one of the most profound principles of interpersonal exchange (Gouldner 1960). Recent evidence from neuroscience research supports this argument (Hernandez Lallement et al. 2013; Tricomi et al. 2010). Future analyses might nevertheless explore a J-shaped relationship between effort-reward imbalance and health, where obviously exaggerated, unjustified rewards in combination with low effort are expected to stimulate unpleasant feelings of social disapproval.

Turning to the issue of *defining a threshold*, specifically based on scores obtained from the ER ratio, *several risks* have to be taken into account. First, assuming that the two units of the effort and reward scales are strictly comparable, an algorithm dividing ‘effort’ by ‘reward’ by adjusting for unequal item numbers results in a different prevalence of persons at risk, depending on whether the two-step or the one-step answer format has been applied (see Fig. 2.3 above). The simulated scores suggest a high number of ‘false positive’ classifications in the one-step procedure. In other words, additional ROC curve analysis needs to be performed in order to adjust the cut-off point accordingly. This has been done e.g. by Kurioka et al. (2013), whereas in the Msaouel et al. (2012) study this was not accomplished, with the consequence of reporting an excessively high prevalence of Greek health care workers exposed to stressful work (80.7 %).

Second, a problem of underestimation of ER ratio with health outcomes may arise in case of a high prevalence of the exposure. For instance, in a study of hotel room cleaners, Krause et al. (2010) reported a mean ER ratio of 1.3 (SD 0.9), but conducted analyses based on a cut-point 1.0. This procedure resulted in weak effect sizes in terms of odds ratios, compared to additional analyses based on quartiles of the ER ratio where odds ratios were substantially higher (see Yokoyama et al. (2014) for a similar underestimation). On the other hand, in cases where the sample distribution of the ER ratio is positively skewed (i.e. lower values are much more frequent), the test specificity largely increases if the ER ratio is dichotomized at 1.0. As a consequence, not only the strength of the association between the effort-reward imbalance scale and health will be overestimated, but also the corresponding standard errors of estimates (see Lehr et al. (2010) for a detailed cut-point analysis).

A third criticism relates to the substantial loss of information by reducing the data set to a dichotomized variable. Therefore, as mentioned above, analyses based on thresholds should be performed very carefully, considering the specific distribution of scales and eventually performing additional ROC analysis. In all cases, continuous data analysis should be the first strategy (Niedhammer et al. 2004; Royston et al. 2006), and evidence so far suggests that scores in the upper quartile of the distribution often indicate susceptibility to elevated health risks.

2.3.3 Trans-cultural Application of Scales

To translate and apply a survey instrument in a different language and socio-cultural context is considered a highly challenging task. First, the *translation process* itself has to meet defined quality criteria including forward- and backward translation by two independent native speakers with bi-lingual competence, ascertaining the provision of language-specific equivalence of meaning (Harkness et al. 2010). Today, different tools of language management utility are available, but the fine-tuning of translation usually requires elaborated personal experience with respective language. Once this translation process has been achieved, discrepancies in meaning and uncertainties are discussed among experts. In case of the ERI questionnaire they often involved consultations with the author of the instrument. As a next step, the translated questionnaire needs pre-testing and related data analysis, resulting eventually in further revision before being ready for routine assessment. With the development of the *Differential Item Functioning* (DIF) approach (Holland and Wainer 1993) it has become possible to estimate in cross-cultural comparative investigations to what extent insufficient item functioning is attributable to difficulties in translation – as an example Choi et al. (2009).

A related second, much more challenging problem of applying standardized questionnaires across countries concerns the *cultural variation of* the *meaning* of specific terms, verbal expressions or whole sentences, and the divergences of underlying attitudes and social norms. This fundamental problem has been discussed in major publications (Burke 2010; Hofstede 2001; House et al. 2004), and cannot be analyzed in detail here. Yet, several examples of problems in ascertaining an equitable meaning of translated items of the ERI scales may illustrate the case.

In a recently developed Arabic version of the ERI questionnaire, the item content of “job security” reflects two meanings, “employment security” and “employees’ physical protection at work”. While the latter notion is not at all intended in the original version, it is more widely rooted in the experiences of Arabic people and their culture (Almadi et al. 2013). A second example refers to items of the ‘effort’ scale. When testing item functioning between a Japanese and a Dutch sample, the item “I am often pressured to work overtime” strongly deviated from the expected convergence (Tsutsumi et al. 2009). This observation may point to the specific cultural background of excessive work obligations in Japan, as reflected by the Karoshi phenomenon, among others (Yang et al. 2015). Regarding the results of factorial analysis in several investigations conducted in Asian countries, the item “I get easily overwhelmed by time pressures at work” displayed loadings of similar strength on the factor ‘over-commitment’ and on the factor ‘effort’ (Almadi et al. 2013; Eum et al. 2007; Li et al. 2005). Thus, a clear distinction between extrinsic and intrinsic aspects of demanding situations seems to be prevented by respective cultural backgrounds.

These challenges have to be taken into account, in particular in a measurement approach that is expected to contribute to the explanation of work-related health risks in a globalized economy, as is the case with ERI. As indicated in several chapters of this book (specifically part III) it is nevertheless rather remarkable to see the degree of consistency of associations of stressful work in terms of ERI, as measured in different languages, and poor health across different countries not only within a single continent (e.g. Europe), but also between different continents (e.g. Siegrist et al. (2012)).

So far, to our knowledge, the *ERI questionnaire* has been *translated and psychometrically validated in 14 different languages*. The main psychometric properties are given in Table 2.2. In general, the internal consistency of the scales is satisfactory, and the factorial structure of the scales has been replicated in the majority of samples by confirmatory factor analysis. Moreover, criterion validity has been explored in several studies, confirming the utility of the scales in explaining health risks.

Additional translations of the ERI questionnaire were performed in several languages, but respective publications did not provide detailed data on psychometric validation, particularly on confirmatory factor analysis. These language versions are Arabic (Almadi et al. 2013), Czech, Hungarian, Lithuanian, Polish (Pikhart et al. 2001), Greek (Msaouel et al. 2012), Italian (Zurlo et al. 2010), Japanese (Tsutsumi et al. 2001), Mongolian (Bagaajav et al. 2011), Russian (Pikhart et al. 2004), Sinhala (Gamage and Seneviratne 2015), Slovakian (Hasselhorn et al. 2004), and Spanish (Macias Robles et al. 2003).

Notably, as the first version out of Europe, the Japanese version of the ERI questionnaire deserves special attention. In addition to the satisfactory psychometric properties (Tsutsumi et al. 2001), the Japanese version also demonstrated valid responsiveness to organizational change over time (Tsutsumi et al. 2002). Methodologically, the Japanese team was the first to test the two different rating procedures in the standard version (Fekete et al. 2014; Juvani et al. 2014; Li et al. 2012a, b; Tsutsumi et al. 2008) and the short version (Kurioka et al. (2013) (for more details see Sect. 2.3.1; see also Chap. 8). Moreover, the cross-cultural comparability of the ERI questionnaire was critically evaluated by means of differential item functioning (DIF) analyses (Tsutsumi et al. 2009).

In conclusion, despite far-reaching challenges of conducting trans-cultural comparative research the findings based on the ERI questionnaire provide convincing evidence that these comparisons offer reliable and valid information. Still, further testing and critical appraisal of available evidence will be required.

Table 2.2 Overview of psychometric properties of the ERI questionnaire in different language versions (in alphabetic order)

Language version	Population	Cronbach's α coefficients	Confirmatory factor analyses	Discriminant validity
Chinese (Li et al. 2005)	Healthcare workers, 192 men, 608 women	Effort: 0.78	Goodness-of-fit index > =0.90	Gender, age, education
		Reward: 0.81		
		Over-commitment: 0.74		
Danish (Weyers et al. 2006)	367 female nurses and nurses' aides	Effort: 0.71	Goodness-of-fit index > =0.90[a]	–
		Reward: 0.78		
		Over-commitment: 0.76		
Dutch (Hanson et al. 2000)	775 employees from four companies, 82 % men, 18 % women	Effort: 0.71	Goodness-of-fit index > =0.90[a]	–
		Reward: 0.70–0.77		
		Over-commitment: 0.82		
English-British (Siegrist et al. 2004)	Whitehall II Study (civil servants)	Effort: 0.73 men, 0.76 women	Goodness-of-fit index > =0.90[a]	Gender, age, education
	2783 men, 914 women	Reward: 0.83 men, 0.84 women		
		Over-commitment: 0.81 men, 0.82 women		
Farsi (Yadegarfar et al. 2013)	227 male employees of Iran Polyacryl Corporation	Effort: 0.70	Goodness-of-fit index > =0.90[a]	–
		Reward: 0.88		
		Over-commitment: 0.72		
Finnish (Kinnunen et al. 2007)	1301 managers, 70 % men, 30 % women	Effort: 0.83	Comparative fit index > =0.90[a]	Gender, age, marital status, managerial levels
		Reward: 0.87		
		Over-commitment: 0.76		
French (Siegrist et al. 2004)	GAZEL (French National Electric and Gas Company)	Effort: 0.75 men, 0.75 women	Goodness-of-fit index > =0.90[a]	Gender, age, education
	7251 men, 2923 women	Reward: 0.86 men, 0.88 women		
		Over-commitment: 0.79 men, 0.79 women		

(continued)

Table 2.2 (continued)

Language version	Population	Cronbach's α coefficients	Confirmatory factor analyses	Discriminant validity
French-Belgian (Siegrist et al. 2004)	Somstress study (4 companies across Belgium)	Effort: 0.64 men, 0.72 women	Goodness-of-fit index > =0.90[a]	Gender, age, education
	2055 men, 1,739 women	Reward: 0.78 men, 0.77 women		
		Over-commitment: 0.81 men, 0.80 women		
German (Siegrist et al. 2004)	Public transport employees	Effort: 0.68 men, 0.61 women	Goodness-of-fit index > =0.90[a]	Gender, age, education
	267 men, 48 women	Reward: 0.86 men, 0.87 women		
		Over-commitment: 0.74 men, 0.64 women		
Korean (Eum et al. 2007)	908 male petrochemical workers	Effort: 0.71	Goodness-of-fit index > =0.90	Age, education, employment grade
		Reward: 0.86		
		Over-commitment: 0.75		
Norwegian (Lau 2008)	1803 municipality employees, 368 men, 1433 women	Effort: 0.72	Goodness-of-fit index > =0.90[a]	Gender, age, education, occupational groups
		Reward: 0.78		
		Over-commitment: 0.76		
Portuguese-Brazilian (Griep et al. 2009)	1509 nursing personnel, 86.5 % women	Effort: 0.73	Goodness-of-fit index > =0.90[a]	–
		Reward: 0.76		
		Over-commitment: 0.75		
Spanish in six Latin-American countries (Argentina, Chile, Colombia, Mexico, Peru, and Venezuela) (Juarez-Garcia et al. 2015)	1292 health professionals, 283 men, 1009 women	Effort: 0.80	Goodness-of-fit index > =0.90[a]	Age, marital status, education
		Reward: 0.86		
		Over-commitment: 0.73		

(continued)

Table 2.2 (continued)

Language version	Population	Cronbach's α coefficients	Confirmatory factor analyses	Discriminant validity
Swedish (Siegrist et al. 2004)	WOLF (several companies representing different sectors in the Northern region of Sweden, Norrland)	Effort: 0.71 men, 0.78 women	Goodness-of-fit index > =0.90[a]	Gender, age, education
	738 men, 222 women	Reward: 0.79 men, 0.70 women		
		Over-commitment: 0.80 men, 0.80 women		
Thai (Buapetch et al. 2008)	828 garment factory workers, 137 men, 691 women	Effort: 0.77	Goodness-of-fit index > =0.90	–
		Reward: 0.81		
		Over-commitment: 0.66		

[a]Indicates the second-order factor analysis on reward scale

2.4 Some Suggestions for Future Developments

Up to now, the ERI questionnaire has been applied in its original or shortened version in a large number of epidemiological investigations and in many experimental or naturalistic studies in several parts of the world. *Uniform application of a measurement* approach must be considered a relevant *scientific goal*. In earlier years several important publications testing the ERI model were based on proxy measures, compromising the comparability of findings. It is therefore crucial to *apply psychometrically validated*, *standardized ERI measures* in future research. Despite this call for increased comparability there must also be room for further improvements and innovations of a method that was originally developed more than two decades ago. In this section, some respective suggestions are given.

One suggestion concerns the *specification of the measurement model*. Two major models have been largely debated in the psychometric literature: the reflexive and the formative measurement models. Whereas reflexive models assume that the latent variable causes the observed changes in the items or indicators (classical test theory), formative models postulate, in contrast, that indicators cause changes on the latent variable scale (Bollen and Lennox 1991; Diamantopoulos et al. 2008). Furthermore, indicators in formative models are not required to correlate, and may be rather interpreted in the framework of conventional multiple regression models as independent variables determining the values of the latent variable. Hence, the usual practice of summing up the item scores for calculating an unweighted overall score may be inadequate in formative scales, since some items may have a much larger influence in the overall levels of the latent variable (Fayers et al. 1997).

Following classical test theory, the latent variables of the ERI questionnaire were originally developed within the framework of reflexive models (Hanson et al. 2000; Peter and Siegrist 1997; Siegrist 1996b). This approach has recently been challenged by Pitts (2014) who pointed out that the latent variables 'effort' and 'reward' do not necessarily imply changes in the corresponding items, and should therefore be analyzed by means of a formative measurement model in order to avoid potential misspecification of the measurement model. However, the assumption of a formative model seems to suffer from important epistemological and methodological problems including the difficulties of assessing construct validity and model identification, measurement error, and unchallenged causality assumptions (Edwards 2011). Thus, given the fact that the ERI scales have shown acceptable levels of reliability, criterion and discriminant validity, satisfactory predictive power in occupational health and social epidemiology research, and factorial group and time invariance (de Jonge et al. 2008; Rantanen et al. 2012; Törnroos et al. 2014), it seems likely that their summary statistics based on the reflexive measurement model provide robust scientific information, especially so if the critical aspects discussed above are taken into account.

Critical aspects may be extended to include the specification of a particular psychometric model, e.g. item-response theory, latent class variables, formative or reflexive models (Borsboom 2006; Borsboom et al. 2004; Hayduk and Littvay 2012). Moreover, in line with modern psychometric test theory, criterion-based item scoring can be applied to compute scale scores that are independent of empirical score distributions and, thus, well comparable across studies. One such approach was successfully applied to the ERI questionnaire (Hadzibajramovic et al. 2015).

Even most sophisticated methodological approaches cannot resolve the problem that *self-reported data* reflect *perceptions of reality* rather than an 'objective' reality. Yet, for several reasons this problem should not be overstated (Kompier 2005). First, major traditions in social and behavioral sciences, including human stress research, argue that *subject's definitions* of what is real *matter most* because these definitions "are real in their consequences" (Thomas and Thomas (1928), 571f.). Second, a substantial body of evidence indicates that much of what is reported as experienced reality through interviews or questionnaires is in line with observable or otherwise independently confirmed facts. This is ascertained by *triangulation*, e.g. by comparing reported information with biographical data, administrative records, validation by significant others etc. (Siegrist et al. 1988). Another way of tackling the problem of potential distortion inherent in subjective reports is the *aggregation of individual data* at the level of homogenous groups and to compare results obtained from aggregate measures as predictors with the results obtained from individual measures as predictors. For instance, in an important study on the prediction of disability pension due to depression by effort-reward imbalance at work, mean scores of ERI data were computed for work units. "Thus, all employees in the same work unit were given the same work unit-level score, regardless of their …own survey responses" (Juvani et al. (2014), 268). The results of this study demonstrated that "high ERI was associated with an increased risk of disability pension due to depression. This association was observed using both work unit- and individual-level measurement of ERI" (Juvani et al. (2014), 270).

Third, as mentioned earlier in this chapter, there is always a need to *examine systematic bias* inherent in subjectively reported data where possible. For instance, several investigations documenting associations of work stress in terms of the ERI model with health included measures of personality traits, e.g. temperament (Tei-Tominaga et al. 2009) and morningness-eveningness (Willis et al. 2008), or of personal response styles, e.g. negative affectivity (Bosma et al. 1998; Ostry et al. 2003; von dem Knesebeck et al. 2009), and adjusted the final estimates for these confounding influences. In future research these arguments concerning the nature of subjective information deserve continuous careful attention.

Innovative developments of the content of the model's indicators and of the format of presenting items or questions are *desirable* as well. For instance, the 'effort' component is narrowly defined and does not adequately capture more recent developments of job demands, e.g. in the human service and IT sectors (Van Vegchel et al. 2001). Including *respondents*' *preferences* concerning inequity or loss aversion and fairness might add a further element to the interpretation of consequences of failed social reciprocity (Fehr and Gintis 2007). With respect to the intrinsic component of the model the focus on over-commitment represents effort- related coping rather than reward-related coping, suggesting that the inclusion of a measure of *reward sensitivity* could improve our understanding of the dynamics of imbalance (Allisey et al. 2012). Of course, there must be a trade-off between the benefits of extending the measurement and the costs of changing established procedures. Methodological innovations are proposed as well. For instance, *vignette questions* representing failed reciprocity in work-related exchange could contribute to a better estimate of the respondents' standards of comparison (Kristensen and Johansson 2008). One could even think of including a short version of an *economic game* into a computer based interview (Dohmen et al. 2011).

In *conclusion*, research on work stress and health based on the ERI questionnaire has produced a substantial amount of new knowledge with relevance to science and policy. At the same time, some methodological problems have been identified, and solutions for further improvement in conjunction with distinct innovations are expected to strengthen this line of inquiry in the near future.

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Chapter 3
A Life Course Perspective on Work Stress and Health

Morten Wahrendorf and Tarani Chandola

3.1 Introduction

Occupational health research has established strong evidence on the impact of work stress on health, mostly based on the development of theoretical models of work stress and their empirical tests in the frame of occupational cohort studies (Siegrist and Marmot 2006). Yet, despite this important progress, most studies are based on working populations and investigate the risk of developing a disease in relation to the exposure to work stress at baseline. This leaves at least two gaps of knowledge: First, because most studies are limited to working populations that have yet to reach older ages, little is known on the long-term consequences of work stress on health beyond working life, as well as about the origins of work stress at earlier stages of the life course. A second – and often overlooked – shortcoming relates to the measurement of work-related stress which is usually restricted to one single time-point only (e.g.: Kivimaki et al. 2012; Siegrist et al. 2012; Reinhardt et al. 2013). This, for example, does neither include information on duration of exposure nor on the cumulative and repeated experience of disadvantages at several occasions. Research, thus, needs to extend the analytical time frame when studying work stress and health. This extension concerns both the analyses of work stress and health across different life stages and a refined and more comprehensive measurement of work stress within larger trajectories.

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Addressing and extending current research along these two shortcomings is concordant with a ‘life course perspective’, being the predominant framework of sociological and epidemiological research. But what are precisely principal components of the ‘life course perspective’? And how can they help to extend current research on work stress and health? These questions are at the core of the present chapter, in which we first summarise some principal aspects of life course research for a closer examination on what they offer for the study of work stress and health. Thereafter, in the second part of the chapter, we summarize respective research in the field.

3.2 Life Course Principles and How They Help to Think About Work Stress and Health

The life course approach has become increasingly popular within epidemiology. It is predominately used to refer to all kinds of studies investigating long-term effects of exposures during the life course on later health or disease risks (Kuh et al. 2003). At this point, though, it is often overlooked that “Life course epidemiology implies more than a longitudinal study” (Kuh et al. 2003). Rather, the life course approach introduces a conceptual framework for research, or *life course principles* (Elder et al. 2003) to orient research. These principles do not only encourage researcher to think on the temporal order of their data and to extend the time frame between exposure and outcome. Importantly, they also help to make sense to individual lives by proposing a set of principles or rules on to how life courses are shaped and structured. This has important consequences, whether in terms of formulation of models on how exposures across the life course can affect health later on (Kuh and Ben-Shlomo 1997), the choice of variables and strategies of exposure assessment (George 2014; Aisenbrey and Fasang 2010), or the interpretation of empirical findings against the background of historical and personal contexts (Elder et al. 1998; George 2003). The life course perspective thus adds to a longitudinal perspective, pointing to particular principles on how the lifecourse is shaped, and thereby, helps to elucidate the development of health and disease.

Among the existing life course principles (Elder et al. 2003; Pearlin 2010; George 2013; Heinz et al. 2009), the most common and perhaps the most obvious characteristic is the fact that life course research takes a long-term view on temporal trajectories, where the past is linked to the present (Abbott 2001). This puts a special focus on time, as one of the most fundamental structures of life courses, and also the central dimension by which trajectories can be compared and characterized (George 2014). Because it is such an essential characteristic of the life course, the way how time characterizes trajectories is fundamental to the different conceptual models to understand life course influences on health and disease (Kuh and Ben-Shlomo 1997). Time, in this context, is clearly more than just the temporal ordering within the data as to establish causal relationships (Hill 1965). It is also a core dimension of trajectories to describe, for example, how long someone is exposed to stress at work, or when he or she experiences work stress across the life course. Therefore, by distinguishing three ways on how time can be conceptualized, we illustrate possible extensions of research on work stress and health. Each of these focuses on a particular mechanism linking work stress and health later on, and is related to existing conceptual models in life course epidemiology to analyse life course influences on health and disease.

3.2.1 Time: Duration and Risk Accumulation

The notion of duration and accumulation is a core aspect of life course research, and one fundamental way how trajectories (including the exposure to numerous risk factors) can be characterized. Hereby, the question is not only if, but also how long or how often a person is exposed to disadvantages, such as stress at work. For example, a person may have spent several years in a disadvantaged job with stress at several occasions, and as a result he or she may be more likely to develop poor health as compared to a person who only worked for a short while in the same job, or only experienced stress occasionally. Measuring stress at several occasions may also help to avoid potential misclassifications, and enable to identify chronically exposed workers with higher reliability. Given that every person may be exposed to stress at some point in his or her lifecourse, repeated measures of work stress may indeed help to distinguish between chronically exposed workers and those who are almost never or only occasionally exposed to stress at work. In this context, the notion of accumulation and duration draws the attention on the intensity and chronicity of the exposure. In general, a dose-response relationship is assumed, where *more* exposure to work stress also means *more* disease or poorer health. Yet, as already mentioned above, the majority of studies restrict the measurement of work stress to one time-point without information on duration of exposure or cumulative experience of work stress at repeated occasions. This is surprising, because the potential importance of duration and accumulation seems obvious.

Conceptually, there are two additional aspects to consider when thinking about accumulation of work stress. First, it is likely that stress at work – and its effect on health – is also correlated with other social factors and stress in other areas. This, for example, could mean that a person with stressful working environment is at the same time more likely to have stress at home, to have a low income, as well as unhealthy behaviours. In this case stress should be measured in terms of total number of stressors or disadvantages at one time point, but in different life areas (Turner et al. 1995). Another important way of thinking of stress accumulation highlights that exposures to work stress often cluster longitudinally with other risk exposures, where work stress is part of larger trajectories of disadvantages. This latter aspect is an important idea, because it broadens the perspective to larger trajectories of aggregated disadvantages, with work stress being one part of it. At the same time, this asks whether the origins of work stress can be traced back to other factors, in particular circumstances at earlier stages of the life course. For example, disadvantages in early life may result in lower educational attainment, which in turn can be followed by disadvantaged occupational positions and the exposure to stressful working conditions during working life. Therefore, early life may be seen as the starting point in a trajectory, setting a person on a pathway where he or she accumulates further advantages or disadvantages over the life course. Life course epidemiologists usually refer to the "accumulation of risk" or the "pathway" model at this point (Dannefer 2003; Ferraro and Shippee 2009), where disadvantages in early life do not only increase the risk of poor health, but also of additional disadvantages in the life course. From a sociological perspective, this has been labelled as "Matthew effect" (Merton 1968), referring to the tendency of widening inequalities where the rich get richer while the poor get poorer over time (see also: Siegrist 2015). One should keep in mind that this perspective opens a large window to the study of life course influences of work stress on later health, in particular the study of direct and indirect effects of early life circumstances via work stress on health in older ages. For example, one may ask to what extent links between childhood circumstances and health in older ages are due to labour market disadvantage and stressful conditions during working life. Yet, because data covering early childhood and stages of people's occupational careers are scarce, few studies have addressed this question and – with the exception of the studies mentioned in the second part of this chapter – knowledge on the origins of work stress in early ages is still limited.

Taken together, the notion of duration and risk accumulation in life course research suggests that a focus on single-point measures does not capture adequately the full range of stress exposures affecting health later on, and additionally, that work stress does not occur independently within the life course, but is often interrelated to additional disadvantages, in particular at earlier stages of the life course.

3.2.2 Time: Timing of Exposure and Critical Periods

Another important notion of life course research refers to timing, that is, the question at which age an exposure takes place. With regard to health-related consequences of work stress, for example, we may ask whether job insecurity or low job promotion prospects has the same meaning and the same impact on health for a person aged 60 years versus someone aged 35 years (Chandola et al. 2008). It is possible that the impact is higher for the younger person. This age-specific vulnerability to work stress could be due to a higher importance of the work role and individual responsibilities during midlife as compared to later phases of working life (Willis et al. 2010). Furthermore, older workers who are exposed to work stressors may become resilient to such stresses, or alternatively they could represent a "survivor" cohort with comparatively good working conditions and with stressed workers leaving the labour force at an earlier age. On the other hand, although the prevalence of work stress may decrease as workers reach retirement age, older workers who are stressed by work may have more negative health impacts if they have to remain in paid employment. As such, the notion of timing in life course research points to existing specificities of different life phases and specific profiles of those who are on the labour market, with mitigating or buffering effects on health-related consequences of the same exposure. Hereby the emphasis – in contrast to the notion of duration – is not on risk clustering and possible origins of work stress, but rather on existing specificities of different life stages that affect the effects of work stress on health. Again, although this idea appears rather obvious, most studies are limited to midlife working populations so far. As a consequence, only few studies have addressed this aspect (Shultz et al. 2010; Chandola et al. 2008), and it is generally assumed that work stress affects health equally throughout working life.

In line with this argument, life course epidemiology has developed the concept of "critical periods" (Kuh and Ben-Shlomo 1997). The most prominent example in that respect is the Barker hypothesis (Barker 1990) claiming that life expectancy and disease development are irreversibly programmed through disadvantages in foetal stages of the life courses (e.g. because of malnutrition during pregnancy). An important aspect of the critical period model is that the exposure to disadvantage has long-lasting effects that are assumed to be independent of subsequent circumstances, that is, that are irreversible if they occurred during the critical period. In this context, some scholars have also formulated an alternative, less deterministic variant of the model, the "sensitive period model", where an exposure would have its strongest but not its only effect during the sensitive period – a scenario that may be more likely in case of work stress and health. It is also worth to note that most research on critical periods is based on studies using prenatal, infant or adolescence stages of the life courses as "critical" time window of interest (Viner et al. 2015), but few studies have applied these ideas to the experience of work stress at different stages of working life – again a possible extension for future research.

While the "critical period model" in life course epidemiology usually defines critical periods in term of biographical age and specific time windows within individual life course, it is, though, also possible that critical periods are defined in accordance to historical periods (Elder 1998). For example, it may be that someone who has a precarious job during a time of recession may exhibit stronger health-related consequences compared to someone exposed to similar working conditions during non-recessionary periods (Riumallo-Herl et al. 2014). It seems thus possible to define critical periods both according to biographical and historical timings. But in the latter case, existing studies are also scarce and it is generally assumed that the effect is universal and independent on historical contexts (see Chap. 16 for the role of socio-political background and its effect on work stress and its health-related effects).

In sum, the notion of timing suggests that health-related consequences of work stress vary according to life-stages and according to historical periods (chronological age vs. historical date).

3.2.3 Time: Order and the Sequential Character of Trajectories

The two previous aspects either draw attention to exposures' duration or to its timing within larger trajectories. A third important way to describe trajectories is to reflect on the embeddedness of an exposure within larger trajectories, and to describe entire employment sequences. This draws the attention to the fact that exposures should not be isolated from larger histories (Sackmann and Wingens 2003; Aisenbrey and Fasang 2010), but also to consider their order in entire trajectories. For example, trajectories of work stress can have specific patterns, with declining or increasing levels of work stress across time. Probably, health-related consequences would be weaker if trajectories have declining levels of stress across working life. Similarly, in case someone finds a job after an episode of unemployment, the health-related consequences may be different compared to someone who remains unemployed for a longer period (Bartley 1994). Hence, the notions of order and sequencing points to the importance to adopt a more holistic perspective that describes entire trajectories and sequences, and thereby, does not lose sight of complete histories.

Studies linking entire sequences and health are still scarce in occupational health research. Furthermore, with except of the "social mobility model" pointing to the importance of summary measures of occupational trajectories (in particular upward mobility versus downward mobility (Blane et al. 1999; Vanhoutte and Nazroo 2015)), there have been few conceptual ideas on to how describe trajectories as a whole. These ideas can easily be applied to levels of work stress and we may, for example, describe increasing or decreasing levels of work stress throughout an extended time period. Yet, looking at entire trajectories may not only help to describe specific patterns of stress exposure. But we may also identify distinct types of employment histories, which by themselves are stressful (Siegrist and Wahrendorf 2013; Wahrendorf et al. 2013). For example, employment histories marked by repeated precarious employment and continued disadvantaged occupational positions may provoke – as a whole – negative emotions and stress reactions due to the continued frustration of social rewards. Similarly, trajectories defined by failed promotion prospects, involuntary job losses and job instability may exert adverse long-term effects on health and well-being. Thus, when investigating entire employment sequences, we may not only look at trajectories of work stress, but also ask if specific types of employment histories prevent the experience of core notions of existing models of work stress, that is, the experience of reward or control. Unlike the risk accumulation model, this does not ask if work stress can be traced back to conditions in early life, but rather if specific employment trajectories promote or prevent the experience of work stress.

In sum, the notion of order and sequencing highlights the importance not to isolate single events from their context, but to investigate the effect of trajectories as a whole, in particular the way how exposures are organized within larger trajectories and if entire types of trajectories provoke the experience of stress at work.

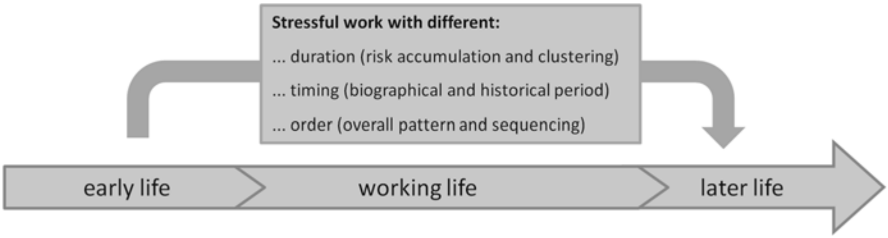

Fig. 3.1 A lifecourse perspective on work stress and later outcomes

Taken together, life course epidemiology has more to offer than a simple analysis of links between exposure to work stress and later health. There are also different ways of how we can describe and specify the experience of work-related stress during working life, especially in terms of its accumulation and clustering with other risk factors across the life course, its timing at different phases of individual biographies, and finally, as a part of or characteristic of larger employment histories. These ideas – as applied to epidemiology – may help to elucidate life course influences of work stress on health and disease. Briefly said, the aforementioned notions underline that the meaning of stress and its long-term consequences for health depends on its clustering with other exposures, on when stress is experienced across the life course, and on the overall pattern. These ideas are summarized in the following framework (Fig. 3.1).

3.3 Evidence

The next section reviews existing evidence of studies addressing the association between work stress and health in a life course perspective. In accordance to the previous section we first focus on evidence considering repeated exposures and duration. Thereafter we describe studies that consider the timing of work stress exposure, and finally, we describe studies investigating entire histories and their effects on health and well-being. The included studies rely on an own literature search in popular databases (e.g. Pubmed and Scopus), as well as on studies – and existing cross-references – that we've collected in our own reference management systems. We thereby rather aim to give some examples and an overall summary on how studies address the life course perspective, and not to summarize complete evidence based on a more systematic literature review. Only longitudinal studies that were published in peer-reviewed journals are included.

3.3.1 Cumulative Work Stress

Tables 3.1 and 3.2 list identified studies using at least two measurement points to study stress exposure at work and its effect upon health. We both consider studies based on the Effort-Reward Imbalance Model and the Demand-Control Model. In terms of health outcomes cardiovascular diseases (Table 3.1) and mental health outcomes (Table 3.2) are distinguished.

CVD-Risks Most studies studying links between repeated exposure to work stress and CVD-risks were published within the last decade and are either from North-America or from Europe. In sum, studies support that cumulative measures of work stress are significantly associated with increased risks of cardiovascular disease. Yet, when contrasting the identified studies of Table 3.1, four aspects are worth noting: First, most of the studies (eight out of ten) focus on blood pressure as an outcome, either measured by casual measures (e.g. during a nurse visit) or by ambulatory blood pressure monitoring (ABP), with generally smaller sample size in latter cases. Second, the evidence appears more consistent for men than for women, with one study also indicating that the effect of work stress is limited to women with high education (Laflamme et al. 1998). Third, there is no difference with respect to the model of work stress used, thus, indicating that repeated exposure to both job strain and effort-reward imbalance is linked to poorer health later on. Fourth, in most studies we not only observe that repeated exposure to work stress (in most studies, on two occasions) is significantly linked to poorer health, but also in case of an increase of work stress. Overall, this clearly supports that studies using repeated measures of work stress allow for a refined exposure assessment of work stress. Notably, while 8 out of 10 of the reviewed studies revealed significant associations in our case (either the Effort-Reward Imbalance Model and the Demand-Control Model), in a systematic review of studies on work stress and coronary heart disease (using single time point measurements of work stress), findings were less consistent, in particular in case of the Demand-Control Model where only 3 out of 11 studies reviewed reported significant associations (Kivimaki et al. 2006). This suggests that measuring work stress across the working life course may be particularly important when examining associations with chronic diseases. An example of such analyses is shown in the Fig. 3.2 below based on British data taken from the Whitehall II study (Chandola et al. 2006). The figure shows an increasing association between the numbers of times a worker is exposed to work stress (across 14 years) and their odds of developing metabolic syndrome.

Mental Health The studies on cumulative work stress and mental health are listed in Table 3.2. In contrast to studies on CVD-risks, the used outcomes appear more diverse and range from psychiatric disorders, anxiety and depressive symptoms, to chronic fatigue, life satisfaction and quality of life. Again, most reviewed studies are from North America or Europe, with one additional study from Australia. Overall, sample sizes are also larger than in case of CVD-risks. Most studies assess work stress in terms of the Demand-Control model (10 out of 14), while three

Table 3.1 Overview of studies linking cumulative work stress and cardiovascular diseases

Author, year	Sample	Age range and observation period	Measure of work stress	Measure of health	Main finding
Schnall et al. (1998)	195 men working at different work sites in New York, US (prospective cohort study with 3 year follow-up)	30–60 at baseline, 3 years	Job strain at two occasion (baseline and follow-up) regrouped into four categories	Ambulatory blood pressure monitoring (ABP) at two occasions (baseline and follow-up)	Men with job strain at both occasions have highest ABP and those without job strain lowest ABP. Decreasing levels of job stress are related to a decrease in ABP.
Laflamme et al. (1998)	210 women working as white collar workers in Québec City, Canada (information collected at two occasions)	"all ages", ~ 2 years	Repeated measure of job strain (median time difference of 14 months) regrouped into four categories	Ambulatory blood pressure monitoring (ABP) at T2	Women with job strain at both occasions have highest ABP at T2, but only in case of high education.
Fauvel et al. (2003)	209 men and women working in a chemical company in France (prospective cohort study with 5 year follow-up)	18–55, 5 years	Job strain at two occasion (baseline and follow-up) regrouped into four categories	Ambulatory blood pressure monitoring (ABP) at T2 and casual BP at baseline	Levels of Blood pressure at T2 were similar for all groups, irrespective of job strain and its dynamics.

(continued)

Table 3.1 (continued)

Author, year	Sample	Age range and observation period	Measure of work stress	Measure of health	Main finding
Markovitz et al. (2004)	3,200 employed men and women from 5 US-cities (prospective cohort study with 8 year follow-up)	18–30 at baseline, 8 years	Job strain (including single dimensions) at two occasion (baseline and follow-up), using baseline scores and changes to T2 in the analyses	Casual measure of BP (hypertension) at baseline and follow-up, and use of antihypertensive medications at follow up	Baseline job strain, as well as an increase in job strain is associated with incidence hypertension, in particular among white women and men (irrespective of age, BMI and education).
Riese et al. (2004)	159 female nurses from Amsterdam, the Netherlands	Average age: 35,9 (SD: 8,5), average interval 12,2 months	Job strain at two occasions (baseline and follow-up) regrouped into four categories	Ambulatory blood pressure monitoring (ABP), Heart rate, and heart rate variability (RMSSD) at follow-up	Job strain was not related to any of the outcomes under study.
Chandola et al. (2005)	3,697 men and women employed in London (Whitehall II) with 16 years follow-up	35–55, 16 years	Effort-Reward Imbalance at two occasions (baseline and 11 year follow-up, including overcommitment) including change between both occasions	Incidence diagnosed angina (self-reported, between 11 and 14 years follow up)	Increase in ERI is associated with an increased risk of incident angina.
Chandola et al. (2006)	10,308 men and women employed in London (Whitehall II) with 14 years follow-up	35–55, 14 years	Cumulative exposure to ISO-strain (four measurement occasions across 14 years)	Metabolic syndrome (based on obesity, triglycerides, cholesterol, blood pressure and fasting glucose)	The risk of metabolic syndrome is gradually higher the more frequent a person experienced work stress across 14 years.

Guimont et al. (2006)	8395 men and women working as white collar in Québec city, Canada (prospective cohort study with 7.5 years follow-up)	18–65, 7,5 years	Job strain at two occasion (baseline and follow-up) regrouped into four categories	casual measure of BP (systolic and diastolic) at baseline and follow-up	Men with job strain at both occasions have significantly higher blood pressure at follow-up than those never exposed. Men with job strain at both occasions and with increasing levels of job stress have an increase in BP.
Gilbert-Ouimet et al. (2012)	1,595 men and women working as white collar in in Québec city, Canada (prospective cohort study with 3 years follow-up)	<60 at baseline, 3,3 years	Effort-Reward Imbalance at two occasion (baseline and follow-up, including overcommitment) regrouped into four categories	Ambulatory blood pressure monitoring (ABP) at two occasions (baseline and follow-up) and Hypertension	Among women repeated exposure to ERI is related to an increase in BP and hypertension incidence.
Trudel et al. (2015)	1,394 men and women (white collar workers in Québec City, Canada)	Average age: Men 43,3, women: 42,3, 5 years	Effort-Reward Imbalance and job strain at three occasion regrouped into five categories (patterns of exposure)	Ambulatory blood pressure monitoring (ABP) at three occasions and Hypertension	Among men chronic exposure to active jobs (high demands but no low control) is related to higher risk of hypertension incidence, and the onset of ERI is related to an increase in systolic BP.

Table 3.2 Overview of studies linking cumulative work stress and mental health

Author, year	Sample	Age range and observation period	Measure of work stress	Measure of mental health	Main finding
Stansfeld et al. (1999)	7978 men and women employed as civil servants in London (Whitehall II) with 5 years follow-up	35–55 at baseline, 7,6 years	Single dimensions of the DCS Model and effort reward imbalance at two occasions	Psychiatric disorders based on the general health questionnaire (GHQ)	Men and women with increasing levels of job demands and with decreasing levels of social support have higher risks of psychiatric disorders, and men with decreasing decision authority.
Bourbonnais et al. (1999)	1741 nurses in Québec, Canada (prospective cohort study with 1.5 year follow up)	No information about age, 1,5 years	Job strain at two occasion (baseline and follow-up) regrouped into four categories	Psychological distress	Job strain at both occasions and increasing levels of job strain are linked to higher levels of distress compared with the remaining groups.
de Lange et al. (2002)	1477 men and women working in different companies in the Netherlands (prospective cohort study, 3 years follow-up)	Average age 35,6 (SD: 8,8), 3 years	Job strain (quadrant measure) at four repeated occasions, regrouped to 11 different job strain histories	Depressive symptoms (CES-D depression scale) at four occasions	Both stable and increasing job strain is related to increasing levels of depressive symptoms.
(Godin et al. 2005)	1986 men and women working in the private or public sector in Belgian (prospective cohort study with 1 year follow-up)	18-?, average age 40,5 (SD: 8,4), 1 year	Effort-Reward Imbalance at two occasions (baseline and follow-up) regrouped into four categories	Five indicators of poor mental health: Depression, Anxiety and Somatisation (derived from SCL90), chronic fatigue and psychotropic drug consumption	Number of stress experience is gradually related with poor mental health for both men and women, with particular importance of onset of work stress for men.

Buddeberg-Fischer et al. (2008)	433 physicians at a Swiss medical school (prospective cohort study with 4 year follow-up)	Average age 31,3 (SD:2,4) at last follow up, 4 years	Effort-Reward Imbalance at two occasions including overcommitment (T2 and T3) regrouped into four categories	Anxiety and depression (HADS-D), physical and mental well-being, and life satisfaction	Both men and women with constant or increasing work stress (ERI) or high overcommitment have worse mental health than the remaining groups.
Ibrahim et al. (2009)	2556 men and women from a representative Canadian cohort study (NPHS, 8 years follow-up)	18–56 at baseline, 8 years	Job insecurity, job strain and social support at work at three occasion over 6 years (included separately)	Depressive symptoms, distress and self-rated health	Adverse working conditions are related to poor health, in particular more recent conditions (stronger impact of 2-years lag versus 6-years lag).
Lohela et al. (2009)	1,212 men and women working at four large companies in Sweden (prospective cohort study with 3.5 years follow-up)	18–64 at baseline, 3,5 years	Job strain at two occasions (baseline and follow-up), regrouped into four categories	Health-related quality of life (EQ-5D)	Continued job strain and onset is related to negative change in health.
(Wang et al. 2009)	4,866 men and women from a representative Canadian cohort study (NPHS, 10 years follow-up)	15–74, 10 years	Job strain at two occasion (baseline and follow-up) regrouped into four categories	Incident major depression	Both stable and increasing job strain is related to higher risks of incidence major depression.

(continued)

Table 3.2 (continued)

Author, year	Sample	Age range and observation period	Measure of work stress	Measure of mental health	Main finding
Strazdins et al. (2011)	1,975 men and women from a representative Australian cohort study (Path, 4 years follow-up)	40–44, 4 years	Changes in job demands and control scales (based on DC-Model), and job insecurity scales between two occasions	Depression and anxiety	Improved working conditions are related to positive changes in mental health, while worsening conditions are associated with negative changes.
Stansfeld et al. (2012)	3,942 men and women employed as civil servants in London (Whitehall II) with 10 years follow-up	35–55 at baseline, 11 years	Job strain and social support at work at three occasion over 10 years, each regrouped into four histories, as well as into a cumulative score	Major depressive disorder	Both stable and increasing job strain is related to increasing levels of depressive symptoms, as well as risk of depression is gradually linked to cumulative job strain and low social support.
Weigl et al. (2012)	415 junior doctors, men and women (prospective cohort study with 2 years follow-up)	Average age at baseline: 30,5 (SD:2,7), 33 months	Work overload, job autonomy and professional support at two occasions, each combined into a cumulative score	Depressive symptoms	Levels of depressive symptoms are positively linked with cumulative experience of job autonomy.
Smith and Bielecky (2012)	3,745 men and women from a representative Canadian cohort study (2 years follow-up)	15–74, 2 years	Changes in job strain and sub dimensions based on two occasions (baseline and follow-up)	Depression	An increase in psychological demands is related to an increased risk of depression.

Li et al. (2013)	417 junior physicians, men and women in a German hospital (prospective cohort study with 3 year follow-up)	Average age: 30,4 years (SD: 2,61), 33 months	Effort-Reward Imbalance at two occasions (T1 and T2) included separately, as mean ERI scores and as changes	Depressive symptoms	Negative changes in work stress and work stress at T2 revealed highest levels of depressive symptoms.
Bentley et al. (2015)	13,545 men and women from a representative Australian cohort study (HILDA, 10 years follow-up)	15–?, 10 years	Changes in job control at ten occasions (continuous and divided into quintiles)	Mental component score (SF-36)	Increasing levels of job control are related to increasing mental health.

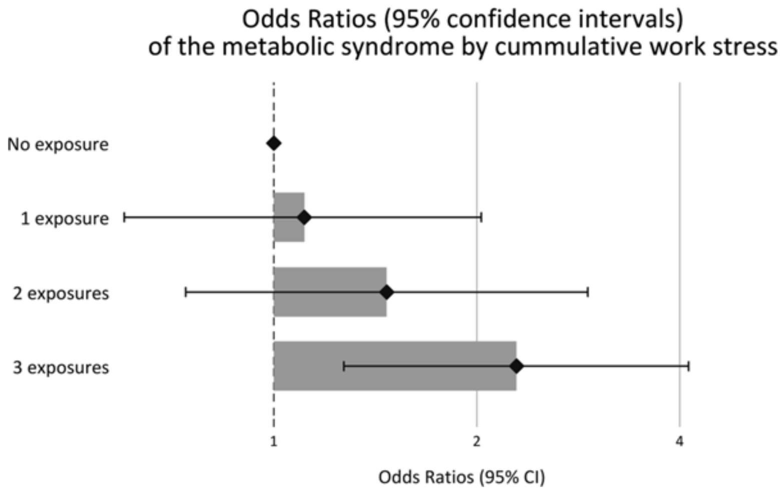

Fig. 3.2 Odds ratios of metabolic syndrome by cumulative work stress (Based on Chandola et al. 2006)

studies are based on the Effort-reward Imbalance, and one on both. Main findings reveal a clear picture and underline two aspects: First, in case the level of work stress increases over the observation period, the levels of mental health is also decreasing over time. Second, repeated experience of work stress over the working life time is associated with poorer mental health, suggesting a gradual dose-response relationship between number of stress experiences and likelihood of poor health.

However, because most reviewed studies are based on two measurement occasions only (10 out of 14 studies), a more nuanced investigation of the character of the association is not possible. This surely requires more measurement occasions. Another way of addressing the question of accumulation and duration, though, is not to use the repeated experience of work stress to different time points (as in the studies above), but to include information on exposure duration, for example, the number of years someone spent in a stressful job. The Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan et al. 2013) offers an excellent opportunity to do so, where detailed retrospective information on respondent's work history is collected among older adults. This not only includes length of each job a respondent had in his or her previous working career, but also the psychosocial working conditions of respondent's main job (including core dimension of the DC and ERI models). By combining this information, we are enabled to link the number of years a respondent have worked in a stressful job (between age 30 and 65) with the level of depressive symptoms during retirement. Along these lines, own preliminary findings are illustrated in the figure below. Specifically, we present the estimated function between years in work stress (in terms of low reward and low control) and number of depressive symptoms for both men and women aged 65 or older. For both indicators of work stress and sexes, we see that there is a somewhat

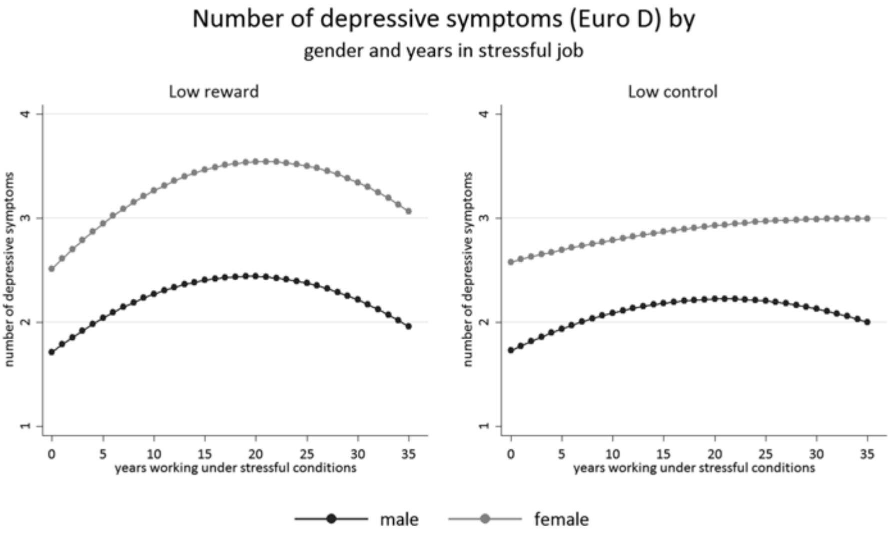

Fig. 3.3 Links between years spent in stressful work and number of depressive symptoms (Based on own calculations using SHARE (n = 7046))

inverted U-shaped association between years in a stressful job and levels of depressive symptoms, with a steep increase at the beginning, highest levels of depressive symptoms with about 20 years spent in stressful work and a flattering effect thereafter. Importantly, it is unlikely that the observed shape of the association is due to selection, where people with high depressive symptoms self-report higher levels of work stress (and spend less years on the labour market). Analyses also exclude respondents with poor health prior and during working life, and are adjusted for country and age. The flattering effect after 20 years may probably also point to a health-related relief for those who retire from an extended period in a stressful job (Westerlund et al. 2009) (Fig. 3.3).

We now turn to the question how work stress is clustered with other risk exposures, in particular circumstances at earlier stages of the life course.

3.3.2 Risk Clustering and Origins of Work Stress

Numerous studies document that employment conditions and levels of work stress during working life are linked to adversity in early life, and specifically to childhood poverty and socioeconomic circumstances. This includes effects on youth unemployment (Caspi et al. 1998), financial difficulties in midlife (Kuh et al. 1997; Kuh and Wadsworth 1991), job insecurity (Power and Matthews 1997), and general labour market disadvantage in working life (e.g. involuntary job loss or episode of unemployment) (Dragano and Wahrendorf 2014). In addition to that, studies also demonstrate long-term effect on levels of psychosocial stress at work (Elovainio

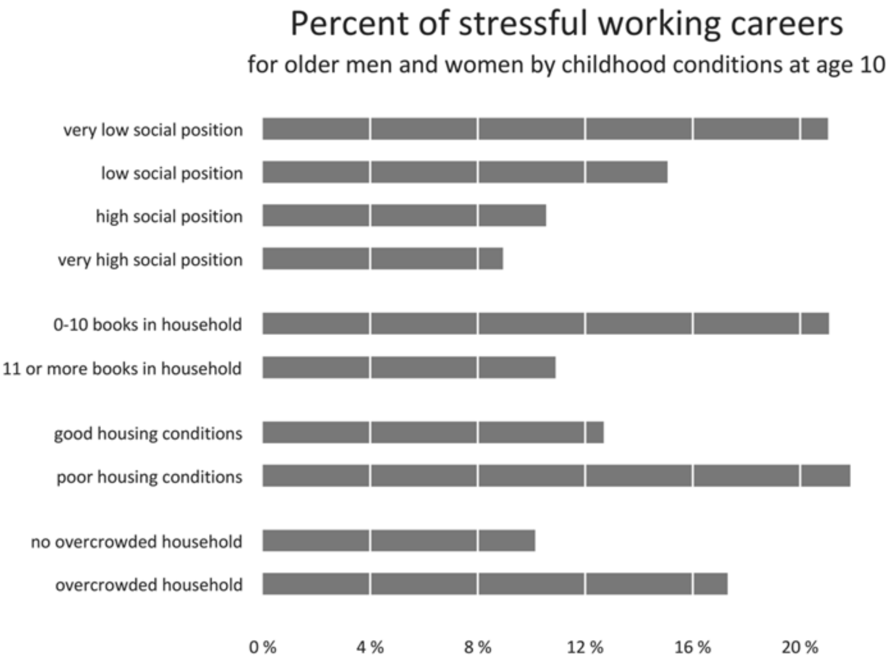

Fig. 3.4 Percent of people with stressful working careers by childhood disadvantage (Based on own calculations using SHARE (n = 10,562))

et al. 2007; Wahrendorf and Siegrist 2014). An example of such a risk clustering or risk accumulation throughout the life course is given in the following figure, where links between childhood circumstances (four measures of disadvantages) and stressful work are presented. Stressful work refers to an overall assessment of the working career after labour market exit, as well as it includes information on work stress for the main job of the working career (measured according to the DC and ERI Model, see (Wahrendorf and Siegrist 2014) for details). Each indicator of disadvantage is clearly linked to higher levels of stressful work (Fig. 3.4).

So far, the presented studies do focus on the cumulative experience of work stress, its origins in early life and health-related consequences for later life. Next, we briefly describe those studies that address whether the timing of work stress makes a difference for its effect on health.

3.3.3 *Timing of Work Stress*

To describe studies on the timing of work stress and its effect on health later on, we first turn back to Tables 3.1 and 3.2 and compare the age ranges covered by the studies. Overall, it becomes clear that most studies are based on occupational cohorts recruited from midlife populations covering an age range roughly from 30 to 55 in the majority of the cases (see also Chaps. 4 and 5 in this book for single point measures of work stress). This underlines that evidence is most consistent and mainly builds on midlife working populations, and additionally – as pointed out in the first section – that comparatively little is known on the long-term consequences of work stress on health beyond working life. A growing number of studies, though, show that midlife working conditions are also linked to health beyond working life. More specifically, research has documented long-term effects of stressful work on mental health, either in terms of general disadvantages on self-rated health (Westerlund et al. 2009), or in terms of work stress assessed by the DC and the ERI Model on physical and mental functioning (Wahrendorf et al. 2012) or depressive symptoms (Wahrendorf et al. 2013). With regard to the timing at which work stress is experienced, this suggests that midlife is a crucial phase with higher importance of the work role and most consistent effect on health both during and beyond working life. Yet, albeit all studies include age as an additional covariate in the analyses, only few studies explicitly test whether the effect of work stress on health differs by age, with one notable exception supporting that the impact of job strain is slightly higher for younger workers (Chandola et al. 2008).

3.3.4 *Order of Work Stress and Employment Histories*

The reviewed studies in Tables 3.1 and 3.2 show that the accumulated exposure to work stress is related to poorer health later on, and additionally, that a low level followed by high level is related to poorer health as well. This already points to the importance of ordering principles, and to apply a more holistic approach to describe entire histories with specific patterns of stress exposure and distinct types of employment histories. An important development in life course research, at this point, is the growing popularity of sequence analysis (Aisenbrey and Fasang 2010; Abbott and Tsay 2000), in combination with increasing availability of data on life course trajectories (e.g.: Börsch-Supan et al. 2013). Sequence analyses not only allow an in-depth description of trajectories and their patterns, but it also enables to identify and regroup similar types of sequences (e.g. employment histories) into empirically distinct clusters. The order of event is one important aspect at this point (Studer and Ritschard 2015), but aspects like exposure duration and timing can equally be considered when comparing sequences. For example, in a study focussing on employment histories of older European, it became apparent that specific types of employment histories are associated with lower quality of life in later life, with notable differences between men and women (Wahrendorf 2015). Specifically, for men quality of life is highest in case of strong ties to the labour market and a continuous full-time employment history. For women, though, best quality of life was found if histories include spells of domestic work before re-entering the workforce (either as part-time or full-time). Or, focussing on women, a recent study combined work and family histories during midlife and linked these combined trajectories to higher mortality risk, particular in case of single non-working histories of mothers (Sabbath et al. 2015). Another recent study based on British men and women also characterised work-family life courses and investigated their links with subjective wellbeing (Lacey et al. 2015). In accordance to the findings above, findings suggest that men and women who have strong ties to paid work have higher life satisfaction, but only in case this is combined with parenthood and marriage. These studies illustrate that sequence analysis is a powerful tool for life course research identifying certain trajectories associated with health later on.

3.4 Concluding Remarks

This chapter provides a summary of some core perspectives of life course research and what they offer for the study of work stress and health. In this context, it highlights that life course epidemiology is more than just linking earlier exposure to work stress health later on, but it should also consider the duration, timing and ordering of the exposure to work stress across the life course. In fact, the study of work and health is a good example to illustrate how conceptual ideas of life course research helps to extend and to enrich epidemiology, where time is more than just the temporal ordering in the data. In addition, it is crucial to specify the duration, timing and ordering of an exposure within individual life courses. Although future research is needed to address these issues in more details, this chapter shows that they are promising and a growing number of studies, encouraged by recent life course data and methodological developments in the field.

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Chapter 4
A Social Inequalities Perspective on Effort-Reward Imbalance at Work

Nico Dragano and Morten Wahrendorf

4.1 Introduction: Occupational Inequalities in Health and Their Explanation

It is a core finding of population health that adverse social and economic conditions are linked to poorer health and shorter life expectancy. Several important drivers of this social gradient in health have been identified and there are at least two reasons why work is one of them (WHO Commission on Social Determinants of Health 2008). First, work determines the access to important health- related material and immaterial resources such as income, social integration or self-esteem. Second, work has direct effects on health via a wide range of work-related exposures and resources, such as physical or psychosocial working conditions. An unequal distribution of these conditions could, for example, be an important reason for existing socioeconomic differences in health. Before discussing the role of working conditions in more detail and before having a closer look at the 'effort-reward-imbalance' (ERI) model in this context, we will briefly summarize main empirical findings on health inequalities. This overview will be restricted to findings based on working populations and individuals' occupational position. Thereafter, we will present a conceptual framework helping to disentangle the different links between occupational position, working conditions and health. In accordance with the identified pathways we will then describe evidence focusing on ERI as one possible driver of health inequalities in modern economies. Finally, a short reflection about the consequences for prevention at the levels of companies and national occupational safety and health policies is given.

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4.1.1 Evidence: Occupational Inequalities

Evidence on the importance of occupational position for health is available from studies that investigated health inequalities among working populations by comparing mortality rates of workers from different occupational positions, either in terms of qualification level, occupational status or occupational class. One of the first cohort studies describing an increase in mortality risk from higher to lower hierarchical levels was the British Whitehall study. The study sample were civil service employees in London who were followed up for incident disease and mortality (Marmot et al. 1978). Using this information Marmot and colleagues found a stepwise increase in mortality rates due to cardiovascular disease from high to low occupational grades (i.e. a social gradient in health). Incidence was, for instance, 3.6-fold higher in employees from the lowest grades compared to the highest grade employees, such as supervisors and professionals. Meanwhile, numerous studies replicated this finding of an occupational gradient of mortality in the working population in different countries (Burrows et al. 2012; Kivimaki et al. 2007; Kunst et al. 1998a, b; Niedhammer et al. 2011; Mackenbach et al. 1997, 2003, 2008; Muntaner et al. 2004; Stringhini et al. 2011; Virtanen and Notkola 2002; Son et al. 2002). Results are largely consistent for all-cause mortality and for different causes of death, including cardiovascular and stroke mortality, mortality from external causes, cancer mortality or death due to respiratory disease.

Mortality differences suggest an analogous pattern for non-fatal disease. This has been tested for a large range of single diagnoses and diagnostic groups. In brief, there is solid evidence for an occupational gradient in non-fatal cardiovascular disease. For example, Geyer and colleagues found a pronounced increase in rates of non-fatal myocardial infarction in relation to a decreasing occupational position in a large register based follow-up study (Geyer et al. 2006). Comparable inequalities were found for hospital admission due to myocardial infarction (Huisman et al. 2008; Andersen et al. 2004) or stroke (Kivimäki et al. 2009). Other health outcomes for which occupational inequalities were observed are musculoskeletal pain and disorders (Aittomaki et al. 2007; Mehlum et al. 2008), poor physical health functioning (Lahelma et al. 2015), occupational injuries (Niedhammer et al. 2008), diabetes (Geyer et al. 2006), or poor self rated health (Niedhammer et al. 2008; Mackenbach et al. 1997; Kaikkonen et al. 2009). Higher disease risks in lower occupational positions are also evident for mental disorders measured by indicators like mental functioning (Sekine et al. 2009) or depressive symptoms (Hoven et al. 2015).

In regard to work-related health outcomes Virtanen and colleagues reported considerably higher short- and long-term sickness absence spells in blue collar workers compared to white collar workers (Vahtera et al. 1999), a finding that corresponds to other studies on inequalities in sickness absence (Piha et al. 2013; Niedhammer et al. 2008; Melchior et al. 2005). A further important outcome category of inequality research is disability retirement. One example is a study by Mansson et al. (1998) that found an over fourfold-increased risk of early retirement due to a disease of the musculo-skeletal system, based on a Swedish longitudinal study. This result has been replicated for other disability diagnoses indicating a robust association between disability and occupational position (Krokstad and Westin 2004; Haukenes et al. 2011; Ervasti et al. 2013).

Although findings for mortality and morbidity are consistent it must be mentioned that the strength of the associations varies considerably between the studies. This may partly reflect 'real' differences in the degree of occupational inequalities between different populations and countries. Differences, though, are also likely to be a result of the large heterogeneity in research methods and health outcomes under study. For example, many different ways to measure the occupational position have been used, ranging from dichotomous comparisons between blue and white collar workers to more sophisticated occupational class concepts like the Erikson-Goldthorpe-Portocarero scheme (Wahrendorf et al. 2013).

4.1.2 Explanations: Different Pathways

Apart from methodological considerations different explanations for those patterns of occupational inequalities in mortality, morbidity and work-related outcomes were proposed. In an attempt to summarize knowledge about the explanatory pathways, Clougherty and colleagues proposed a simple framework to systematize the different links between occupational position, workers health and explanatory factors (Clougherty et al. 2010). Building on this framework and adding information from other conceptual papers (Hoven and Siegrist 2013; Landsbergis 2010; Lipscomb et al. 2006) we distinguish between four main – albeit interrelated – mechanisms: *selection*, *confounding*, *mediation*, *and effect modification*. We use these terms to illustrate the main underlying processes, though are aware that their meaning may be different in analytical epidemiology.

Selection occurs when individuals with impaired health cluster in disadvantaged occupational positions. Processes of clustering may happen at different stages of the career with some of them beginning very early in the life course. Health during childhood, adolescence or early adulthood may have an impact on educational attainment (Chittleborough et al. 2006), which in turn influences opportunities on the labor market (Dragano and Wahrendorf 2014). Young people with chronic illnesses or disabilities are at a higher risk to experience an unfavorable start into their employment career and are thus more often forced to enter occupations with less reputation and employment security. Later in life, illness or disability does again influence the occupational position as poor health may lead to downward mobility or block career opportunities. Importantly, selection and socioeconomic inequalities are mutually related during the whole period of adulthood as individuals from disadvantaged social groups have higher disease risks and are consequently more often affected by negative selection.

A second mechanism is the *confounding* of the association between occupational position and health by education and income. There is definitely a strong coincidence between a low occupational position, low education and/or low income (Landsbergis

2010; Clougherty et al. 2010; Huisman et al. 2008) as all three indictors are subdimensions of the latent construct, socioeconomic position' (SEP). For instance, persons with lower educational degrees tend to have less qualified occupations and those occupations are usually less well paid. If occupational position is used to measure social position, it is likely that part of its association with health is explained by an overlap with education and income which both have a strong influence on health- related living conditions, behaviors (e.g. nutrition, physical activity), and attitudes (e.g. self-esteem, health literacy).

The third mechanism is directly related to characteristics of the occupation or, more precisely, to the quality of work. Various positive and negative influences on health emerge from the tasks performed, the work environment and work organization, or from employment conditions. *Mediation* takes place when health-adverse working conditions are more frequently experienced by workers from lower occupational positions – with the respective consequences for their health. The mediation hypothesis has repeatedly been investigated for a large number of physical and psychosocial occupational risk factors. Empirical studies have, for instance, found that injury risks, ergonomic, physical or chemical hazards are more common in disadvantaged occupational positions, in particular in the case of manual occupations (Borrell et al. 2004; D'errico et al. 2007; Hämmig et al. 2014; Hämmig and Bauer 2013; Lahelma et al. 2009; Mehlum et al. 2008; Melchior et al. 2005; Montano 2014; Platts et al. 2013). The presence of psychosocial risk factors is also related to the occupational position, as a number of studies suggest (Hämmig et al. 2014; Hoven and Siegrist 2013; Kristensen et al. 2002; Melchior et al. 2005; Niedhammer et al. 2008; Wahrendorf et al. 2013). An oversimplification should, however, be avoided, as the distribution across occupational positions varies considerably by risk factors. For some work- related factors even a reverse gradient was observed, with higher exposure in higher positions (Dragano et al. 2015). It is therefore necessary to analyse mediation separately for each single occupational risk factor. Here, we will do this for work stress measured in terms of the effort-reward imbalance model.

The last mechanism in the framework is the *effect modification* of an association between occupational hazards and health by occupational position. More specifically, it has been suggested that workers with disadvantaged occupational positions are more vulnerable to the negative effects of occupational exposures on health than workers with more advantaged occupational positions. A higher vulnerability can be the result of the above described negative influences of low education or low income on living conditions and lifestyles, which may reduce the person's ability to cope with work- related strains. Moreover, vulnerabilities may origin from early life health disadvantages (see selection mechanism) or from risk clustering of several occupational risk factors together with non-work related risk factors (e.g. poverty, bad housing conditions). The common consequence is that workers with disadvantaged occupational positions are more likely to suffer from work-related exposures.

4.2 Work Stress, Effort-Reward Imbalance and Health Inequalities

In the following part we describe the possible role work- related stress in terms of the effort-reward imbalance (ERI) model may play as a possible driver of unequal health in working populations. To do so, we follow the abovementioned framework, with a focus on mediation and effect modification. However, as selection and confounding are alternative explanations, we will also comment on them. As a comprehensive overview requires a differentiated view of the underlying exposure we start with a short description of those theoretical elements of the ERI model which are important in the context of occupational inequalities.

The main theoretical idea of the ERI model is that a violation of the social norm of reciprocity evokes a negative emotional or stress reaction. Albeit such a violation is not necessarily limited to the working situation (see Chaps 12 and 13) it has been the main focus of the application of the theoretical model so far. The established operationalization of the model in the work context differentiates between two dimensions, 'effort spend at work' and 'rewards gained in return'. A negative proportion between high costs (efforts) and low gains (rewards) is defined as a high strain combination of unmet reciprocity or "effort-reward-imbalance". The effort dimension reflects psychosocial strain at work, and it is in general operationalized as a uni-dimensional additive scale of items which ask for common quantitative demands and stressors like constant time pressure, frequent disruptions or an increase in demands. Reward, instead, is a multidimensional construct with different types (also called 'transmitter systems') of rewards, i.e. esteem, money, job security or promotion prospects. The common measurement instrument includes items on all types. The 'esteem' scale, for instance, measures the workers' perception of receiving appropriate respect, support, or prestige from coworkers, supervisors and relevant others. 'Job security' summarizes items about fear of job loss and undesired change at work while 'promotion prospects' is operationalized as a subjective evaluation of the adequacy of job promotion prospects. Money as an important reward system is also rated subjectively as the adequacy of salary/income.

A further important component of the model is an intrinsic dimension of effort-reward-imbalance termed 'over-commitment'. Siegrist (1996) has introduced this personal 'trait' to explain, why individuals accept situations of non-reciprocity in general, invest inappropriately high efforts, and are particularly sensitive to rewards. In the following sections we demonstrate the importance of distinguishing between the single model components, including the different sources of reward, when relationships of work stress with occupational position are investigated.

4.2.1 Mediation: Evidence

A necessary condition for mediation is an independent effect of the potential mediator variable on the outcome of interest, that is, of work stress on health. This is clearly the case in a large number of stress-associated diseases that have been tested in longitudinal and experimental studies with regard to ERI. Effects have for example been shown for somatic diseases like cardiovascular disease (Backé et al. 2012; Koch et al. 2014; Kuper et al. 2002; Siegrist 2005; Steptoe and Kivimäki 2013), mental disorders (Bonde 2008; Rugulies et al. 2013; Theorell et al. 2015), sickness absence (Janssens et al. 2014; Ndjaboué et al. 2014), disability retirement (Dragano 2007; Juvani et al. 2014), and health-adverse behaviors (Head et al. 2004) (for detailed reviews see Chaps. 5, 6, 7, 8, 9, 10, and 11).

The second prerequisite of mediation is that the predictor under study is associated with the mediator variable. In case of occupational inequalities exposure prevalence should increase with decreasing occupational position. To see whether this condition is met in case of the ERI model one can first look at bivariate associations of measures of the model with indicators of occupational position. The number of publications which report such associations for the ERI model is small and mostly restricted to its extrinsic components. An instructive example is provided by an analyses of data from an international study with participants from 11 European countries, published by Wahrendorf et al. (2013). They observed a gradual increase in the prevalence of effort-reward imbalance with decreasing occupational position, assessed either in terms of occupational class, occupational status, or occupational skill level. Yet, this finding does not correspond with descriptive data from a number of other studies which revealed either no association between occupational position and the effort-reward ratio or even a reversed association, with higher ERI scores in higher professional groups (Peter et al. 1998; Rugulies et al. 2013; Siegrist et al. 2004; Wege et al. 2008; Chandola et al. 2005). When discussing this discrepancy of results one should keep in mind that considerable levels of ERI were observed even among lower occupational positions, and that differences between occupational groups were generally modest or small in those studies. A further study is noteworthy in this context because it has analyzed changes of ERI according to occupational position. In the British Whitehall cohort study ERI was more common among employees with higher occupational grades at baseline, but was substantially reduced at follow-up, whereas such a reduction over time was not observed among employees with lower grades (Chandola et al. 2005).

Studies of the intrinsic component of the ERI-model are largely absent so far. We identified only two reports on the distribution of over-commitment by occupational position. The first one is a result from the Swedish WOLF study showing that workers in white collar jobs were more often overcommitted than blue-collar workers (Peter et al. 1998). The second study is an analysis from Siegrist and colleagues (2004) who calculated bivariate statistics to describe associations between over-commitment and educational degrees in five European cohort studies. There was a tendency towards higher over-commitment in workers with higher educational degrees in four studies, but differences were not pronounced.

Another way to study mediation is to simultaneously look at the statistical association between occupational position, a health outcome, and the potential exposure measure. This is achieved by adjusting for the exposure variable in regression models with occupational position as the independent and health as the dependent variable. A reduction in the crude effects for occupation after adjustment for the exposure is then interpreted as limited evidence of mediation. Pathway analysis offers an alternative method. A recent longitudinal investigation based on this method (Hoven et al. 2015) revealed that a statistically significant part of the association between occupational position and depressive symptoms was mediated by effort-reward-imbalance. This finding replicates an earlier report of results from the Whitehall II study by Stansfeld et al. who found that the statistical association (point estimates) of occupational position with depression was attenuated when ERI and job strain were adjusted for in multivariate regression models (Stansfeld et al. 2003). Another corresponding, yet cross-sectional finding (Du Prel et al. (2014) was derived from data of a population based study, documenting an attenuation of the association between low education and depressive symptoms after inclusion of ERI in multivariable analysis. A further longitudinal investigation of the Whitehall II study used diabetes as a health outcome and found that the association between employment grade and incidence of type II diabetes was partly mediated by effort-reward imbalance in multivariate regression models (Kumari et al. 2004).

As the number of empirical investigations using the full measurement of the ERI model as a potential mediator is still small, it is of interest to consider evidence from studies using alternative, yet partly overlapping measurements of psychosocial work stress. In particular, the majority of published studies used the established job demand-control model to assess work stress. A recent review by Hoven and Siegrist identified 17 longitudinal studies on mediation based on this model. In sum, there was modest support in favor of the mediation hypothesis, but results were not straightforward. Interesting information in this respect comes from investigations which analyzed the single dimensions of the demand-control (DC) model. The ‘control’ dimension (skill discretion and decision authority) tends to be consistently inversely distributed, with significantly lower levels of job control in lower occupational positions or in low-skilled occupations (Schuette et al. 2015; Kristensen et al. 2002; Melchior et al. 2005; Niedhammer et al. 2008; Vanroelen et al. 2010). The consistency of this finding is not surprising, as low control is an inherent characteristic of low-skilled jobs, and therefore, of a lower occupational position. Demands, however, are not necessarily higher in the lower occupational positions, in particular psychological demands, the second main dimension of demands within the model. These latter demands were generally more pronounced for higher occupational positions. As the ‘demand’ dimension of the DC-model is closely linked to the effort dimension of the ERI model, a comparable picture may exist for effort. Yet, systematic evidence is not available so far.

The latter finding points to another gap of knowledge: the lack of studies investigating the socioeconomic differences of each single dimension of the ERI model.

In view of the reported findings on the DC-model one may suggest that the components 'effort' and 'reward' are also differently linked to occupational position. The few available studies which report scale-specific distributions support this assumption. One example is the validation study by Siegrist and colleagues which used education instead of occupational position as an indicator of SEP (Siegrist et al. 2004). The authors reported the sum scores of the 'effort' and 'reward' scales for three educational groups from five large cohort studies separately. Hereby, effort was considerably higher for worker with higher education levels in all studies, while reward showed the opposite pattern with lower levels of reward for workers with lower educational level. A similar finding based on a sample of Danish workers was reported by Rugulies et al. (2013). Here, levels of effort among higher occupational positions were generally higher than levels of rewards, resulting in an imbalance in the effort-reward ratio for higher occupational positions.

A more detailed investigation of the mediation mechanism for the three subscales of the 'reward' dimension has not been conducted so far. Again, indirect evidence can be derived from investigations using alternative measurements, with solid evidence in the case of job security. Several studies have demonstrated that the level of insecurity is higher for workers with lower occupational positions and with a lower educational qualification (Schuette et al. 2015; Dragano et al. 2015; Kristensen et al. 2002; Borrell et al. 2004).

Differences of job insecurity seem to be quite pronounced. For example, in a study conducted by Schuette and colleagues (2015), based on 33,443 workers from the European Working Conditions Survey, prevalence differences in job insecurity were 18.5 % for men and 20.9 % for women when comparing the highest to the lowest occupational position. The same study also revealed lower levels of social support among disadvantaged occupational positions, a dimension that is partly related to the 'esteem' dimension of rewards. This finding is in line with other studies (Melchior et al. 2005; Kristensen et al. 2002; Niedhammer et al. 2008, 2011). In addition, unfair treatment at work (another indicator linked to 'esteem') has been investigated in a study by de Vogli et al. (2007). Again, people with more disadvantaged occupational positions had generally higher levels of unfair treatment. Finally, single item analyses suggest that promotion prospects are generally lower among workers with lower occupational positions (Hämmig and Bauer 2013; Schuette et al. 2015).

4.2.2 Effect Modification: Evidence

A higher vulnerability to adverse health effects of stressful work in terms of ERI among workers in lower occupational positions has been proposed as a further mechanism by which ERI contributes to occupational inequalities in health. Compared to the mediation mechanism, however, the empirical evidence is still restricted. In a recent review Hoven and Siegrist (2013) identified only two longitudinal studies testing modification for work stress based on the ERI model. The first one is an analyses of data from the Whitehall II study that explored if the strength of the effect produced on incident coronary heart disease or on physical and psychological functioning by ERI varied by occupational position (Kuper et al. 2002). Stratified cox-regression models revealed slightly stronger effects for the lowest occupational position as compared to medium and high positions in case of coronary heart disease. No indication of an effect modification, however, was found for physical or psychological functioning. The second longitudinal study investigated effect modification in relation to the onset of depressive symptoms in a 5-year follow up period based on a Danish cohort study (Rugulies et al. 2013). Overall, ERI predicted new depressive episodes, but stratified regression demonstrated that the effect was much stronger in the lower occupational positions.

Additional evidence can be derived from four cross-sectional studies. Wege and colleagues (2008) tested the interaction between ERI and occupational position for the three outcome measures 'depressive symptoms', 'low self-rated health', and 'angina pectoris' in the baseline sample of a population based cohort study in Germany. For all outcomes, associations with ERI were more pronounced among workers with low occupational positions, albeit the interaction was significant for depressive symptoms only. Another cross-sectional investigation of interaction published by Herr et al. revealed no difference in the association of ERI with musculoskeletal symptoms between blue and white collar workers (Herr et al. 2015). It is worth noting, however, that this result has a limited validity because the outcome assessment refers to a period of time preceding the assessment of work stress. Insomnia was the health outcome of an investigation of a large sample of male public service workers in Japan (Yoshioka et al. 2013). Workers with the lowest position who were exposed to ERI had a 6.24-fold higher odds ratio of reporting insomnia than the reference group (workers with the highest position and without ERI). Noteworthy, this is the only study that additionally considered the intrinsic component over-commitment and found a similar trend. In addition, a strong interaction of occupational position with over-commitment was observed, with more pronounced effects of over-commitment on insomnia among workers with lower occupational positions. Finally, a cross-sectional study explored modification by using the extrinsic ERI components for three self-reported health measures (Toivanen 2011). Although a tendency for stronger associations between ERI and health measures in lower positions was found for all outcomes, interactions did not reach statistical significance in most cases.

4.2.3 Selection and Confounding: Evidence

In our explanatory framework selection and confounding are not directly related to the health-related consequences of working conditions, but are introduced rather as processes preceding or interfering with the association of occupational position with health (Clougherty et al. 2010). We argue that it is nonetheless important to have a closer look at those alternative explanations when studying the role of single mediating factors. In other words, selection and confounding could both affect the predictor and the mediating variable.

Starting with selection, we think that a bias is not very likely. Although it seems possible that some individuals with preexisting disease – and a lower occupational position as a result – may perceive their working conditions as more stressful than healthy people there is no empirical evidence supporting the assumption that this selection bias accounts for observed main effects of ERI on health. Numerous longitudinal studies have shown that ERI predicts disease in previously healthy subjects which precludes reverse causation. Moreover, a study of severely disabled workers has shown that the strength of associations between ERI and health complaints was similar to the one reported from studies with non-disabled workers (Fekete et al. 2014).

We come to the same conclusion for a possible confounding effect exerted by income and education. Such an effect is rather unlikely in view of robust evidence from cohort studies that adjusted for those variables while investigating effects of ERI on health outcomes (see e.g. Chaps. 5 and 6). The strength of the exposure-outcome association was in general robust even after adjustment for education or income in those studies. Moreover, as already described in the section on mediation, the association between ERI and education seems to be rather weak – a fact that precludes a major role of confounding.

4.3 Summary and Discussion of the Empirical Evidence

It is self-evident that a single exposure like effort-reward imbalance can only partly explain the occupational gradient in complex and multi-causal disease outcomes. However, the evidence suggests that ERI does indeed contribute to the occupational gradient. Additionally, the findings reviewed in this chapter indicate that a more differentiated analysis of the model's single components reveals some particularly important aspects that are summarized as follows:

- Results of an inverse relationship between occupational position and the effort-reward ratio are not consistent, indicating that the mismatch between high efforts and low rewards is not necessarily more pronounced in lower occupational positions;
- One explanation of this inconsistency points to different types of associations for the two subscales 'effort' and 'reward';
- Although elevated overall levels of efforts, defined as psychosocial strain at work, are observed among all occupational groups, efforts nevertheless tend to be higher among workers in more advantaged occupational positions;
- Men and women working in lower occupational positions experience significantly less rewards in terms of salary, esteem, job security and promotion prospects;

– There is a tendency of stronger effects on poor health among workers in lower occupational positions, suggesting their higher vulnerability to the negative influence of work stress on health.

The first four statements relate to the mediation hypothesis. In sum, the evidence suggests that low rewards may be an important mediator while efforts and over-commitment are not necessarily a particular burden for people working in lower occupational positions. These opposing trends may explain why the effort-reward ratio did not show a consistent gradient in the (few) empirical studies conducted so far. It is therefore important to investigate the single components of the model in detail.

Low reward has been found to predict health outcomes even independent of effort (Siegrist et al. 2005; Nakata et al. 2011; Bellingrath et al. 2008). Accordingly, it is of particular interest to notice that workers in lower occupational positions are significantly more disadvantaged in terms of access to all dimensions of reward, i.e. esteem, money, promotion prospects and job security, compared to those in higher positions. This tendency may be the consequence of lower wages in occupations at the lower end of the occupational hierarchy or in jobs requiring low or no qualification. Many of those occupations do also offer limited opportunities for promotion and for further qualification. Correspondingly, skill discretion is rated lower among men and women working in lower occupational positions (Andersen et al. 2004; Hämmig and Bauer 2013; Schuette et al. 2015). Job insecurity is also significantly higher among low occupational positions. One reason may be that the labor market for low-skilled occupations has constantly been under pressure during the last decades, as rationalization and downsizing have become a common phenomenon of economic globalization worldwide (see Chap. 1). Cuts, replacement or relocation of jobs are easier to perform for tasks requiring less qualification or those suitable for substitution by technology. The perception of insecurity is likely to reflect an objectively higher risk of job loss for these occupational groups. From a psychological point of view the anticipated consequences of job loss may be perceived as particularly threatening among low-skilled workers, thus contributing to an increased sensitivity in situations of job instability. Disposing of a high skill level can be regarded as a stress-protective factor in times of increased job instability. This observation supports the significance of 'skill level' as a core dimension of classifying occupational positions (as is the case with the EGP-scheme).

Higher levels of efforts (or demands) among higher occupational positions were repeatedly observed (Kaikkonen et al. 2009; Rahkonen et al. 2006; Kivimäki et al. 2009). Certain aspects of psychological efforts can indeed be considered as characteristics of higher qualified white collar work and/or leading positions. Long working hours, for instance, are more common in self-employed and in managerial positions than in manual occupations where working time is often more strictly regulated and controlled (Dragano et al. 2015). Other types of psychological demands such as high responsibility, mental work disruption, or the requirement of high mental concentration are also associated with higher qualified work. Yet, other aspects of effort, such as work pressure, are also highly prevalent among workers in lower positions, especially so in times of work intensification, rationalization and organizational restructuring.

Once exposed to chronic stress, workers from all occupations exhibit negative health effects, but studies also reveal a tendency for a more pronounced influence of ERI on health in case of low occupational positions. Albeit the evidence needs to be extended at this point, this increased vulnerability has been attributed to different factors. The simultaneous exposure of workers with lower occupational positions to psychosocial and physical work hazards is one such factor (Toch et al. 2014). Risk clustering in conjunction with stressful experience in other life domains is another explanation (Sperlich and Geyer 2015) (see Chap.13). It is well known that health-adverse living conditions and behaviors are more prevalent among persons living in disadvantaged social and economic circumstances. Impaired health, fewer options to recover, and dysfunctional coping strategies are possible consequences that restrict options of mastering stress at work.

Stronger effects of ERI on health among people living in lower social positions could also be related to some specific psychological characteristics of stressful experience. A psycho-physiological stress reaction is triggered by a person's perception of the situation as threatening or challenging in the absence of appropriate intrinsic or extrinsic coping resources (Lazarus and Folkman 1984). We have already argued that resources such as wealth or social support may be less often available to low-skilled workers. Two examples illustrate possible consequences. First, while failed reciprocity at work can be compensated to some extent by available external resources (e.g. strong family support or esteem by friends), these resources are often lacking among disadvantaged workers. Second, among more privileged workers, material wealth may help buffer the threats related to financial strain, by compensating income loss by available savings. This option is less often present in groups with low socioeconomic position.

Additionally, protective personal resources such as self-confidence or self-esteem are less pronounced in lower skilled people, thus aggravating appraisals of, and emotional reactions to, stressors at work. As their opportunities of experiencing intrinsic reward at work are restricted, extrinsic rewards are receiving primacy, and their absence or inadequacy elicits additional stress reactions. It is well known that socioeconomic disadvantage reinforces negative attributions and cognitions, and this fact may help explaining an increased susceptibility of people in lower socio-economic positions to adverse working conditions.

A last argument emphasizing the importance of unequal health effects of stressful work according to occupational position can be derived from one of the core assumptions of the theoretical model. Whereas rational choice theory claims that a person who experiences a mismatch between high costs and low gains reacts to this situation by reducing his or her effort, ERI theory maintains that options of reducing effort are often not available, e.g. due to lack of alternative choice in the labor market or limited control of the immediate job conditions (Siegrist 1998, 1996). Accordingly, with lower social positions of workers within an organization, opportunities tend to be reduced to modify or escape an adverse job situation. This dilemma has already been pointed out by Johannes Siegrist in his model description:

"*For instance, blue collar workers with reduced opportunities of changing jobs will not minimize their effort at work even if their gain is low. The reason for this behavior is obvious: the possible costs produced by disengagement* (e.g. *the risk of being laid off or of facing downward mobility*) *by far outweigh the costs of accepting inadequate benefits. Thus, under defined conditions of low occupational status control, effort-reward imbalance is maintained contrary to the prediction derived from the expectancy value theory of motivation*" (Siegrist 1998).

4.4 Conclusions for Research and Prevention

This chapter has illustrated how ERI may help to understand why workers in lower occupational positions are more likely to suffer from poor health as compared to people in more privileged positions, and additionally, it has presented respective scientific evidence. In sum, the evidence supports the notion that improving psychosocial working conditions in terms of ERI among workers in lower social position contributes to a reduction of health inequalities. However, not all dimensions of the theoretical model are of similar significance in this regards. Given a high degree of consistency in the social distribution of two core reward components, 'job security' and 'appropriate salary', these dimensions offer promising entry points for interventions. Specifically at the national level, such interventions could aim at extending integrative labour market policies to vulnerable and disadvantaged occupational groups, strengthening their opportunities of maintaining or improving their jobs, or of returning to work after a disruptive event (Wahrendorf and Siegrist 2014; Dragano et al. 2011). In addition, national regulations of minimum income for low salary workers should be established. Turning to the level of single organisations, companies may broaden opportunities for continued training and provide fair salaries for their workers. Further recommendations informed by these research findings concern measures of strengthening working people's resources of coping with adversity at work. Again, such measures can be developed at the level of national programmes (e.g. in terms of protective labour market policies) and at the level of companies, for example by providing long-term contracts and by offering supportive services (e.g. occupational safety and health, rehabilitation services) (see Chaps. 15 and 16).

Another set of recommendation relates to possible extensions of existing research. First, while a systematic assessment of work stress based on a theoretical model allows for a more nuanced perspective helping to identify specific interventions, a more comprehensive assessment of occupational positions appears equally important to identify high risk groups more appropriately. In fact, among existing studies measures of occupational position are very heterogeneous and often not based on available theoretical models, thus resulting in the production of inconsistent findings and limited comparability. Along these lines, it seems necessary to specify, classify and compare occupational groups in much more detail and to identify particular high risk groups of workers (Rugulies et al. 2009). Two final recommendations relate to the fact that many studies on health-related consequences of work stress are based on occupational cohorts with participants who were working at study onset (often recruited from single companies). This restriction fails to represent the full range of occupational conditions, in particular a growing segment of non-standard employment arrangements including temporary workers, irregular or contingent workers, or those working on demand. A further limitation of mainstream occupational cohort studies concerns the lack of data on potential selection processes operating at the stage of entry into labour market. It is hoped that existing birth cohort studies following populations that are now reaching working age can reduce this gap of knowledge. Additional evidence on life course trajectories may become available from the few cohort studies that collect systematic retrospective data on workers' occupational histories.

In conclusion, research based on the ERI model has identified promising entry points of interventions to reduce work-related health inequalities, in particular those improving low rewards in terms of job security, promotion prospects, wages and salaries among disadvantaged groups of workers. Beside the challenge of policy makers, employers and related stakeholders to implement new scientific knowledge into practice, there remain challenges to future research, in particular a more comprehensive assessment of the afflictions of stressful work in a rapidly changing world of work and employment.

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Part II
Work Stress and Health: Reviewing the Research Evidence

Chapter 5
Work Stress and Cardiovascular Disease: Reviewing Research Evidence with a Focus on Effort-Reward Imbalance at Work

Mika Kivimäki and Johannes Siegrist

5.1 Introduction

A widespread popular notion tells that stressful work environments are damaging the heart of working people. Although the notion has found support from findings of epidemiologic studies, there remain controversies about their significance, and some relevant questions still require additional answers. One such question concerns the identification of distinct features of a health-adverse psychosocial work environment at a level of generalization that allows for their measurement in a wide variety of occupations. This identification is best achieved through the proposition of a theoretical model.

Yet, developing such a model is a complex process requiring unraveling hidden aspects of everyday experiences and observations. In developing the model of effort-reward imbalance (ERI) at work, Johannes Siegrist and his team explored reports of a large number of young men who survived their first acute myocardial infarction and who were interviewed during their stay in a rehabilitation clinic (Siegrist 1984). The following is an example of such reports from a 35-year old man:

> *My boss was directing a small printing company where I was engaged since a couple of years. From the very beginning, I enjoyed my job and was very committed to my work. As the boss appreciated my continued high engagement he told me one day: 'When I will retire in a few years, you will become my successor'. From that moment, I even intensified my efforts at work, often going to the office on weekends and even shortening my holidays. With*

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these prospects in mind, my job turned out to be the top priority in my life. After two years, on a Monday morning, my boss entered my room and told me: 'I am sorry, but you can't get the job that I promised you.' I was totally shocked. It was the end. He broke his promise out of the blue. While I was a moderate smoker before, I immediately started smoking 60 or more cigarettes each day. A few days after this shocking Monday, during my stay at work, I experienced a sudden attack of severe chest pain and I broke down. I was immediately brought to the hospital where a myocardial infarction was diagnosed.

This example illustrates several key aspects of work stress that were incorporated in the ERI model. These include having too much work to do, both as a result of increasing extrinsic demands and intrinsic work-related motivations. Importantly, the major reward rightly expected for the efforts was withdrawn as the promised prospects of successful job promotion did not materialise. This created an imbalance between 'cost' and 'gain'.

In work life, imbalance between effort and rewards is often experienced in a less dramatic way (for a comprehensive description of the ERI model see Chap. 1). Even the single components of the model, high effort at work (e.g. experienced as overtime work) or low reward (e.g. experienced as a lack of job security and stability) may be powerful enough to trigger sustained stress reactions. According to the ERI model, this can result in adverse long-term effects on cardiovascular health, a hypothesis tested in a number of large-scale investigations, without an explicit link to the ERI model, but consistent with its core assumptions.

The following section will briefly review recent evidence from large-scale epidemiologic studies, and it points to convergences with, and divergences from, the ERI model. Convergence is obvious in case of overtime work (long work hours) and in case of job insecurity and instability. Divergence becomes most evident in comparisons with the leading work stress model of job strain which proposes that a combination of high demand and low control at work has deleterious effects on cardiovascular health (Karasek 1979; Karasek and Theorell 1990). We briefly review results from these research directions and then give an account of main findings from research testing the ERI model with respect to cardiovascular risk and disease. The final section discusses methodological issues and implications of current knowledge for prevention.

5.2 Work Stress and Cardiovascular Disease: Significant Research Directions

During the past 20 years impressive progress in occupational epidemiology concerned with stressful work and cardiovascular disease has been seen. A substantial part of this research was devoted to the analysis of work-time related risks, of harmful effects of job insecurity, and of a health-adverse psychosocial work environment, as defined by distinct stress-theoretical models. In this section, a brief review of most recent findings on these associations is provided.

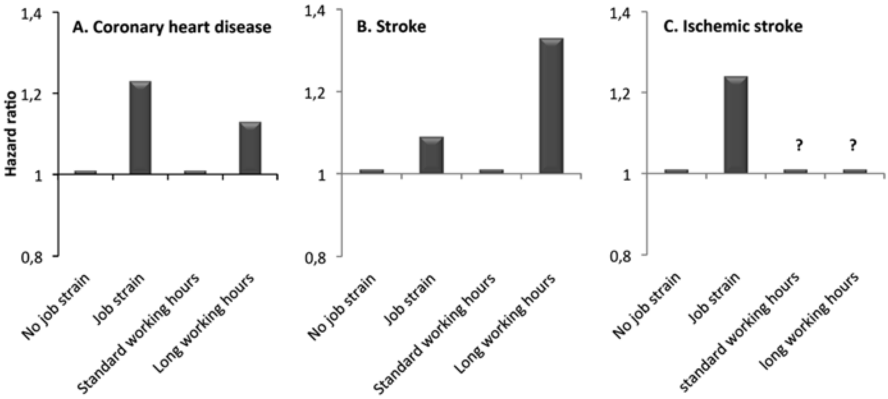

Fig. 5.1 Associations of job strain and long working hours with incident coronary heart disease and stroke according to IPD-Work consortium meta-analyses (Data based on Kivimäki et al. 2012, 2015; Fransson et al. 2015)

Overtime work, measured as long working hours, can be considered a *proxy measure for high effort at work*. Several recent studies have examined the association between long working hours (typically referring to 55 working hours or more per week) and risk of coronary heart disease *(*CHD, see below Fig. 5.1). An early meta-analysis of four prospective studies noted a relative risk of 1.39 (95 % Confidence Interval (CI): 1.12–1.72) for individuals working long hours compared to those working standard 35–40 weekly hours (Virtanen et al. 2012), while a more recent meta-analysis based on 22 prospective cohort studies with a total of 600,000 men and women from Europe, the United States and Australia found a more modest effect. The summary relative risk of CHD for working long hours (55 h per week or more) compared to standard 35–40 h was 1.13 (95 % CI 1.02–1.26) (Kivimäki et al. 2015). The associations with stroke have received relatively little attention, in part because only one fourth of the events occur before age 65. Yet, in a recent meta-analysis of data from over 500,000 adults, a moderate relationship between long working hours and stroke was observed, the relative risk being 1.33 (95 % CI 1.11–1.61) (Kivimäki et al. 2015). Long working hours were robustly associated with increased risk of stroke across all socioeconomic groups, men and women, as well as younger and older employees. The I^2 statistics indicated that heterogeneity in effect estimates between studies was small suggesting that the evidence is consistent or reasonably consistent (Kivimäki et al. 2012; Fig. 5.1).

Job insecurity/instability defines one of the three reward components in the ERI model. This condition has been studied with regard to CHD independent of this model. Based on the findings of a systematic review (Virtanen et al. 2013) and on a more recent analysis of data from the British Whitehall II study (Ferrie et al. 2013), associations with elevated risks of CHD were observed although the effect size was reduced by the effects of adverse socioeconomic circumstances and unhealthy behaviors. Furthermore, in a series of studies from Finland, the degree of organizational downsizing was used as a proxy measures for work stress, with special emphasis on reduced job stability and security (Vahtera et al. 1997, 2004). The analysis of 22,400 employees who ‘survived’ the restructuring process by remaining in the downsized organizations showed that cardiovascular disease mortality was 2.0 (95 % CI 1.0–3.9) times higher after major downsizing than after no downsizing (Vahtera et al. 2004). High work pressure in combination with reduced job stability is a typical constellation of stressful work following the downsizing process (Cooper et al. 2012). It is of interest to note that excess cardiovascular mortality in this study occurred during the first 4 years after downsizing, thus potentially reflecting the stressful nature of this exposure (Vahtera et al. 2004). However, these findings should be interpreted with caution as the number of cardiovascular deaths was small (n = 79), and thus it is possible that the association was observed by chance. The most recent meta-analysis of job insecurity in relation to CHD risk comes from the IPD-Work consortium which aggregated data from 17 prospective studies. According to that study, employees with perceived job insecurity have 1.19 (95 % confidence interval 1.00–1.42) times higher risk of incident coronary heart disease compared to those with secure jobs, although this association was partly attributable to the worse socioeconomic circumstances and less favorable risk factor profiles among people reporting high job insecurity (Virtanen et al. 2013).

Overtime work and job insecurity/instability can be considered proxy measures of relevant aspects of high effort and low reward respectively. The *demand-control (or job strain) model* proposed by Karasek (1979) with its focus on job task profiles clearly differs from the ERI model. The job strain model not only complement the ERI model, but also preceded it being the starting point of systematic theory-based research on work stress and cardiovascular disease (Karasek et al. 1981). Up to now, the association between job strain and CHD has been studied in a large number of prospective epidemiologic associations, and several systematic reviews and meta-analyses have established a robust, statistically significant and relevant association (e.g. Kivimäki et al. 2006; Steptoe and Kivimäki 2013). Accordingly, the pooled relative risk of CHD across prospective studies is 1.34 (95 % CI 1.18–1.51) times higher for employees reporting job strain compared to those free of job strain (Kivimäki et al. 2014a). The association between job strain and incident CHD is seen in men and women, among younger and old, as well as across all levels of socioeconomic position (Kivimäki et al. 2012; see Fig. 5.1). As this effect estimate has remained remarkably stable over time, it is unlikely that additional studies using the same study design will substantially change this result (Kivimäki et al. 2014b).

Much fewer studies have analyzed the link between job strain and stroke (e.g. Tsutsumi et al. 2009; Toivanen and Hemstrom 2008; Kuper et al. 2007; Fransson et al. 2015). Recently, a large analysis resulting from the IPD-Work consortium was accomplished, containing some 1.8 million person-years at risk (mean follow-up 9.2 years). This analysis included a total of 2,023 first-time stroke events, 1,049 of them being ischemic stroke (Fransson et al. 2015). The hazard ratio for job strain relative to no job strain was 1.24 (95 % CI 1.05–1.47) for ischemic stroke, but no statistically significant association was observed for hemorrhagic or overall stroke (see Fig. 5.1).

In *summary*, a significant body of knowledge resulting from collaborative international research demonstrates robust associations of distinct components of stressful work, such as overtime work, job insecurity/instability, and job strain, defined as exposure to a highly demanding job with poor control, with elevated risk of CHD and/or stroke. In the next section, we describe how this body of evidence is complemented by a further stress-theoretical approach towards analyzing work and employment in relation to cardiovascular risk and disease.

5.3 Evidence on Effort-Reward Imbalance and Cardiovascular Disease

5.3.1 First Results from Studies in Germany

As described in Chap. 1, the ERI model was developed in the frame of a prospective study on cardiovascular risk factors and disease in a blue-collar cohort in Germany (Siegrist 1996). The core assumption of the model that a combined effect of one or more indicators of high effort *and* of low reward at work improves risk prediction over and above the effects of single indicators of the psychosocial model was analyzed in multiple ways. One of the first tests concerned the identification of men with *elevated atherogenic risk*, as defined by a clinically relevant adverse ratio of low-density to high-density lipoprotein cholesterol. A respective finding based on analysis of variance with repeated measurement demonstrated a significant effect of an interaction term of two indicators, high workload due to downsizing ('occupational instability') and low reward in terms of 'perceived job security' on atherogenic risk, after adjusting for confounders (Siegrist et al. 1988). Using logistic regression analysis to differentiate a high coronary risk group characterized by *co-manifestation of hypertension and high atherogenic lipid level* from the remaining sample of blue collars resulted in a more than threefold elevated odds ratio of a variable combining indicators of high effort and low reward, compared to those with low or no stress at work (Peter 1991). Similar findings were obtained from a cross-sectional study on male middle managers, where a combination of high effort and low reward was associated with elevated odds of hypertension (Peter and Siegrist 1997) and co-manifestation of atherogenic lipids and elevated fibrinogen (Siegrist et al. 1997).

Importantly, the core hypothesis was tested to predict *incident CHD* over a 6.5 years observation period in the blue-collar cohort. While less than 8 % of those who remained free from CHD exhibited the critical constellation of high effort and low reward, compared to 38 % of future CHD victims, a robust regression estimate was not observed probably due to the small number of cases (Siegrist et al. 1990). However, inclusion of cases with sub-clinical CHD resulted in a multivariate odds ratio of 6.1 (95 % CI 2.0–18.8) (Siegrist and Peter 1994).

5.3.2 Replications and Extensions

Clearly, these preliminary results required independent replication from prospective investigations with larger sample size and longer follow-up periods. Data from the *British Whitehall II study* provided one such opportunity. In 1998, results of the first comparative test of the demand-control and the ERI models of work stress were published, based on data from 6895 male and 3413 female civil servants (Bosma et al. 1998). Indicators of effort and reward were computed from the baseline questionnaire which also contained items based on the job strain questionnaire measuring demand and control at work. In addition, an externally assessed measure of job control was included. Incident CHD including self-reported angina pectoris over a mean 5.3 years of follow-up was linked to baseline levels of work stress. The imbalance between intrinsic efforts and job-related rewards (poor promotion prospects, blocked career) was associated with a 2.15-fold higher risk of new CHD, independent of the effects of the alternative job strain model. Low job control, but not the combination of high demand and low control (i.e., job strain), was linked to an elevated CHD risk of 2.38 if job control was self-reported, and of 1.56 if externally assessed. In both cases, adjustment for relevant confounders was made, including negative affectivity as a potential reporting bias. That study demonstrated for the first time an independent explanatory contribution of either work stress model with respect to CHD.

In 2002, a *new analysis* of Whitehall II data was performed, with an improved measurement of the components ‘effort’, ‘reward’ and ‘over-commitment’ and with a longer observation period (mean length 11 years) (Kuper et al. 2002). In the final multivariable adjusted model, *the risk of fatal or non-fatal CHD was elevated* by 26 % among those scoring high on effort-reward imbalance, and equally among those with a high level of over-commitment, compared to the group free of effort-reward imbalance and over-commitment.

A further prospective study was conducted among *blue-collar workers in Finland*, where a cohort of 812 employees who were free from cardiovascular diseases at baseline was followed over a mean period of 25.6 years. After adjustment for age and gender, employees with effort-reward imbalance, measured as low salary, lack of social approval, and few career opportunities relative to effort required at work, had a 2.4-fold (95 % CI 1.3–4.4) cardiovascular mortality risk compared with employees with low or no stress at work (Kivimäki et al. 2002). This ratio remained significant after additional adjustment for occupational group and biological and behavioral risks at baseline. Importantly, this study observed a similar risk ratio for the combination of high demands at work and low job control, thus confirming the independent prediction of cardiovascular risk by the two complementary work stress models (Kivimäki et al. 2002). A more detailed re-analysis of these data, taking into account the impact of adverse socioeconomic circumstances in childhood and in adulthood, confirmed that hazard ratios for cardiovascular mortality remained virtually unchanged. For instance, with income (salary) as an indicator of adult socioeconomic position, the hazard ratio was 2.56 (95 % CI 1.2–5.3) in case of effort-reward imbalance, and 2.15 (95 % CI 1.1–4.4) in case of job strain (Brunner et al. 2004). A drawback was a low number of outcome events (72 cardiovascular deaths).

The vast majority of investigations in this field were interested in explaining the occurrence of new CHD events in occupational groups initially disease free. Yet, as preventing recurrence of CHD among those who survived their first acute myocardial infarction is a significant clinical and public health problem, it is unfortunate that very few studies have examined the role of stressful work in predicting recurrent CHD. A recent meta-analysis included five such prognostic studies with follow-up of >3 years and clinical ascertainment of recurrent events. A *significant association with recurrent CHD* was observed, with a hazard ratio (HR) for ERI relative to non-ERI of 1.65 (95 % CI 1.2–2.2) (Li et al. 2015a). One of the five studies recruited a group of 738 middle-aged men and women with first myocardial infarction in Canada. In that study, ERI was associated with a hazard ratio of 1.75 (95 % CI 0.99–3.08) with a similar association for low reward only (HR: 1.77 (95 % CI 1.16–2.71 (Aboa-Eboulé et al. 2011). Recently, a perception of worsening psychosocial work characteristics has also been linked to an increased cardiovascular disease risk (Li et al. 2015a). In a group of female hospital nurses, for example, individuals who experienced an increase in ERI had a higher rate of prevalent or incident CHD (Li et al. 2015b). Thus, there is preliminary evidence to suggest that psychosocial work characteristics may not only be associated with the development of CHD but also its course, a finding relevant for the secondary prevention of CHD.

A major challenge is to understand the nature of these associations. In the original German research described above, effort-reward imbalance at work was not only associated with incident disease risk, but also elevated probability of several cardiovascular risk factors that could mediated the associations with endpoints. These preliminary findings have in part been confirmed by independent studies. One of the first investigations came from Sweden, where baseline data from a cohort of 5720 healthy employed men and women showed that high effort, low reward, and over-commitment were differentially related to cardiovascular risk factors according to gender. Among men, the adjusted prevalence odds ratio (POR) of *hypertension* was 1.62 (95 % CI 1.07–2.43) for those with an effort-reward ratio higher than 1.0 (Peter et al. 1998), whereas over-commitment was not related to cardiovascular risk. Among women, over-commitment, but not effort-reward imbalance ratio, was associated with *elevated LDL cholesterol* (POR 1. 39 (95 % CI 1.09–1.77). While these findings are derived from a cross-sectional analysis, additional results from investigations with a prospective design have been reported. In a study of 1595 white collar workers in Canada, work stress and blood pressure were assessed twice over a 3 years period. Among women aged 45 or older with a high level of effort-reward imbalance at both times, the cumulative *incidence of hypertension* was 2.78 times higher than in unexposed women of the same age. Additionally, it was found that men and women scoring high on over-commitment had higher mean blood pressure at the end of follow-up than those scoring low (Gilbert-Ouimet et al. 2012). Further findings along these lines from naturalistic studies of physiological activity in everyday life or from experiments have been reported in Chap. 7.

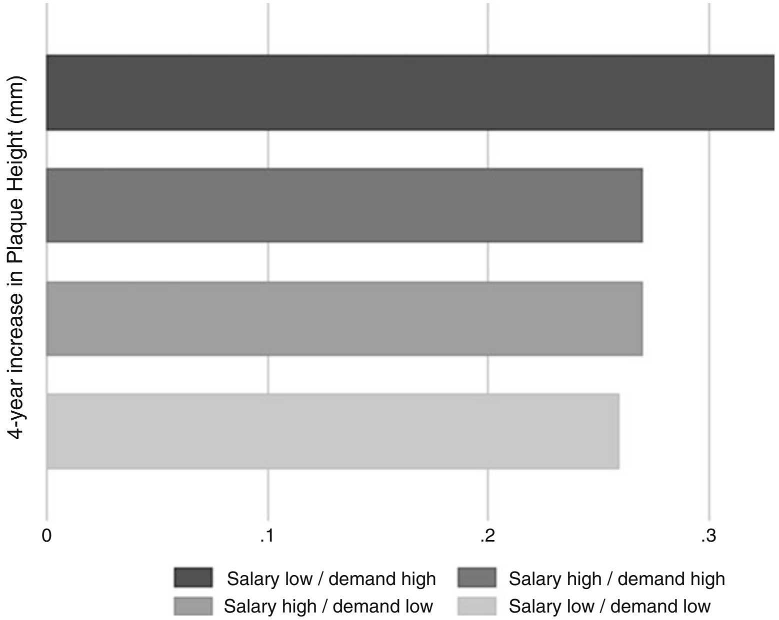

Fig. 5.2 Mean increase of carotid intima media thickness (mm) over a 4 year period according to effortful job and economic reward (four groups of male blue collar workers in Finland (n = 940)). Significant increase in the high stress group after adjustment for baseline and relevant confounders (0.32 ± 0.02 mm; p = .04) (Own visualization based on (Lynch et al. 1997) and adapted from (Siegrist 2015))

Lastly, there is some evidence to support the missing link from work-stress to preclinical disease. Of the two studies addressing this question, the first was conducted among 940 Finnish men. In that study, *increase in carotid intima media thickness* (CIMT) over a 4 year period was analyzed according to effortful job and economic reward, interpreted as proxy measures of the ERI model. As shown in Fig. 5.2, men with effortful jobs in combination with low salary exhibited a faster mean progression of plaque height than those without this stressful combination. The magnitude of this difference was not substantially reduced after adjustment for important confounders (Lynch et al. 1997).

The second study was conducted in China and included assessment of CIMT and ERI among 508 men and 226 women. Each ERI component was associated with CIMT in men and women in bivariate analyses and this result was robust to multivariable adjustments among women: This was not the case in men as the statistical significance was lost after adjustment for age, hypertension, hyperlipidemia, diabetes mellitus, or body weight (Xu et al. 2010).

In summary, there is a growing body of evidence indicating that the ERI model contributes to the explanation of cardiovascular risk factors, of subclinical and overt cardiovascular disease (especially coronary events) in addition to already existing substantial amount of knowledge on psychosocial adversity at work.

5.4 Open Methodological Issues and Implications for Prevention

5.4.1 Strengthening Methodological Quality: Assessing Bias and Confounding

Bias and confounding are important considerations when evaluating observational epidemiological evidence. One of the main reasons of establishing the IPD-Work consortium was to strengthen the methodological quality of research in this field, with a special focus on attempts to minimize biases and confounding that often threaten the validity of results obtained from observational studies.

One of the first improvements of methodological quality of research in this consortium was the attempt to minimize post hoc decision making when testing hypotheses on the link of work stress with cardiovascular disease. This was obtained by *defining the measurement* of the predicting variables and by publishing these procedures well *in advance to the factual analysis* of empirical data. For instance, with regard to the measurement of the job strain model, the exposure was harmonized across cohorts in a validation study, with investigators masked to outcome information (Fransson et al. 2012). A similar procedure was applied in case of the ERI model (Siegrist et al. 2014).

Second, to evaluate and reduce *publication bias*, both published and unpublished data were used in meta-analyses by the IPD-Work consortium (e.g. Kivimäki et al. 2012. Steptoe and Kivimäki 2013; see also Kivimäki et al. 2014b). Furthermore, to reduce random error and allow sub-group analyses, the largest available databases to date were used (in case of long working hours, for example, over 600,000 study members contributing 4,800 CHD events were included in the analysis; Kivimäki et al. 2015).

Third, an often stated criticism of observational studies, even those with a prospective design, relates to the problem of *reverse causation*. It is argued that a bias in self report data on work stress may arise among participants with advanced preclinical disease or an already existing, still undiagnosed disease under study, such that the disease may have an impact on perceptions of, and susceptibility to, stressful work. To minimize this bias, disease events that occurred in the first few years of follow-up were excluded from the analyses (left-censoring). There was no strong evidence to suggest that the summary estimates for the association between work stressors and cardiovascular disease would be importantly confounded or biased. In view of the large sample size in the pooled evidence, it is also unlikely that the association would have been observed by chance (Kivimäki et al. 2014a).

Having addressed several methodological limitations of bias and confounding and having met most of the Bradford Hill criteria required for postulating a causal relationship between exposure (work stress) and health outcome (cardiovascular disease) in epidemiologic research there remains still a substantial challenge, i.e. the demonstration that eliminating the exposure is followed by a reduction in disease incidence (Bradford Hill 1965). Obviously, it seems almost impossible to conduct *randomized controlled trials* (RCTs) with adequate statistical power to demonstrate that a substantial reduction of psychosocial stress at work results in a clinically meaningful decrease in the incidence of cardiovascular disease. While recent advances of intervention studies in this field of research are discussed in a later chapter (see Chap. 15), the lack of feasibility of RCTs must be considered a one of the key methodological limitation in this field of research.

5.4.2 Implications for Clinical Practice, Policy and Future Research

In recent years, several policy initiatives have been developed to strengthen healthy work, not least as a reaction to a growing public awareness of the potential adverse health effects of stressful work. Research evidence, such as that discussed in this chapter, can support and strengthen public awareness and instruct decision-making at political level. One such policy initiative concerns the restriction of excessive working hours. In many countries, preventing excessive work stress is a legal obligation. For instance, the European Union Working Time Directive provides employees the right to limit their average weekly working time to 48 h, and the European Agency for Safety and Health at Work has launched the healthy workplaces campaign 2014–2015 to promote psychosocial work environment.

While these developments are welcome, there remains nevertheless the question whether work stress also ought to be considered as a target for cardiovascular disease prevention. There is general agreement that prevention strategies should be based on an evaluation of the evidence on benefits, harms and cost-effectiveness using systematic and transparent approaches, such as the GRADE (Grades of Recommendation Assessment, Development and Evaluation) system (Balshem et al. 2011). Evaluation for scientific quality begins with a systematic review of the best available evidence for a given risk factor. Without evidence from intervention studies, the GRADE conclusion that applies to the evidence to date is that "the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different" (Balshem et al. 2011, p. 404). Although there is no definitive indication for stress reduction in the primary prevention of cardiovascular events in clinical practice, as mentioned above, promoting awareness of the link between stress and heart health would seem to be a worthwhile goal in workplace wellness promotion. We encourage investigators in the field to focus on potential psychological, behavioral and biological mechanisms mediating links between work stress and health outcomes as this is still a major gap in the current evidence base. We also encourage stress researchers to conduct intervention studies to determine whether the observed associations can be replicated in experimental designs, such as cluster-randomized trials, or natural experiments. Such studies come with great challenges, but they are needed to advance research in a field which hitherto has been dominated by observational evidence.

In *conclusion*, substantial progress in research on associations of distinct aspects of stressful work with cardiovascular disease has been made in recent years. This holds true especially for study of long working hours (as an indicator of high effort at work), job insecurity/instability (as an indicator of low reward at work), job strain, the most-widely used work stress model, as well as for the complementary work stress model of ERI. Whereas scientific challenges still remain to be addressed by future research, a robust body of knowledge is already available to support initiatives of strengthening healthy work at different policy levels.

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Chapter 6
Effort-Reward Imbalance and Affective Disorders

Reiner Rugulies, Birgit Aust, and Ida E.H. Madsen

In this chapter, we examine whether effort-reward imbalance (ERI) at work may contribute to the development of affective disorders. Affective disorders describe affective excesses, encompassing both elated and depressed affect. Excessive elated affect pertains to mania and bipolar disorders, excessive depressed affect without history of elated affect pertains to depressive disorders. Here, we mainly focus on depressive disorders. The reasons are, first, that depressive disorders are of particular public health relevance as they are regarded as one of the most important contributors to the loss of healthy life years in the world. Second, whereas ERI has been discussed as a potential risk factor for depressive disorders, we are not aware of discussions relating ERI to elevated mood and disorders in the manic or bipolar spectrum. This chapter has four major sections. Section 6.1 examines the construct of affective disorders by attending to current and past debates on conceptualisation and diagnosis. Section 6.2 discusses different theories on the causation of affective disorders, including the potential role of ERI. Section 6.3 presents the results of a systematic review of the epidemiological literature on ERI as a risk factor of affective disorders. Finally, Sect. 6.4 gives an outlook on where to go with research on ERI and affective disorders in the future.

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6.1 What Are Affective Disorders?

As a psychiatric term, the category of affective disorders, encompassing the diagnoses of mania, bipolar disorders and depressive disorders, is a relatively new invention, evolving in the eighteenth century (Blazer 2005, pp. 39–56). Before this point, phenomena now associated with depressive disorders, such as sadness, dysphoria, anhedonia, gloom, weariness, exhaustion, and despair were captured in the term *melancholia* dating back to the work of Hippocrates (ca. 460–370 BCE) and his humoral theory positing that diseases are caused by an imbalance in the four basic bodily liquids; blood, black bile, yellow bile, and phlegm (Blazer 2005, pp. 39–56; Krieger 2011, pp. 42–57). Melancholia was thought to be caused by an excess of black bile (Greek: μέλαινα χολή, *melaina chole*).

Psychiatry arose in Europe in the eighteenth and nineteenth century from the asylums, grim places that since the fifteenth century had incarcerated under horrible conditions a diverse population of people who were not fitting into the new rational society emerging from mercantile capitalism (Dörner and Plog 1996, pp. 459–479; Davison and Neale 1990, pp. 7–22). The probably most influential person for the new medical discipline of psychiatry was the German psychiatrist Emil Kraepelin (1856–1926) who developed a comprehensive classification system of mental disorders that has influenced psychiatry up until today (Kendler 1986; Shorter 2015). Kraepelin introduced a sharp dichotomy between *dementia praecox* and *manic-depressive insanity*. In contemporary psychiatry dementia praecox corresponds to the diagnosis of schizophrenia, whereas manic-depressive insanity corresponds to the diagnostic group of affective disorders.

Kraepelin's paradigm was one of *somatogenesis*, i.e. he posited that psychiatry is a sub-discipline of general medicine and that psychiatric phenomena were caused by disorders in bodily structures and processes, in particular in the brain (Davison and Neale 1990, pp. 19–20; Shorter 2015). Other paradigms claim *psychogenesis*, i.e. causation by psychological states and processes, and *sociogenesis*, i.e. causation by social environment and social structures (Davison and Neale 1990, pp. 29–59; Keupp 1988; Shorter 2015). Paradigms that attempt to mediate between somatogenesis, psychogenesis and sociogenesis are diathesis-stress models and bio-psycho-social approaches (Davison and Neale 1990, pp. 55–57; Dörner and Plog 1996; Engel 1977; Monroe and Simons 1991). A more detailed discussion of different theories on the causation of affective disorders is presented in Sect. 6.2.

The two main diagnostic tools for mental disorders are the *International Statistical Classification of Diseases and Related Health Problems* of the World Health Organization, covering both physical diseases and mental disorders, currently in its 10th version (ICD-10, World Health Organization 2015), and the *Diagnostic and Statistical Manual of Mental Disorders* of the American Psychiatric Association of the USA, solely covering mental disorders, currently in its 5th edition (DSM-5, American Psychiatric Association 2013). Whereas the ICD-10 is the universal coding system for reimbursement, mandatory for numerous health professions worldwide (Reed et al. 2011), the DSM is probably the most influential tool in psychiatry, spearheading paradigm shifts in the field (Shorter 2015). The most fundamental change happened when the DSM-II (American Psychiatric Association 1968) was replaced with the DSM-III (American Psychiatric Association 1980), a revolutionary shift that transformed psychiatry, first in the USA and subsequently worldwide (Mayes and Horwitz 2005; Shorter 2015; Kawa and Giordano 2012).

6.1.1 From Endogenous and Exogenous Depressive Disorders to a Unitarian Model

The DSM-II, released in 1968, was strongly influenced by psychodynamic theories in the Freudian tradition that had dominated the psychiatry of post-second world war USA (Mayes and Horwitz 2005; Shorter 2015). Regarding affective disorders, the DSM-II made a major distinction between *endogenous* depressive disorders, i.e. depressive disorders that primarily originated from within the person (encompassing the diagnoses of *involutional melancholia* and *manic-depressive illness*, *depressive type*) versus *exogenous* depressive disorders, i.e. depressive disorders that were an excessive reaction to life experiences (encompassing the diagnoses of *psychotic depressive reaction* and *depressive neurosis*) (American Psychiatric Association 1968; Blazer 2005, pp. 39–56; Akiskal and McKinney 1973).

In contrast, the DSM-III, replacing the DSM-II in 1980, dropped the psychodynamic theories, stated that for most mental disorders the aetiology is unknown and declared itself as "atheoretical with regard to etiology or pathophysiological process except for those disorders for which this is well established and therefore included in the definition" (American Psychiatric Association 1980, p. 7).

In accordance with this atheoretical approach, the aetiological concepts of different endogenous and exogenous caused depressive disorders were replaced by a unitarian model with one main diagnosis, *major depressive episode*, a diagnosis strictly based on number and severity of symptoms and level of impairment. The DSM-III allowed, though, a diagnosis called *dysthymic disorder* (followed by a parenthesis including the abandoned term of *depressive neurosis*) that described a chronic but milder form of depressive disorders. Robert L. Spitzer the chairman of the DSM-III task force later explained that this diagnosis was a comprise and a part of what he coined as *the neurotic peace treaty* that had to be made to get the approval of the psychodynamic oriented psychiatrists on the American Psychiatric Associations' board of trustees (Bayer and Spitzer 1985).

6.1.1.1 Reasons for the Paradigm Shift

According to Mayes and Horwitz (2005) the DSM-III revolution had multiple reasons, including concerns that the government and insurance companies no longer would pay for psychotherapies that were directed towards the "worried well" instead towards individuals with severe disorders, threats by other professional groups such as clinical psychologists and social workers that were offering "talk therapy" at cheaper rates than psychiatrists, and a desire to make psychiatry more research-focused like other branches of medicine. Mayes and Horwitz concluded:

> The DSM-III's creation was not the result of a carefully orchestrated conspiracy, but neither was it an accident or 'chance-like sequence' of events as some have argued. It did not stem from any new knowledge about the causes of mental illnesses nor their treatments. […] Instead, its symptom-based focus stemmed from the efforts of research-oriented psychiatrists who wanted to standardize diagnostic criteria and focus attention on the symptoms of mental disorders, rather than on their underlying causes. (Mayes and Horwitz 2005, p. 265)

To replace endogenous and exogenous depressive disorders with a unitarian model had already been proposed in 1973, in an influential article published in *Science* by Akiskal and McKinney. They suggested a model of gene-environment interaction, in which genetics, psychosocial stress and neurochemical changes would lead to a "neurophysiologic final common pathway" of depressive disorders (Akiskal and McKinney 1973). With the DSM-III, the unitarian model became reality in the new diagnosis of a major depressive episode that quickly developed into the "bread and butter of psychiatry" (Blazer 2005, p. 29).

6.1.1.2 Critique of the Unitarian Model

Some psychiatrists have argued that clinical differences, for example regarding psychomotor disturbances and responsiveness to psycho-pharmaceutical and electroconvulsive therapy, contradict the unitarian model and call for a distinction between a melancholic and non-melancholic depression, with the former regarded as the more severe disorder (Bolwig and Shorter 2007; Parker 2000; Parker et al. 2010).

From a social epidemiological point of view, Dan G. Blazer, a prominent psychiatrist and member of the DSM-5 task force, pointed out that the unitarian model of a major depressive episode and the loss of the terms of endogenous and exogenous had negatively impacted psychiatry.

> The disappearance of the concept of depression as a reaction (not the designation *depressive reaction*) is an unfortunate constriction of psychiatric thought. Depression is once body, mind and environment. Depression is at once endogenous and exogenous. The interaction of the person with the social environment elicits and shapes what comes to be labeled as a psychiatric disorder, such as major depression. (Blazer 2005, p. 55)

According to Blazer (2005) the "birth and growth of major depression" (pp. 19–37) elicited a decreased interest in aetiology and an increased focus on diagnosis and psycho-pharmaceutical treatment of symptoms that promoted a reductionist somatogenic perspective and the retreat of social psychiatry, at least in the USA.

6.1.1.3 Developments Since the DSM-III

The subsequent DSM editions of DSM-III-Revision (1987), DSM-IV (1994), DSM-IV-Text Revision (2000) and DSM-5 (2013) retained the unitarian model of a major depressive episode, however several changes were made to the diagnostic criteria. In the latest edition, DSM-5, two new diagnoses were added; *disruptive mood dysregulation disorder* that was included to offer an alternative to the diagnosis of bipolar disorders in children that were regarded as overdiagnosed and overtreated (American Psychiatric Association 2013, p. 811) and *premenstrual dysphoric* *disorder* that was promoted from an appendix in DSM-IV-TR to a fully recognised diagnosis. In addition, the DSM-5 removed the so-called *bereavement exclusion*, which had stipulated that under certain conditions a major depression should not be diagnosed in the first 2 months after the death of a loved one (American Psychiatric Association 2000, p. 356). In particular the removal of the bereavement exclusion was harshly criticized as a pathologisation of normal grief that would lead to dramatic increase in false positive diagnosis (Dowrick and Frances 2013; Wakefield 2015a, b). It was also pointed out that a large number of members of the DSM-5 task force received financial support from pharmaceutical companies who have an interest in expanding diagnoses of psychiatric disorders (Raven and Parry 2012; Cosgrove and Krimsky 2012). Proponents of the removal of the bereavement exclusion argued that the exclusion was not applicable in praxis (Corruble 2012), and that psychiatry should not "'normalize' the serious disorder of major depression simply because it occurs in the context of recent bereavement" (Pies 2014, p. 21).

6.1.2 The Diagnosis of Affective Disorders in the ICD-10

Although the DSM has generated most of the controversial debates in psychiatry, the main international diagnostic tool for psychiatric disorder is the ICD (Reed et al. 2011). The current version, ICD-10, came in use in 1994. With regard to affective disorders, the ICD-10 classifications are similar but not completely identical to the classifications from the DSM-III and its subsequent editions.

6.1.2.1 ICD-10 Diagnostic Codes F30 to F39

In the ICD-10, mood (affective) disorders belong to *Chapter V*: *Mental and behavioural disorders*, and encompass the diagnostic codes in the block F30 to F39 (World Health Organization 1992, 2015). Table 6.1 gives an overview of these codes. Disorders that include excesses in elated mood are classified under the diagnostic codes F30 (mania) and F31 (bipolar disorders). Here, the ICD-10 and DSM-5 differ, as the DSM-5 does not have a separate category for mania, but instead includes diagnoses of bipolar I and bipolar II, with the former comprising mania with and without depressive episodes (American Psychiatric Association 2013, pp. 123–154). The disorders of most interest for this chapter are classified in the ICD-10 under the diagnostic codes F32 (depressive episode) and F33 (recurrent depressive episode) that correspond to the DSM-5 diagnosis of a major depressive episode.

Table 6.2 shows the ICD-10 diagnostic criteria for a depressive episode. As in the DSM, diagnosis is based on the presence of specific symptoms, regardless of possible causes. There are three core symptoms (depressed mood, loss of interest and enjoyment, and reduced energy) and seven accompanying symptoms, with the combination of these two categories of symptoms leading to the diagnoses of a mild, moderate or severe depressive episode (see Table 6.2). The symptoms should be present for at least 2 weeks, although the ICD-10 allows shorter periods if "symptoms are unusually severe or of rapid onset" (World Health Organization 1992,

Table 6.1 ICD-10 diagnoses for mood [affective] disorders (F30-F39)

F30 manic episode
Hypomania (F30.0); mania without psychotic symptoms (F30.1); mania with psychotic symptoms (F30.2); other manic episodes (F30.8); manic episode, unspecified (F30.9)
F31 bipolar affective disorder
Current episode hypomanic (F31.0); current episode manic without psychotic symptoms (F31.1); current episode manic with psychotic symptoms (F31.2); current episode mild or moderate depression (F31.3); current episode severe depression without psychotic symptoms (F31.4); current episode severe depression with psychotic symptoms (F31.5); current episode mixed (F31.6); currently in remission (F31.7); other bipolar affective disorders (F31.8); bipolar affective disorders, unspecified (F31.9)
F32 depressive episode
Mild (F32.0); moderate (F32.1); severe without psychotic symptoms (F32.2); severe with psychotic symptoms (F32.3); other depressive episodes (F32.8); depressive episodes, unspecified (F32.9)
F33 recurrent depressive disorder
Mild (F33.0); moderate (F33.1); severe without psychotic symptoms (F33.2); severe with psychotic symptoms (F33.3); in remission (F33.4); other recurrent depressive disorders (F33.8); recurrent depressive disorder, unspecified (F33.9)
F34 persistent mood [affective] disorders
F34.0 Cyclothymia (F34.0); dysthymia (F34.1); other persistent mood [affective] disorders (F34.8); persistent mood [affective] disorders, unspecified
F38 other mood [affective] disorders
Other single mood [affective] disorders (F38.1); other recurrent mood [affective] disorders (F38.1); other unspecified mood [affective] disorders (F38.8)
F39 unspecified mood [affective] disorder

Information in this table derived from: 1) World Health Organization (1992). The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines. World Health Organization, Geneva. Available from: http://www.who.int/classifications/icd/en/bluebook.pdf and 2) World Health Organization (2015). International Statistical Classification of Diseases and Related Health Problems 10th Revision. ICD-10: Version 2015 (Web Page). Available from: http://apps.who.int/classifications/icd10/browse/2015/en (Accessed 3 October 2015).

p. 100). It is assumed that depressive episodes will be accompanied with reduced functioning in core areas of life (work, education, domestic, social), with more severe impairments in the case of a severe depressive episode.

6.1.2.2 Other Disorders and Conditions Related to Affective Disorders

In addition to block F30 to F39 there are also other places in the ICD-10 with diagnostic codes that are related to affective disorders. Some of them might be of particular interest with regard to a possible role of the work environment in the aetiology of affective disorders. Block F40–49 covers heterogeneous diagnoses related to *Neurotic*, *stress-related and somatoform disorders* including *Mixed anxiety and depressive disorder* (F41.2), *Reaction to severe stress*, *and adjustment disorders* (F43) and *Neurasthenia* (F48), a disorder characterized by feelings of extreme mental or bodily fatigue, or both that was from the mid-nineteenth to the early twentieth century at frequently diagnosed mental disorder, in particular in the USA (Crocq

Table 6.2 ICD-10 diagnostic criteria for depressive episode (F32, F33)

Core symptoms
Depressed mood
Loss of interest and enjoyment
Reduced energy leading to increased fatiguability and diminished activity
Accompanying symptoms
Reduced concentration and attention
Reduced self-esteem and self-confidence
Ideas of guilt and unworthiness (even in a mild type of episode)
Bleak and pessimistic views of the future
Ideas or acts of self-harm or suicide
Disturbed sleep
Diminished appetite
Diagnosis
Symptoms should be present for at least 2 weeks
Mild depressive episode: at least four symptoms including two core symptoms
Moderate depressive episode: at least five, preferable six symptoms including two core symptoms
Severe depressive episode: at least six symptoms including all three core symptoms

Information in this table derived from: World Health Organization (1992). The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines. World Health Organization, Geneva. Available from: http://www.who.int/classifications/icd/en/bluebook.pdf.)

2015; Ehrenreich, pp. 74–96). Deep down in the ICD-10, there is a C*hapter XXI*: *Factors influencing health status and contact with health services* including several codes for *Problems related to employment and unemployment* (Z56.0–Z56.7) and a code for *Burn-out* (Z73.0), a condition, like neurasthenia, characterised by high levels of fatigue and exhaustion (Maslach et al. 2001; Kristensen et al. 2005; Schaufeli and Taris 2005). Finally, outside of the ICD-10, there is a substantial literature on conditions called various names, for example *minor depression*, *sub-syndromal depression*, or *sub-threshold depression* that challenge the notion that depressive disorders should be viewed as categorical and not as continuous entities (Fogel et al. 2006; Pincus et al. 1999; Rodriguez et al. 2012; Solomon et al. 2001).

6.1.3 Prevalence of Affective Disorders

In the National Comorbidity Survey Replication study (NCS-R), conducted in the USA from 2001 to 2003, the 12-month prevalence of a major depressive episode was estimated as 6.6 % (Kessler et al. 2003), whereas bipolar I and bipolar II disorders had a prevalence of 0.6 and 0.8, respectively (Merikangas et al. 2007). A review of 17 European studies (Wittchen and Jacobi 2005) found similar results (6.9 % for major depressive disorders and 0.9 % for both bipolar disorders combined).

Life-time prevalence of affective disorders is more difficult to estimate as investigators have to rely on the ability of the participants to accurately recall depressive episodes in the past. A review of 16 studies found life-time prevalence of depressive disorder in the range of 3.0–24.4 % with a mean of 11.7 % (Goodwin et al. 2006). In NCS-R, life time prevalence of a major depressive episode was 16.2 % (Kessler et al. 2003), whereas life time prevalence of bipolar I and II disorders was about 1 % each (Merikangas et al. 2007). In an article, published in 2010, Moffitt et al. challenged the estimate for depressive disorders as too low. Using data from the Dunedin New Zealand birth cohort, a unique cohort with a retention rate of 96 % of the participants at age 32, they assessed life-time prevalence of depressive disorders by combining measures on 12-month prevalence conducted at age 18, 21, 26, and 32. This yielded a life-time prevalence of major depressive episode at age 32 of 41.4 %, i.e. a prevalence that was more than double as high as the rate in NCS-R. Moffitt et al. (2010) argued that traditional epidemiological studies have underestimated the prevalence of psychiatric disorders, including depressive disorders, because of incomplete samples that did not include homeless and institutionalized individuals and due to failure of respondents to recall episodes of disorders that occurred years or even decades ago.

6.2 Aetiology of Affective Disorders

Numerous somatogenic, psychogenic and sociogenic theories of the aetiology of affective disorders have been proposed, but the empirical evidence is still limited. Today, it is widely assumed that affective disorders involve a complex interplay of biological, psychological and social factors and processes and that a bio-psycho-social model is most appropriate for understanding the causal pathways (Caspi and Moffitt 2006; Dörner and Plog 1996; Harris 2001; Kendler et al. 2002, 2006; Licinio and Wong 2005). However, the majority of contemporary psychiatric research is conducted on biological factors (Blazer 2005, pp. 52–56), which have lead some researchers to conclude that the bio-psycho-social model in reality is a bio-bio-bio model (Read 2005; Whitley 2014).

In the following, we review different theories on the aetiology of depressive disorders, while not considering disorders in the manic and bipolar spectrum. First, we address the dominant contemporary theory in psychiatry, which views depressive disorders as a disorder of the brain, likely caused by a gene-environment interaction. Next, we focus on psychological and sociological theories. The section concludes with a discussion of the ERI model as an approach that may bridge sociological and psychological theories of the aetiology of depressive disorders.

6.2.1 The Dominant Theory in Psychiatry: A Brain Disorder Caused by Gene-Environment-Interactions

In the preface of the book "Biology of depression", Licinio and Wong describe depression as

> … a common and complex disorder of gene-environment interactions for which the specific genetic and environmental substrates are still unknown. (Licinio and Wong 2005, p. vii)

The National Institute of Mental Health (NIMH) of the USA, the world's largest funding institution of mental health research, states in a booklet under the header "What causes depression?"

> Most likely, depression is caused by a combination of genetic, biological, environmental, and psychological factors. Depressive illnesses are disorders of the brain. Longstanding theories about depression suggest that important neurotransmitters – chemicals that brain cells use to communicate – are out of balance in depression. But is has been difficult to prove this. (National Institute of Mental Health 2011, p. 6)

These two quotes represent well the dominant contemporary opinion in psychiatry. Depressive disorders are thought to be highly complex and caused by a wide range of different interacting factors, in particular gene-environment interactions related to chemical processes in the brain.

6.2.1.1 Neurochemical Processes

The hypothesis that depressive disorders may be caused by an imbalance of neurochemicals, in particular with regard to *monoamine neurotransmitters* (neurotransmitters containing one amino group, e.g., noradrenalin, dopamine or serotonin) emerged in the 1950s, following the discovery of chlorpromazine as a treatment of psychotic disorders and the testing of the first antidepressants, iproniazid and imipramine (France et al. 2007). Since then, the chemical imbalance or monoamine hypothesis not only inspired numerous research studies but also became a widely spread narrative in the lay audience and in public debates (France et al. 2007; Healy 2015). As evident from the above-listed quote, NIMH endorses the chemical imbalance hypothesis as likely, although acknowledging that the hypothesis "has been difficult to prove". Indeed, despite of a large number of research studies, no biomedical measure of depression has been identified yet, and neither measures of neurochemicals nor neuroimaging can distinguish individuals with depressive disorders from individuals without such disorders (France et al. 2007; Insel 2014).

In the absence of biomarkers for depression, support for the brain chemical hypothesis may be found in studying the efficacy of pharmaceuticals, in particular Selective Serotonin Re-uptake Inhibitors (SSRIs) that target the neurotransmitter serotonin. However, even though SSRIs are widely used in the treatment of depressive disorders and have become a huge commercial success for pharmaceutical companies (Shorter 2014) their efficacy is discussed controversially (Gøtzsche 2014; Nutt et al. 2014). Recent reviews and meta-analyses of randomized controlled trials indicate only modest efficacy of antidepressants (Khan and Brown 2015; Fournier et al. 2010; Kirsch et al. 2008). A meta-analysis by Fournier et al. (2010) concluded that treatment effects of antidepressants compared to placebo "were non-existent to negligible among depressed patients with mild, moderate, and even severe baseline symptoms, whereas they were large for patients with very severe symptoms" (Fournier et al. 2010, p. 51). Assessing the efficacy and the potential harms of antidepressants is hampered by both publication bias, as there is a systematic underreporting of trials that found no efficacy (Turner et al. 2008), and highly problematic research conduct in some trials that overstated benefits and understated harms of antidepressants (Gøtzsche 2015, p. 46–131; Le Noury et al. 2015).

6.2.1.2 Dysregulation of the Hypothalamic-Pituitary-Adrenal Axis

A dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis is of particular interest for research on the contribution of psychological and social factors in the aetiology of depressive disorders, because environmental stressors, including adverse working conditions, may contribute to the dysregulation (Steptoe and Ayers 2004). In recent years, HPA dysregulation and other stress-physiological mechanism have been linked to depressive disorders through loss of neuroplasticity, inhibition of neurogenesis, and increased inflammation (Gold 2015; Pariante and Lightman 2008; Pittenger and Duman 2008). However, knowledge is far away from being conclusive and at the current stage, HPA axis dysregulation as a risk factor for depressive disorders is a hypothesis that needs further research (Knorr et al. 2010; Stetler and Miller 2011; Vammen et al. 2014).

NIMH recently launched a major programme, called *Research Domain Criteria* (*RDoC*) (Insel et al. 2010; Insel 2014) that aims to generate "precision medicine for psychiatry" by creating "a framework for research on pathophysiology, especially for genomics and neuroscience" (Insel et al. 2010 p. 748). Whether this research will lead to a new and better understanding of depression as a brain disorder remains to be seen.

6.2.1.3 Gene-Environment Interaction

Research on gene-environment interaction holds the promise of integrating biological, psychological and social factors into a common model. In a seminal article Caspi et al. (2003) reported that the number of stressful life events predicted risk of major depression at age 26 in a dose-response fashion and that the strengths of association was modified by a polymorphism in the serotonin transporter gene (5-HTTLPR). The association of adverse life events and risk of major depression was strongest among participants with two short alleles on 5-HTTLPR, weaker among those with one short and one long allele and even more weak (but still clearly visible) among those with two long alleles.

Numerous studies aimed to replicate the findings but results are mixed. In 2009 Risch et al. concluded, based on a meta-analysis of 14 studies, that adverse life events predict onset of depressive disorders but that there was "no evidence that the serotonin transporter genotype alone or in interaction with stressful life events is associated with an elevated risk of depression" (Risch et al. 2009, p. 2462). A more recent meta-analysis of 81 studies, though, found an overall effect modification by 5-HTTLPR, but also pointed out that "nearly 26 % of the 81 studies reviewed failed to show any significant associations between the 5-HTTLPR, stress and depression, and 4 studies found opposite results to those expected" (Sharpley et al. 2014, p. 89). The authors concluded that 5-HTTLPR appears to be an effect modifier in the stressor-depression relationship, but that the number of non-supporting studies is too large to dismiss and that more research is needed to explain the heterogeneity of the findings, in particular with regard to different subtypes of depressive disorders.

In a recent review on the "genetics of major depression" Flint and Kendler (2014) concluded that genetic research on major depression has not yet reached a stage where it would cast "light on known, suspected or indeed novel biological processes that explain why some people fall ill" (p. 497). Instead, "genetics does not support any of the biological theories [of depression] put forward to date" (p. 498). As a possible explanation for this failure, Flint and Kendler discussed that multiple genetic loci may be involved in the aetiology of major depression, with each loci may contributing with only small effects. They further discussed that major depression may be more than one disorder, questioning the unitarian model of depressive disorders, or that the interaction of gene and environment is more complex than thought.

Thus, at the current stage of knowledge, little is known about the role of genes and of gene-environment interaction in the aetiology of depressive disorders other than that the possible mechanisms seem to be highly complex. The rapidly emerging field of epigenetics, i.e. research on possible environmental influences on gene expression, will likely further add to this complexity (Januar et al. 2015; Davey Smith 2012).

6.2.2 Psychological Theories of Depressive Disorders

Several and very different psychological theories of depressive disorders have been proposed during the last 100 years. In the following we give a selective and very brief overview of some of the most important theories.

6.2.2.1 Psychodynamic Theories

In psychodynamic theories, i.e. theories in the tradition of the work by Sigmund Freud (1856–1939), the experience of *intrapsychic conflict* is constitutional for all human beings. The conflict has its roots in the encounter between the *id*, representing basic human drives following the *pleasure principle*, and the *super-ego*, representing societal norms and morality usually conveyed to the individuals by their parents in early childhood. The *ego* emerges out of this conflict and has the task to mediate the conflict in accordance with the *reality principle*. Failure in mediating the conflict is expressed in psychiatric disorders in particular in what has been denoted as *neurotic disorders* (Davison and Neale 1990, pp. 32–42).

In psychodynamic theories depressive disorders are a reaction to loss, either material loss, e.g., death of a loved one, or symbolic loss, e.g., recognition that some valued goals can no longer be achieved. In unconscious processes, the lost object is introjected, i.e. is symbolically incorporated by the grieving person. It is assumed that there are ambivalent feelings towards the introjected object, not only love but also hate and anger. After some time, during a process of *mourning work* the individuals free themselves from the introjected object and return to appropriate psychological functioning. However, individuals with a dependent psychological structure, developed during their psycho-sexual development in early childhood, are not able to let the introjected object go and the hate and anger towards the object turns towards themselves, manifesting in a depression (Davison and Neale 1990, pp. 225–226).

6.2.2.2 Cognitive Theories

Psychodynamic theories still play a role in psychotherapy, but currently the dominant psychological explanation of depressive disorders are cognitive theories (Beck 1967; Davison and Neale 1990, pp. 226–234; Weitz et al. 2015). These theories assume that depressive disorders result from dysfunctional cognitions and negative schemata, i.e. that individuals who overgeneralise past failures, ignore past successes, overestimate future adversities and underestimate their abilities to handle these adversities are at increased risk of developing depressive disorders. Although it is assumed that the negative schema is acquired during experiences in childhood and adolescence, cognitive or cognitive-behavioural therapy does not focus on earlier life but on changing the present cognitions.

6.2.2.3 Social-Psychological Theories

Social-psychological theories of depressive disorders concern the impact of interpersonal or group processes on individual's mental health. The early version of the *theory of learned helplessness* suggested that repeated experiences of loss of control elicits a generalised expectation of non-controllability of one's destiny leading to the development of depressive disorders (Seligman 1975). In a later revision of the theory, the social-psychological perspective became less pronounced and the role of attribution processes was more emphasised (Abramson et al. 1978, 1989). Another social-psychological theory is the *social-cognitive model of interpersonal processes in depression* suggesting a vicious cycle, in which depressed or depression-prone individuals (called "targets") are perceived in a negative way by the individuals they interact with. This negative perception is partly due to the social behaviour of the target but also partly due to negative biases towards depressed individuals. This heightened negative perception translates into more negative social behaviours and less genuinely supportive social behaviours, which then exacerbate feelings of rejection and low self-esteem in the target (Sacco 1999).

6.2.2.4 Adverse Life Events

As discussed earlier with regard to gene-environment interaction, adverse life events are associated with an increased risk of depressive disorders (Risch et al. 2009). In a review of the literature Harris points in particular to adversity in childhood, including loss of a parent, neglect, and physical and sexual abuse (Harris 2001). One possible mechanism for linking childhood adversity to later-life risk of depressive disorders may be the "long-term damage to self-esteem or to attachment style (and thus to the ability to access emotional support)" (Harris 2001, p. 22).

With regard to adulthood adverse life events, it seems that the loss of a loved one and experiences related to humiliation and threats to self-esteem are particularly depressogenic (Harris 2001; Kendler et al. 2003; Sowislo and Orth 2013). Experiences of entrapment have also been discussed as a possible risk factor (Harris 2001). Further, a new meta-analysis indicates that exposure to natural and technological disasters, terrorist acts and military combat is associated with an increased risk of depressive disorders (Bonde et al. 2016).

6.2.2.5 A Developmental Model of Depressive Disorders

Kendler and colleagues (2002, 2006) tried to integrate both genetic and psychological risk factors in a developmental model of depression that spans over the life course. They developed a model for predicting the onset of a major depressive episode in women (Kendler et al. 2002) and a very similar one in men (Kendler et al. 2006). Figure 6.1 shows the model for men based on the analysis of 2,935

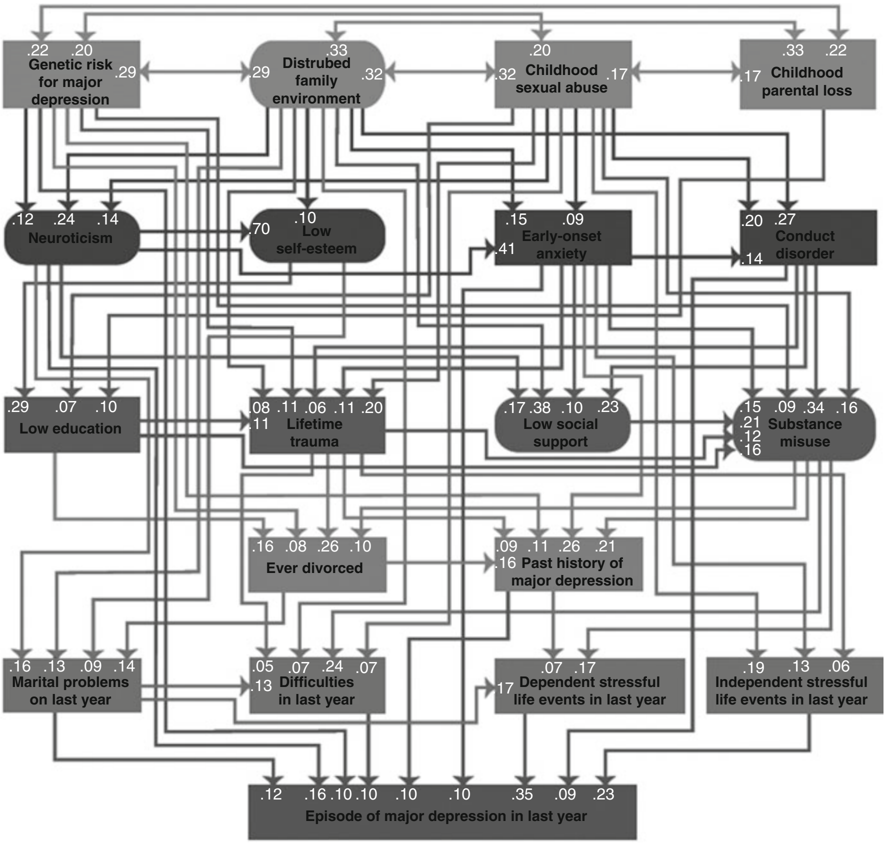

Fig. 6.1 Best-Fit model for the prediction of an episode of major depression in the last year among 2935 men in male-male twin pairs (Adapted from Kendler et al. 2006. Reprinted with permission from The American Journal of Psychiatry (Copyright ©2006). American Psychiatric Association. All Rights Reserved.)

male-male twin pairs. Five different life-course stages – childhood, early adolescence, late adolescence, adulthood and last year before onset – are suggested, each with stage specific risk factors. These risk factors cover a wide range of domains, including genetic disposition, childhood trauma, personality aspects, education, and life events, to name just a few. The risk factor of interest for this chapter, the psychosocial work environment, is not listed as a specific domain but is included in the domains of difficulties in the last year and of stressful life events (Kendler et al. 2002). Importantly, as indicated by the numerous arrows in the figure, the risk factors are interdependent. However, even this already complex model may be an oversimplification and Kendler et al. admitted that "some of our intervariable relationships that we assume take the form of A→B may be truly either A←B or, more likely, A↔B" (Kendler et al. 2006, p. 122). They concluded that depression is "an etiologically complex disorder influenced by risk factors from multiple domains that act in developmental time" (Kendler et al. 2006, p. 115).

6.2.3 Sociological Theories of Depressive Disorders

The developmental model of a major depressive episode in Fig. 6.1 is also interesting for what it does not show. In the model risk factors, such as disturbed family environment, low self-esteem and low education, are occurring over the life course of an individual but the model does not give consideration to societal forces that may promote or hinder these occurrences. This approach has been criticised as *methodological individualism*, i.e. as the overreliance on individual risk factors and the neglect of social determinants of health and illness (Diez-Roux 1998; Rugulies et al. 2004).

Compared to biological and psychological theories, sociological theories have historically played a minor role in the explanation of affective disorders. However, society is present implicitly in the key assumption of the psychodynamic theories, the conflict between the id and the super-ego, as the super-ego represents societal norms and moral demands.

Interest in social determinants of psychiatric disorders increased in the 1950s and 1960s, particular in the USA, leading to the growth of *social psychiatry* as a new discipline (Blazer 2005, pp. 59–76; Dörner and Plog 1996, pp. 459–476). Influential research from this era were for example the work by Hollingshead and Redlich (1958) on *Social class and mental illness*, showing both higher prevalence of psychiatric disorders and less adequate treatment in the lower social classes compared to the higher classes, and the work by Bruce P. and Barbara Snell Dohrenwend examining social determinants of stressors and their relations to mental health (Dohrenwend and Dohrenwend 1981a, b). A meta-analysis published in 2003 corroborated this earlier research on the association of low socioeconomic position with increased prevalence and incidence of depressive disorders (Lorant et al. 2003).

In Europe, Brown and Harris published in 1978 a seminal book on *Social origins of depression* that reported a higher risk of depressive disorders among working class women compared to middle class women in the United Kingdom. Based on comprehensive interviews and a prospective study design the authors concluded that adverse life events (e.g., death of a loved one) or major difficulties (e.g., marital problems) together with pre-existing vulnerability factors, including early death of the mother, lack of a confident and of an intimate relationship, a high number of young children, and unemployment, were the mechanisms that contributed to the high rates of depressive disorders in working class women (Brown and Harris 1978).

A more recent influential work on a sociological perspective of depressive disorders is Alain Ehrenberg's *Weariness of the self*, published in French in 1998 under the title *La fatigue d'être soi – dépression et société* and translated to English in 2010. Ehrenberg examines – with a main focus on discussions and developments in France and by contrasting the Freudian intrapsychic conflict approach with the deficiency approach by Pierre Janet (1859–1947) – the historical changes in the understanding of depressive disorders. According to Ehrenberg, the individuals of the late nineteenth and early twentieth century faced a society demanding conformity, whereas the modern day individuals of the late twentieth and early twenty-first century face a society demanding initiative and mental capacity. The old society, "the universe of law", confronted the individuals with restrictions and rigid rules eliciting anxiety. The new society, "the universe of dysfunction", confronts the individuals with endless opportunities for failure, feelings of inadequacy and insufficiency eliciting weariness and depression.

6.2.4 Bridging Sociological and Psychological Perspectives: The Model of Effort-Reward Imbalance at Work

The ERI model combines a sociological with a psychological perspective. The model aims to offer an explanation how societal phenomena, such as social stratification, economic globalisation or economic crisis, may affect health and illness via generating adverse working conditions that elicit potentially health-hazardous psychological and psycho-physiological processes. Thus, the ERI model belongs to what Martikainen, Bartley and Lahelma have called "psychosocial explanations of health" that "might be more accurately referred to as 'social-psychological' explanations of health" (Martikainen et al. 2002, p. 1091). These psychosocial or social-psychological explanations are concerned with psychosocial factors that while "conditioned and modified by the social structures and contexts in which they exist" are "mediating the effects of social structural factors on individual health outcomes" (p. 1091).

As the ERI model and its measurement are presented in detail in Chaps. 1 and 2, we only describe the model briefly here. The ERI model assumes that social reciprocity is a fundamental principle of interpersonal behaviour and social exchange. In contemporary societies, i.e. the capitalist societies that emerged in Europe in the sixteenth century and that became dominant in the industrial revolution of the eighteenth and nineteenth century (Marx 1983, pp. 741–791; Hobsbawm 1962, 1975, 1987; Fülberth 2005) the labour market is a key area of social exchange, where workers exchange their labour-power for wages (Marx 1983, pp. 557–564).

According to the ERI model, human beings have a deep-rooted expectation of social reciprocity, leading workers to expect that their efforts are equalized by respective rewards. High effort at work is operationalized as time pressure due to heavy workload, interruptions, disturbances, high responsibility, overtime work, high physical demands and increase in demands over time. The reward dimension not only concerns wages, but also occupational status, promotion prospects, job security, esteem, recognition, and respect. The ERI model posits that a *high cost/low gain situation* at work, in which individuals spend high effort while receiving low rewards, elicits emotional distress that affects physical and mental health via both deteriorating health-related behaviours and psychoneuroendocrine and psychoneuroimmune pathways. In addition to working conditions, the ERI model also considers a motivational disposition, called *work-related over-commitment*, that, both alone and in interaction with the work environment, may contribute to risk of disease.

6.2.4.1 Plausibility of ERI as a Contributor to Affective Disorders

There are several aspects of the ERI model that may be of interest with regard to affective disorders. First, the recurrent experience that effort is not matched by adequate rewards may lead to feelings of humiliation and deteriorating self-esteem. Humiliation and subsequent deteriorating self-esteem have been considered as important psychological processes in the development of depressive disorders (Harris 2001; Kendler et al. 2003; Sowislo and Orth 2013). Brown and Harris (1978) have argued that a major cause for depression is the "inability to hold good thoughts about ourselves" (p. 233). It seems reasonable to assume that individuals recurrently exposed to ERI will find it difficult to hold these good thoughts about themselves.

Second, according to Siegrist, ERI occurs frequently under conditions of *dependency* (e.g., lack of alternative choice in the labour market, see Chap. 1). The inability to leave a highly adverse situation may evoke a recognition of *entrapment* and *learned helplessness*, two psychological phenomena that have been discussed as possible pathways to depressive disorders (Davison and Neale 1990, pp. 228–234; Harris 2001; Seligman 1975).

Third, with regard to biological processes, there are some studies indicating that ERI may lead to dysregulation of the HPA-axis, although results are not consistent and difficult to understand, partly because of study design limitations (Chandola et al. 2010). As discussed earlier, HPA dysregulation is one of several biological pathways considered in the aetiology of depressive disorders (Gold 2015; Pariante and Lightman 2008; Pittenger and Duman 2008).

6.2.4.2 Research on ERI and Risk of Affective Disorders

Epidemiological research on psychosocial work environment conditions, including ERI, and risk of affective disorders is a relatively new endeavour. To our knowledge, the first two articles on the prospective association of ERI with risk of onset of poor mental functioning and psychiatric disorders were published by Stephen Stansfeld and colleagues in 1998 and 1999, based on data from the British Whitehall II study (Stansfeld et al. 1998, 1999). The first narrative review on psychosocial work environment and depressive disorders was published by Tennant in 2001 and the first systematic review of prospective studies on psychosocial work environment and common mental disorders, including but not limited to depressive disorders, was published by Stansfeld and Candy in 2006. Subsequent systematic reviews exclusively focussing on psychosocial work environment and depressive disorders were published by Netterstrøm et al. (2008), Bonde (2008), and Siegrist (2008, 2013). The most recent review was published by Theorell et al. in 2015 covering the published literature until June 2013. The review found "moderately strong evidence" for *job strain* (the combination of high psychological demands and low decision latitude see Karasek and Theorell 1990 and Chap. 1), low decision latitude alone, and bullying at work as risk factors for depressive disorders. With regard to ERI, the review identified three articles (Godin et al. 2005; Kivimäki et al. 2007; Rugulies et al. 2013) and concluded that there was "limited evidence" for a role of ERI in the aetiology of depressive disorders.

In the next section, we present the results of our own systematic review of the literature that includes articles published until June 2015.

6.3 A Systematic Literature Review of ERI and Risk of Affective Disorders

To assess if ERI predicts risk of affective disorders, we conducted a systematic review of the literature considering all types of affective disorders as classified by ICD-10 codes F30–F39.

6.3.1 Methods

6.3.1.1 Inclusion Criteria

We included studies fulfilling the following criteria:

- The exposure was ERI, i.e. the study had to include a measure of imbalance between effort and reward at work.

- The endpoint was an affective disorder, i.e. either depressive disorders, mania or bipolar disorders. The disorder had to be documented either by a psychiatric diagnostic interview, a diagnosis by a physician, register data (e.g., dispensing of antidepressants) or by a self-administered rating scale that was validated against clinical measures and dichotomised respondents into cases versus non-cases.
- The study design was prospective, i.e. there was a temporal sequence in which ERI was measured at baseline and onset of affective disorders was measured during follow-up.
- The study was reported in a scientific journal with peer-review, published in English, German, Danish, Norwegian, Swedish, Spanish, or French.

6.3.1.2 Literature Search

We conducted an electronic search in the database Pubmed (http://www.ncbi.nlm.nih.gov/pubmed/) on July 2nd, 2015 using the following search string without restrictions:

(Effort AND Reward) AND (Affective OR Mood OR Depression OR Depressive OR Mental OR Unipolar OR Dysthymia OR Dysthymic OR Dysphoria OR Dysphoric OR Bipolar OR Mania OR Manic OR Hypomania OR Hypomanic OR Cyclothymia OR Cyclothymic) AND (Prospective OR Cohort OR Longitudinal OR Follow up).

Further, we scrutinized the reference lists of eligible articles and major reviews in the field (Netterstrøm et al. 2008; Bonde 2008; Stansfeld and Candy 2006; Siegrist 2008, 2013; Nieuwenhuijsen et al. 2010; Theorell et al. 2015) and our own article collections.

Two authors (RR and IM) independently screened all titles and abstracts to determine preliminary eligibility. In case of uncertainty, the article in question was retained. All preliminarily eligible articles were read in full by RR and IM to determine final eligibility. Two articles were written in German and for these articles BA substituted IM as the reviewer. All disagreements were solved by discussion. The final collection of articles was read by BA to verify eligibility. RR abstracted study characteristics and main results and IM and BA checked the abstracted information against the original articles.

6.3.2 Results

6.3.2.1 Selection of Studies

The electronic search resulted in 94 articles and the additional hand search in 2 articles, of which 40 were preliminarily eligible based on screening of title and abstracts. After full text reading, ten articles remained eligible (Dragano et al. 2011; Garbarino et al. 2013; Godin et al. 2005; Hoven et al. 2015; Juvani et al. 2014;

Kivimäki et al. 2007; Lunau et al. 2013; Rugulies et al. 2013; Siegrist et al. 2012; Wang et al. 2012). Of those, two articles (Kivimäki et al. 2007; Siegrist et al. 2012) reported results from two independent cohort analyses, thus the sample consisted of 12 prospective studies.

Five studies came from the same research project (DRIVERS; Determinants to Reduce health Inequity Via Early childhood, Realising fair employment, and Social protection) using overlapping samples with the same data on both ERI and affective disorders. We included the two non-overlapping studies by Siegrist et al. (2012 (SHARE & ELSA), see Table 6.3 for an explanation of study abbreviations) and Siegrist et al. (2012 (HRS)) because they had (a) the largest study population for SHARE & ELSA and HRS, respectively, and (b) had the main aim to analyse the association of ERI with affective disorders, whereas the other three studies had the main aim to analyse effect modification (Dragano et al. 2011; Lunau et al. 2013) or mediation (Hoven et al. 2015). Consequently, the sample was reduced to nine studies.

Two studies (Kivimäki et al. 2010 (10-Town); Kivikmäki et al. 2010 (FHPS)) investigating the risk of doctor-diagnosed depression were collapsed by Juvani et al. (2014) into one study investigating the risk of disability pensioning due to depression. We kept all three studies, because Juvani et al. (2014) used different measures on both ERI and affective disorder than the two studies by Kivimäki et al. (see Table 6.3)

6.3.2.2 Characteristics of the Included Studies

Table 6.3 shows the main characteristics of the nine included studies in the order of online publication date. All studies examined the risk of depressive disorders, there were no studies with the endpoints mania or bipolar disorders, and consequently we refer to the endpoint as depressive disorders from here on. Time of follow-up was 5 months in one study, 8.9 years in another study and 1–5 years in the remaining seven studies.

The studies were published from 2005 to 2015 and were from Belgium, Canada, Denmark, Finland (three studies), Italy, the USA, and a multinational dataset of 12 European countries.

Study Participants The majority of the studies examined employees from multiple job groups and industries, though some studies showed a preponderance of public sector employees. Mean age of employees was in the 40s, except one study where participants were younger and two studies where they were older. In most studies, both sexes were relatively equally represented, except for three studies with a clear preponderance of women and one study that included men only.

Assessment of ERI All nine studies assessed ERI by self-report. Juvani et al. averaged the individual-level ERI at the work-unit level and used this measure as the main exposure. ERI was measured with the original ERI questionnaire (ERI-Q) in

Table 6.3 Characteristics of the nine eligible studies on effort-reward imbalance at work and risk of depressive disorders

Author, year; cohort	Country	Population characteristics	Assessment of high ERI	Lengths of follow-up	Assessment of depressive disorders (handling of baseline cases (BC))
Godin et al. (2005) SOMSTRESS	BE	1,536 employees from four private and public sector enterprises; Mean age: 41 years (SD: 8); 46 % women	Self-rated; ERI-Q (five effort, 11 reward); Scoring in upper quartile of effort-reward ratio. Exposure defined by combining presence/absence of high ERI at baseline and follow-up; OC: OC-Q (six items) scoring in upper tertile at baseline	1 year	Self-rated; Depression subscale of SCL-90; Cut-off point: Scoring in lowest quartile; (BC: Excluded, however as ERI at follow-up is part of the exposure measure, this study includes a cross-sectional element)
Kivimäki et al. (2007) 10-Town	FI	13,825 governmental employees; Mean age: 45 years; 78 % women	Self-rated; Proxy measures (one effort, three reward); Scoring in upper quartile of effort-reward ratio	3–4 years	Self-reported doctor-diagnosed depression; (BC: Excluded)
Kivimäki et al. (2007) FHPS	FI	4,090 public hospital employees; Mean age: 44 years; 89 % women	Self-rated; Proxy measures (one effort, three reward); Scoring in upper quartile of effort-reward ratio	2–4 years	Self-reported doctor-diagnosed depression; (BC: Excluded)
Wang et al. (2012) LCWPA	CA	2,254 randomly selected employees; Mean age: 43 years; 44 % women	Self-rated; ERI-Q (five effort, 11 reward); Scoring in upper quartile of effort-reward ratio	1 year	Clinical diagnostic interview; First screening for mental health problems, then clinical assessment of depression with CIDI; (BC: Excluded)
Rugulies et al. (2013) DWECS	DK	2,701 members of the general workforce; Mean age: 40 years (SD: 9); 51 % women	Self-rated; Proxy measures (four effort, seven reward); Scoring in upper quartile of effort-reward ratio	5 years	Self-rated; MHI-5; Cut-off point: ≤52; (BC: Excluded)
Siegrist et al. (2012) SHARE & ELSA	AT, BE, CH, DE, DK, ES, FR, GR, IT, NL, SE, UK	6,034 members of the general workforce; Age range: 50–64 years; 47 % women	Self-rated; Shortened version of ERI-Q (two effort, five reward); Scoring in upper tertile of effort-reward ratio	2 years	Self-rated; EURO-D (SHARE) and CES-D short (ELSA); Cut-off point: Not reported but ≥4 on both scales is assumed based on the report from another article (Lunau et al. 2013); (BC: Adjusted for)

Siegrist et al. (2012) HRS	US	673 members of the general workforce; Age range: 50–64 years; 55 % women	Self-rated; Shortened version of ERI-Q (two effort, five reward); Scoring in upper tertile of effort-reward ratio	2 years	Self-rated; CES-D short; Cut-off point: Not reported but ≥4 on both scales is assumed based on the report from another article (Lunau et al. 2013); (BC: Adjusted for)
Garbarino et al. (2013) VI RM	IT	289 members of a police special force; Mean age: 35 years (SD: 8); 0 % women	Self-rated; ERI-Q (six effort, 11 reward); Effort-reward ratio >1.0; OC: OC-Q (six items) scoring in upper tertile; Measures from three time points were combined	5 months	Self-rated; BDI; Cut-off point: ≥10; (BC: Neither excluded nor adjusted for)
Juvani et al. (2014) FPSS	FI	51,874 public-sector employees (work-unit level analysis); Mean age: 44 years; 75 % women. Individual-level analysis was based on a sub-group of 35,260 employees	Self-rated and then averaged at the work-unit level; Proxy measures (one effort, three reward); Scoring in upper quartile of effort-reward ratio	8.9 years	Register data on disability pensioning with a diagnosis of depression according to ICD-10 codes F32-F34 (BC: Excluded, there were no disability cases as all participants were economically active)

Studies are ordered by online publication date; Number of participants refers to the number in the sample used in the analysis with the most-adjusted model, when this information was available. In some studies, population age and sex distribution were reported for the sample of the most-adjusted model whereas in some other studies, population age and sex distribution were reported on the overall sample

Cohort abbreviations: *VI RM* VI Reparto Mobile, *10-Town* 10 Town Study, *DWECS* Danish Work Environment Cohort Study, *ELSA* English Longitudinal Study on Ageing, *FHPS* Finish Hospital Personnel Study, *FPSS* Finnish Public Sector Study, *HRS* US Health and Retirement Study, *LCWPA* Longitudinal Cohort from the Working Population of the province of Alberta, *SHARE* Survey of Health, Ageing and Retirement in Europe, SOMSTRESS=SOMSTRESS (not an abbreviation)

Country abbreviations: *AT* Austria, *BE* Belgium, *CA* Canada, *CH* Switzerland, *DE* Germany, *DK* Denmark, *ES* Spain, *FI* Finland, *FR* France, *GR* Greece, *IT* Italy, *NL* The Netherlands, *SE* Sweden, *UK* United Kingdom, *US* United States of America

ERI-assessment abbreviations: *ERI-Q* Effort-reward imbalance questionnaire as developed by Siegrist and colleagues (five or six effort items (item on physical effort is optional) and 11 reward items), *OC-Q* Work-related over-commitment questionnaire as developed by Siegrist and colleagues (six items)

Depressive disorder assessment abbreviations: *BDI* Beck's Depression Inventory, *CES-D short* Short version of the Center for Epidemiologic Studies Depression Scale, *CIDI* World Health Organisation Composite International Diagnostic Interview, *EURO-D* European Depression Scale, *ICD-10* International Statistical Classification of Diseases and Related Health Problems, 10th version, *MHI-5* Five Item Mental Health Inventory of the Short-Form 36 item (SF-36) Questionnaire, *SCL-90* Symptom Checklist 90 item version

Other abbreviations: *BC* Baseline cases, *ERI* Effort-reward imbalance, *OC* Work-related over-commitment, *SD* Standard Deviation three studies, with an abbreviated version of the ERI-Q in two studies, and with proxy measures in four studies. All studies calculated a ratio of effort and reward. High ERI was defined by scoring in the upper tertile or quartile of the ratio in seven studies and by scoring a ratio of >1 in one study. One study combined presence and absence of high ERI (upper quartile of ratio) at baseline and follow-up into a new measure of changes in ERI. Work-related over-commitment was assessed in two studies.

Assessment of Depressive Disorders Depressive disorders were assessed by scoring above a cut-off point on a self-rating scale in five studies, self-reported doctor diagnosed depression in two studies, a psychiatric diagnostic interview in one study, and ICD-10 diagnostic codes attached to a granted disability pensioning in one study.

Handling of Baseline Cases Cases at baseline were excluded in six studies. Two studies adjusted for baseline case status in the main analyses and excluded baseline cases in supplementary analyses. One study neither excluded baseline cases nor adjusted for them (Garbarino et al. 2013).

Statistical Analyses To assess the association of ERI with risk of depressive disorders, eight studies calculated odds ratios and one study hazard ratios. All studies adjusted their analyses for multiple covariates (Table 6.4). Eight studies used exposure to ERI at baseline as the predictor. The study by Godin et al. (2005) used presence or absence of changes in ERI from baseline to follow-up as exposure. Thus, this study included a mixture of a prospective and cross-sectional analysis.

6.3.2.3 ERI and Risk of Depressive Disorders

Table 6.4 summarises the main results of the nine studies. Seven studies found a statistically significant association between ERI and risk of depressive disorders and two studies found a suggestive, albeit statistically non-significant association (Kivimäki et al. 2007 (FHPS); Siegrist et al. 2012 (HRS)). Effect estimates were relatively similar ranging from 1.49 to 2.32 in the highest exposure group, with the exception of the study by Godin et al. (2005) that reported odds ratios up to 4.6 and Garbarino et al. (2013) that reported an odds ratio of 6.26. However, both studies had a problematic study design and may have overestimated associations due to a cross-sectional element within the prospective design (Godin et al.) and the failure to exclude or adjust for baseline cases (Gabarino et al.).

ERI predicted depressive disorders regardless of whether exposure was measured by the ERI-Q, an abbreviated version of the ERI-Q or by proxy measures, and regardless of whether depressive disorders were measured by a diagnostic interview, register data on disability pensioning due to depressive disorders, self-reported doctor-diagnosed depression or by scores on a self-rating scale.

Table 6.4 Association of effort-reward imbalance at work and risk of depressive disorders in nine prospective studies

Author, year cohort	Cases at follow-up	Estimate for most adjusted model	Covariates used for adjustment
Godin et al. (2005)	Not reported	Compared to ERI t1=no and t2=no (score in highest quartile):	Age, education, threat from global economy, job dissatisfaction, workplace instability
SOMSTRESS		OR = 1.3 (0.5–3.2) women; 1.2 (0.5–2.9) men, t1 = yes and t2 = no	
		OR = 3.2 (1.6–6.4) women; 4.6 (2.3–9.2) men, t1=no and t2=yes	
		OR = 4.6 (2.3–9.0) women; 2.8 (1.3–5.7) men, t1=yes and t2=yes	
		OR = 1.8 (1.0–3.0) women; 2.4 (1.4–4.1) men, for high vs. low OC	
Kivimäki et al. (2007)	896 (6.5 %)	OR = 1.49 (1.22–1.81) for highest ERI-quartile vs. lowest	Sex, age, occupational status, organisational justice
10-Town		p < 0.001 for trend across quartiles	
Kivimäki et al. (2007)	153 (3.7 %)	OR = 1.52 (0.89–2.58) for highest ERI-quartile vs. lowest	Sex, age, occupational status, organisational justice
FHPS		p = 0.24 for trend across quartiles	
Wang et al. (2012)	70 (3.1 %)	OR = 2.32 (1.14–4.73) for highest ERI-quartile vs. lowest	Education, income, job strain, supervisor support, coworker support, working hours, job insecurity, family-to-work conflict
LCWPA		p for trend across quartiles not reported	
		When stratified by sex and with partly different covariates:	
		OR = 2.35 (1.04–5.30) in women; “Not significant” in men	
Rugulies et al. (2013)	99 (3.7 %)	OR = 2.19 (1.12–4.25) for highest ERI-quartile vs. lowest	Sex, age, occupational status, family status, survey method, smoking, heavy alcohol consumption, leisure time physical activity, self-rated health, sleep disturbances, non-severe depressive symptom score
DWECS		p = 0.02 for trend across quartiles	
Siegrist et al. (2012)	Not reported	OR = 1.51 (1.28–1.78) for highest ERI-tertile vs. lowest	Sex, age, education, employment status, working hours, depressive symptoms at baseline, multi-level analysis where individuals are nested within countries
SHARE & ELSA		p for trend across tertiles not reported	

(continued)

Table 6.4 (continued)

Author, year cohort	Cases at follow-up	Estimate for most adjusted model	Covariates used for adjustment
Siegrist et al. (2012)	Not reported	OR = 1.53 (0.91–2.57) for highest ERI-tertile vs. lowest	Sex, age, education, employment status, working hours, depressive symptoms at baseline
HRS		p for trend across tertiles not reported	
Garbarino et al. (2013)	28 (9.7 %)	OR = 7.89 (2.32–26.82) for ERI-ratio >1 vs. ERI-ratio ≤1	Age, rank, education, lengths of employment, origin, married/cohabiting, living in barracks, having children, personality scores
VI RM		OR = 3.27 (1.01–10.63) for high vs. low OC	
Juvani et al. (2014)	WLA: 890 (1.7 %)	HR = 1.63 (1.31–2.04) for highest ERI-quartile vs. lowest (WLA)	Sex, age, place of residence, occupational status, education, income, baseline health, type of employer, type of work contract, size of work unit, mean age of employees in work unit, proportion of fixed-term workers in work unit, work-unit-level job strain
FPSS	ILA: 551 (1.6 %)	p for trend across tertiles not reported	
		HR = 1.90 (1.51–2.40) for highest ERI-quartile vs. lowest (ILA)	
		p for trend across tertiles not reported	

Cohort abbreviations: see Table 6.3; Other abbreviations: *ERI* effort-reward imbalance, *ILA* individual level analysis, *HR* hazard ratio, *OC* work-related over-commitment, *OR* odds ratio, *p* level of statistical significance, *t1* measurement at baseline, *t2* measurement at follow-up, *WLA* work-unit level analysis

6.3.2.4 Work-Related Over-Commitment and Risk of Depressive Disorders

Only two studies, Godin et al. (2005) and Garbarino et al. (2013), examined work-related over-commitment and both studies found a statistically significant association with onset of depressive disorders. As addressed above, both studies had important methodological limitations in the analyses on ERI and depressive disorders. Regarding Garbarino et al. who neither excluded nor adjusted for baseline cases, this limitation also applies to the analysis on work-related over-commitment. Regarding Godin et al. who had mixed exposure assessment on ERI from both baseline and follow-up, however, the limitation does not apply, as exposure to work-related over-commitment was measured at baseline only.

6.3.2.5 Summary and Discussion

In this systematic review of the literature, published until June 2015, we identified seven European and two North American prospective studies examining the association of ERI and risk of onset of depressive disorders. We did not find any study examining mania or bipolar disorders. The most recent published review on psychosocial work environment factors and depressive disorders that searched the literature until June 2013 identified three articles (Theorell et al. 2015). We found that a high level of ERI consistently predicted onset of depressive disorders, regardless of type of measurement of both ERI and depressive disorders. The odds ratios and hazard ratios were relatively similar, ranging between 1.49 and 2.32, with the exception of two studies with problematic methodologies reporting higher estimates.

Work-related over-commitment was only investigated in two studies, both showing over-commitment predicting depressive disorders. However, as one of the studies had failed to exclude or adjust for baseline cases, the data is insufficient to draw a conclusion on the association of work-related over-commitment and risk of depressive disorders. We do not know why work-related over-commitment was not researched more; possible explanations may be that no appropriate measures or proxy measures were available, or that work-environmental or social-epidemiological minded researchers were not interested in examining aspects of employees' personality.

All reviewed studies were non-experimental observational studies and therefore vulnerable to bias by unmeasured confounding. Consequently, causal inference has to be drawn with caution. Large-scale trials in which healthy individuals would be randomly assigned to conditions of high or low ERI and subsequently followed up for several years until onset of depressive disorders do not appear feasible for both practical and ethical reasons. Evidence from observational research may be strengthened by conducting studies that are well-designed for addressing bias and confounding and by examining not only the exposure-endpoint-association, but also the assumed underlying mechanisms. Further, intervention studies may increase knowledge on the role of ERI in the aetiology of depressive disorders. We will address these and other issues in the following fourth and final section of this chapter.

6.4 ERI and Affective Disorders. Where to Go from Here?

Research on ERI and depressive disorders is still a fairly recent endeavour, as demonstrated in our review identifying nine studies since 2005 with six of those published in 2012 or later. For future research on ERI and depressive disorders, we have several questions and suggestions, pertaining to advancing the theory and knowledge on mechanisms, strengthening the epidemiological evidence, and implementing and testing the knowledge in praxis.

6.4.1 Advancing Theory and Knowledge on Mechanism

The ERI model was originally developed and tested regarding the risk of cardiovascular disease (Siegrist 1996a, b; Rugulies and Siegrist 2006; Eller et al. 2009, see also Chap. 5). This included epidemiological, clinical and experimental studies as well as the formulation of specific theoretical assumptions about the psychophysiological mechanism through which ERI may affect cardiovascular health. In contrast, the theoretical foundation for the association of ERI with depressive disorders is less well developed. Earlier in this chapter (Sect. 6.2.4.1) we discussed some aspects of the ERI model (humiliation, threat to self-esteem, entrapment, role of the HPA-axis) that may be important for the development of depressive disorders, but a specific theory on ERI as a risk factor for depressive disorders is lacking. It seems that at some point in time, researchers became curious whether the ERI model, in addition to cardiovascular disease, could also be applied to mental disorders while refraining from expanding the theoretical assumptions of the model accordingly. Thus, an advancement of the theoretical assumptions of the ERI model should be considered, including a clarification how the ERI model relates to the various biological, psychological and sociological theories of depressive disorders (Sects. 6.2.1, 6.2.2, and 6.2.3). Modifications of the ERI measurements may also be considered. For example, recent research suggests that a high level of emotional demands at work predicts onset of depressive disorders (Madsen et al. 2010, 2014a; Magnusson Hanson et al. 2013), although it is unclear whether this indicates a causal association (Madsen et al. 2012). In the light of these findings, ERI-researchers may test whether adding measures of emotional effort would increase the ability of the ERI model to predict depressive disorders.

6.4.1.1 Types of Disorders

Clarification is also needed if ERI may contribute to all affective disorders, including mania and bipolar disorders that have not been investigated yet, or only to depressive disorders, or maybe only to some types of depressive disorders. As discussed earlier (Sect. 6.2.1.3), inconsistent findings on the assumed gene-environment interaction in depressive disorders and the failure to identify specific genetic loci associated with depressive disorders has prompted some researchers to re-consider whether depressive disorders may actually encompass aetiologically different disorders (Flint and Kendler 2014; Sharpley et al. 2014). Further, some researchers have proposed that states of severe exhaustion, sometimes called *exhaustion disorders* (Besèr et al. 2014; Hasselberg et al. 2014) – echoing concepts such as neurasthenia (Crocq 2015; Ehrenreich 2009, pp. 74–96) or burn-out (Maslach et al. 2001; Kristensen et al. 2005; Schaufeli and Taris 2005) – may be more sensitive to adverse psychosocial working conditions than the ICD-10 diagnostic group of depressive disorders.

6.4.1.2 Effect Modification

Closely related to the need of a theoretical advancement of the ERI model is the need for specifying the underlying mechanisms – biological, psychological or social – linking ERI and depressive disorders. It would be of particular interest to elucidate if the association of ERI and depressive disorders is stronger or weaker in specific subgroups. Of the reviewed studies, one study found that the association of ERI and risk of depressive disorders was more pronounced among workers of lower occupational grade compared to workers of higher grade (Rugulies et al. 2013). That the association of psychosocial work environment factors with health endpoints may vary with occupational grade or other measures of socioeconomic position has been discussed for some time, though empirical evidence is inconsistent (Hoven and Siegrist 2013). More research on potential effect modification by socioeconomic position and other factors is needed.

As delineated earlier (Sect. 6.2.1.3), gene environment interaction in the aetiology of depressive disorders, in particular with regard to the serotonin transporter gene, is an intensely researched topic. In most of these studies, environmental factors were measured by either childhood adversity or adulthood adverse life events. From a scientific point of view, it would be desirable to also examine whether associations of adverse psychosocial working conditions, including ERI, and depressive disorders are modified by genetic disposition. However, such research might be problematic from a political point of view, as findings supporting such an interaction might encourage genetic screenings at the workplace to get rid of employees who are suspected as vulnerable.

Effect modification by macro-level factors was investigated in two studies that we did not include in the review, because of overlap with other studies. Dragano et al. (2011) reported that the association of ERI and depressive disorders was strongest and statistically significant in countries with *Southern European welfare state* *regimes* (Italy, Greece, Spain, odds ratio = 2.27), weaker but still statistically significant in *conservative welfare state regimes* (Austria, Belgium, France, Germany, The Netherlands, Switzerland, odds ratio = 1.53) and absent in *Scandinavian welfare state regimes* (Denmark, Sweden, odds ratio = 0.97). In a related analysis, using largely the same dataset, Lunau et al. (2013) found that in countries with protective labour and social policies (e.g., high active labour market policies, high unemployment benefits, low income inequality), the association of ERI and depressive disorders was weaker than in countries that lack such protective policies.

There are several explanations for these findings. First, in societies with specific welfare regimes and protective labour and social policies, ERI may in general be lower and therefore may less often cross a health-hazardous threshold. Second, levels of ERI may be the same in different societies, but high levels of ERI may have a less health damaging effect under specific welfare state regimes and labour and social policies. Third, the effect modification may not be due to welfare state regime and labour and social policies, but due to a third correlating factor, e.g., national cultures or traditions.

It is also possible that the results by Dragano et al. and Lunau et al. were due to chance, bias or specific characteristics of their overlapping datasets. In this context it is important to note that the absence of an association of ERI with risk of depressive symptoms in countries with a Scandinavian welfare state regime (Denmark and Sweden) reported by Dragano et al. was not corroborated by our review. There were four studies from countries with Scandinavian welfare state regimes in the review, and the association of ERI and depressive disorders was statistically significant in three of them (Denmark and two Finnish studies) and suggestive in the fourth (Finland, see Table 6.4).

6.4.1.3 Mediation

The ERI model, as a psychosocial or social-psychological model (Martikainen et al. 2002) is thought to be an intermediate step linking societal phenomena, such as social stratification, economic globalisation or economic crisis, with individual health endpoints (Sect. 6.2.4). However, with regard to depressive disorders, this mediation hypothesis has only been tested in one study (that was not included in our review due to overlap with other studies). The study found that the association of occupational status with depressive disorders attenuated, when ERI was introduced in the pathway analysis, suggesting a mediation effect by ERI (Hoven et al. 2015). More research on this topic is needed, not only with regard to occupational status, but also regarding economic globalisation and crisis.

6.4.1.4 Relation to Other Psychosocial Working Conditions

The most widely investigated exposure in research on psychosocial work environment and depressive disorders is job strain (Theorell et al. 2015), but only two of the nine studies in our review adjusted their analyses for this construct. However, maybe even more important than adjustment for job strain, would be examining the relation of ERI with theories such as organisational justice (Elovainio et al. 2002) and stress-as-an-offense-to-self (SOS) (Semmer et al. 2007, 2015). The theory of organisational justice and the ERI model share a focus on fairness at work and low organisational justice was associated with mental health endpoints in several studies (Ndjaboué et al. 2012). Two of the studies in our review examined both ERI and organisational justice and found that the models predicted depressive disorders independently from each other (Kivimäki et al. 2007 (10-Town); Kivimäki et al. 2007 (FHPS)). The SOS theory and the ERI model both focus on working conditions that are potentially threatening to workers' self-esteem. To date, the SOS theory has been mostly applied in small-scale work-organisational psychological studies. To our knowledge, there is only one large-scale epidemiological study on the SOS theory and mental health, showing that a one-item proxy measure for SOS predicted a decline in general mental health over a 6 year follow-up (Madsen et al. 2014b). ERI was not included in this analysis.

Job security is a component of the ERI reward dimension. There is a growing literature showing that lack of job security is associated with risk of both physical illness and mental disorders, including depressive disorders (Kim and von dem Knesebeck 2015; László et al. 2010; Rugulies et al. 2010; Virtanen et al. 2013). This research indicates that lack of job security per se may be health-hazardous, whereas the ERI model assumes that the health hazardousness of lack of job security depends on the amount of effort spent by the employee. Future studies may consider examining lack of job security both within the ERI model and as a separate risk factor.

Considering other psychosocial work environment factors would also be important for examining potential synergy effects. Simultaneous exposure to ERI and to other adverse working condition may predict onset of depressive disorders to a greater extent than one would expect from adding up the separate exposure. However, to our knowledge, this hypothesis has not been tested yet.

6.4.2 Strengthening the Epidemiological Evidence

Our review showed that ERI was consistently associated with onset of depressive disorders in prospective studies. The major question is, whether or not this association indicates causality. As controlled trials in which participants would be randomly assigned to high or low ERI-conditions by investigators appear not feasible, observational epidemiological studies are indispensable. As all observational studies on psychosocial work environment and health have limitations (Rugulies 2012), we suggest to strengthen the evidence base by combining research methodologies with different strengths and weaknesses that may complement each.

6.4.2.1 Addressing Reporting Bias

A key point in research on psychosocial work environment and depressive disorders is reporting bias, i.e. the concern that unmeasured factors at baseline, e.g., subclinical levels of depressive symptoms, other forms of reduced psychological health, or personality aspects, may cause both overreporting of ERI at baseline and increased risk of depressive disorders at follow-up (Bonde 2008; Kivimäki et al. 2010). Two of the reviewed studies attempted to address this source of bias. Rugulies et al. (2013) adjusted their analysis for indicators of possible reduced psychological health at baseline (non-severe depressive symptoms, poor self-rated health, sleep disturbance). Juvani et al. (2014) calculated the mean ERI-score for each of the 3,221 work-units in their study and assigned this mean score to all members of the respective work-unit, regardless of the employee's actual individual score and whether the employee had filled in the questionnaire or not. Using multi-level analyses, Juvani et al. then examined the association of work-unit level ERI on individual-level risk of depressive disorders. Both Rugulies et al. and Juvani et al. found that ERI predicted onset of depressive disorders.

6.4.2.2 Repeated Measures and a Life Course Perspective

Including repeated measures of both ERI and depressive disorders would give a more precise assessment of exposure and would allow analysing the effect of changes in ERI over time. Repeated measures might be a step towards a life-course perspective that considers the course of ERI throughout the working life. However, a life-course perspective on depressive disorders constitutes also a challenge for ERI-research. As presented earlier in Fig. 6.1, it has been suggested that the development of depressive disorders starts in childhood and adolescence while manifesting in adulthood. If the same early life factors that predispose to depressive disorders also predispose to ERI, then the apparent association of ERI and depressive disorders may be overestimated. Using data from the British Birth Cohort study, Stansfeld et al. (2008) showed that childhood and early adulthood psychological problems predicted mid adulthood job strain levels, probably through selection of individuals with early life psychological problems into disadvantaged jobs. Importantly, though, the association of job strain and onset of depressive disorders remained after adjustment for earlier life psychological problems. Similar analyses regarding the ERI model are lacking.

6.4.2.3 Population Attributable Risk Percent

None of the studies in the review estimated the public health impact of ERI with regard to depressive disorders, i.e. the percentage of new cases of depressive disorders that could be prevented if ERI was eliminated, also known as the population attributable risk percent (PAR%). Calculating PAR% requires estimating the prevalence of the risk factor in the population, which has not been done for ERI, probably because there is no established cut-off point on the ERI-ratio that indicates presence or absence of ERI. Although some studies have used an ERI-ratio of >1 as a cut-point (including one study in our review, Garbarino et al. 2013), ERI is usually defined by scoring in the upper tertile or quartile of the ratio (see also Chap. 2). Thus, the cut-off point at which a presumably health-hazardous level of ERI starts depends on the distribution of ERI in the study sample. The determination of a general cut-off point on the ERI-scale that is independent of the distribution in the study sample would be desirable.

6.4.3 Implementing and Testing Knowledge in Praxis

If we assume that ERI is a causal factor in the aetiology of depressive disorders with a considerable PAR%, how could this knowledge be used for the prevention of depressive disorders? To answer this question, intervention studies are needed examining (a) whether it is possible to reduce ERI at work and (b) whether a reduction in ERI would lead to a decrease in the onset of depressive disorders.

Assuming a 1-year incidence rate of depressive disorder of 3 % (Ferrari et al. 2013) and further assuming that a successful intervention would cut the incidence rate in half (a rather strong assumption), an individual-level randomised controlled trial would need more than 3,000 participants followed-up for 1 year for being able to detect an effect. A cluster-randomised trial, i.e. randomising not individuals but whole workplaces to intervention and control group conditions, would require even larger samples, as these trials are less efficient because of outcome variation between clusters (van Breukelen and Candel 2012). Thus, a workplace intervention study, aiming to prevent onset of depressive disorders, would be an enormously ambitious project and it is not surprising that such a study has not been conducted yet.

There are, however, some intervention studies that investigated whether reducing ERI may have an effect on a continuous score of symptoms that are related to depressive disorders. To our knowledge, the first intervention study on ERI was conducted among 54 bus-drivers in the mid-1990s in Germany. The intervention concerned only a limited part of the ERI model as it aimed to change work-related over-commitment through a stress management program (Aust et al. 1997; Siegrist and Silberhorn 1998). Analyses of working conditions and recommendations for their improvement were provided (Aust 1999, pp. 171–183), but were not a part of the intervention. The study found a statistically significant reduction in work-related over-commitment in the intervention group compared to the control group, and this effect persisted at a 3 months follow-up. Changes in positive and negative mood, however, did not differ between intervention and control group (Aust et al. 1997). Recently, this stress management program was tested in 262 lower and middle level managers in an international manufacturing plant in Germany, however, neither change in ERI nor in work-related over-commitment differed statistically significantly between intervention and control group. There was an intervention effect on perceived stress reactivity, but not on depressive symptoms (Limm et al. 2011).

In Japan, Uchiyama et al. (2013) tested an intervention program on active employee participation and action planning to improve the psychosocial work environment in 434 nurses from 24 hospital units. There was no intervention effect on effort or reward and no effect on depressive symptoms.

In Canada, Bourbonnais et al. (2006a, b, 2011, see also Chap. 15) conducted a non-randomised quasi experimental study to compare changes in work environment and health in an intervention site hospital with a control site hospital. Intervention activities were defined "as the changes undertaken by the hospital to reduce adverse job psychosocial factors" (Bourbonnais et al. 2006a, p. 336). After a 1-year follow-up, there was a statistically significantly reduced ERI-score in the intervention hospital compared to the control hospital (Bourbonnais et al. 2006a), a result that persisted at 3-year follow-up (Bourbonnais et al. 2011). The intervention did not have an effect on psychological distress score, a measure including depressive symptoms, but showed an effect on measures of burnout, in particular, work-related burnout, at both 1- and 3-year follow-up (Bourbonnais et al. 2006a, 2011).

These relatively small-scale workplace intervention studies may provide important insight into whether or not and through which mechanisms ERI may impact symptoms related to depressive disorders. However, it seems questionable whether these types of interventions can contribute to a measurable reduction in depressive disorders at the population level. Maybe a more promising intervention strategy would be to focus on macro-level factors, i.e. factors at the legislation and policy level. As discussed earlier (Sect. 6.4.1.2), two studies reported that associations of ERI with risk of depressive disorders varied by type of welfare state regime and extent of protective national labour and social policies (Dragano et al. 2011; Lunau et al. 2013). Because the two studies used overlapping datasets and some of their results conflict with results from studies in our review (see Sect. 6.4.1.2), it would be premature concluding that welfare regime and labour and social policies are able to modify the health-hazardousness of psychosocial working conditions. However, if further research would provide more evidence for this hypothesis, then this would open up a new perspective for the prevention of depressive disorders by changing legislation and policies.

Finally, a role of ERI might be considered in the prevention of recurrence of depressive disorders. In recent years, there has been an increasing interest, in particular in the Nordic countries and in The Netherlands, in enhancing time to return-to-work of employees who are long-term sick-listed with depressive and other mental disorders (Arends et al. 2012; Nieuwenhuijsen et al. 2014; Martin et al. 2015). It is often assumed that a fast return to work is desirable, as long absence spells greatly diminish chances for future labour market attachment (Kivimäki et al. 2004). However, if adverse working conditions, such as ERI, were causally involved in the depressive disorder that led to sickness absence, a return to the same working conditions may increase risk of recurrent depressive disorder. Thus, screening for ERI and other adverse working conditions may be useful when developing return-to-work and occupational rehabilitation plans. In countries where municipal social security officers have a key role in the return-to-work process (e.g., Denmark see Aust et al. 2015), it would be possible to implement such a screening tool at the national level and to evaluate whether this implementation has an effect on the design of return-to work and occupational rehabilitation plans and on subsequent changes in recurrence of depressive disorders.

6.4.4 Conclusion

In conclusion, affective disorders in general and depressive disorders in particular are highly complex phenomena and their conceptualisation and diagnosis have undergone major and controversially discussed changes in the past. Despite numerous research studies on the somatogenesis, and to a lesser extent on the psychogenesis and sociogenesis, the aetiology of depressive disorders is still poorly understood. We concur with those researchers who conclude that onset of depressive disorders is determined by various interacting factors from multiple domains, including biological, psychological and social factors. Our systematic review of prospective cohort studies on ERI and depressive disorders suggests that ERI may be one of these factors. Further research on ERI and affective disorders may in particular focus on advancing ERI theory and understanding mechanism, strengthening the epidemiological evidence, and implementing and testing knowledge in praxis.

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Chapter 7
Psychobiological Pathways from Work Stress to Reduced Health: Naturalistic and Experimental Studies on the ERI Model

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7.1 Introduction

Stress at work and its negative impact on the health status of employees are major problems for modern societies. According to statistics from the UK Health and Safety Executive from 2006 to 2007, mental health problems especially stress, depression and anxiety accounted for 46 % of days lost due to work-related illness, thereby constituting the main cause of absences due to work-related illness (Cooper 2008). A wide body of epidemiological and prospective evidence has been accumulated during the last decade, showing associations between psychosocial stress at work and disease endpoints such as cardiovascular disease, the metabolic syndrome, type 2 diabetes as well as psychiatric conditions (Kivimäki et al. 2006; Eller et al. 2009; Siegrist 2010, 2013; Angerer et al. 2014; Backe et al. 2012; Glozier et al. 2013; Li et al. 2013; Schmidt et al. 2015). The two organizational stress models that inspired most of the above cited research activities over the last decade are the job-demand-control model (Karasek and Theorell 1992) and the effort-reward-imbalance model (Siegrist 2002; Siegrist and Peter 1996), which is the focus of the present volume.

The model of effort-reward-imbalance, as already described in great detail in previous chapters, postulates that the experience of a failed reciprocity between high work-related costs and low occupational rewards leads to a state of emotional distress, which can result in sustained strain reactions and consequently leads to

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adverse health effects and reduced well-being over time. Over-commitment (OC), the intrinsic component of the ERI model (Siegrist 2002; Siegrist and Peter 1996), is conceptualized as a motivational pattern of excessive work-related commitment and a high need for approval, which is assumed to increase the risk of strain due to unreciprocated exchange. Evidence has shown that ERI and OC impact on self-rated health and well-being, health behaviors as well as physical diseases (Bosma et al. 1998; Kivimäki et al. 2002; Tsutsumi and Kawakami 2004; van Vegchel et al. 2005; Siegrist 2005; Rugulies et al. 2009; Siegrist and Rödel 2006). To gain a deeper understanding of the link between ERI/OC and health which is suggested by these findings and in order to develop effective interventions to prevent health impairments, a precise definition of the term stress as well as knowledge of potential underlying psychobiological pathways are essential. Previous work has implicated two main pathways through which stress can impact on physical health. On the one hand stress can influence people's health behavior, like smoking, choice of diet, exercise or adherence to medical treatment and on the other hand stress can directly initiate unfavorable alterations in different physiological systems, thereby increasing an individual's vulnerability to a range of physical diseases. A review by Siegrist and Rödel (2006), based on 46 studies measuring psychosocial work stress in terms of the job-demand-control-model and the ERI model however found only moderate support for the relationship between work stress and health behavior. Heavy alcohol consumption among men, overweight as well as multiple co-occurring risk factors showed the strongest associations with health behavior.

The present chapter will therefore review current results on the relationship between ERI/OC and alterations in the regulation of the physiological stress response, which has evolved as a highly adaptive reaction to ensure survival when an organism is confronted with a physical or psychological challenge. The present chapter is organized in three main sections. After a brief introduction on organizational stress models as well as general conceptualizations of stress, the second section serves to introduce McEwen's Allostatic Load Model and gives an overview over main components of the biological stress system, namely the sympatho-adrenal-medullary (SAM) axis and the hypothalamus-pituitary-adrenal (HPA) axis. The third section summarizes empirical findings that relate the effects of psychosocial work stress in terms of effort-reward-imbalance and over-commitment to alterations in stress related physiological systems, which increase the risk for a plethora of adverse health outcomes. The chapter closes with an outlook emphasizing the potential of the theoretical framework of the effort-reward-imbalance model to shape stress prevention programs in order to minimize health risks associated with work stress.

7.1.1 Brief History of the Stress Concept

Hans Selye, the father of modern stress research, first conceptualized stress as a non-specific response of the body to non-specific biological, chemical, physical or social challenges that were assumed to elicit a 'general adaptation syndrome' via the secretion of glucocorticoids (Selye 1950). Focusing primarily on the role of the sympathetic nervous system in the response to emergency situations, Walter Cannon in turn defined stress in terms of the stimulus required to elicit adrenomedullary responses (Cannon 1914). He coined the term fight-flight response, describing the responses to an acute threat. However, it soon became apparent that stress cannot be defined solely by an organism's physiological reaction. Mason (1975) was able to demonstrate that specific situational and personal characteristics, such as novelty, ambiguity or a person's sense of control over a threatening challenge are a crucial element in the stress process, triggering different autonomic and neuroendocrine responses. It then became evident that stress responses varied according to the quality of the challenge and the availability of the person's ability to cope with this challenge. In line with this notion, the transactional stress model of Lazarus and Folkman (1984) emphasized the role of subjective appraisal processes as determinants of emotional and physiological responses to the experience of a challenging situation. They defined stress as the experience of a mismatch between the demands put on an individual in a challenging situation and his or her abilities to cope. Finally, the cognitive activation theory of stress (CATS) by Ursin and Eriksen (2004) offers a comprehensive definition of stress, which distinguishes four aspects: input or stress stimuli, the individual processing or the stress experience, the non-specific, general stress response and finally the experience of the stress response. The stress response is believed to serve as a general alarm in a homeostatic system and is therefore described as an essential and necessary physiological response. The alarm elicits specific coping behaviours, which are dependent on acquired expectancies of the outcomes of stimuli and available responses.

7.2 From Allostasis to Allostatic Load

McEwen's allostatic load model aims to outline a theoretical framework explaining how chronic stress can lead to health impairments. It postulates that an organism responds to challenge by initiating an allostatic response, a complex pathway for adaptation and coping, and shuts off this response when the challenge has passed. The term allostasis was originally introduced by Sterling and Eyer (1988) to describe how the cardiovascular system adjusts to resting and active states of the body. Allostasis depicts a fundamental physiological principle 'maintaining stability through change': In order to maintain stability, an organism must vary all the parameters of its internal milieu and match them appropriately to environmental demands. The effective coordination of allostatic responses depends on the brain's evaluation of threat (McEwen 2007; Herman et al. 2005) and subsequent physiological responses, which are predefined by inter-individual differences in various factors such as genetics, experiences (trauma, life events), coping styles or health behaviors (Juster et al. 2010).

7.2.1 Core Stress Systems Involved in Allostatic Responses

In case of challenge, the sympathetic–adrenal–medullary (SAM) axis initiates the release of catecholamines (adrenaline and noradrenaline) and the hypothalamic–pituitary–adrenal (HPA) axis secretes glucocorticoids that mobilize energy necessary for fight-or-flight responses (Sapolsky et al. 2000). The SAM axis functions as a global alarm system and is comprised of two pathways. The neural pathway of the SAM axis is characterized by the innervation of effector organs by noradrenergic synapses, whereas the endocrine pathway describes the release of catecholamines by the adrenal glands. Circulating catecholamines stimulate effector organs via adrenergic receptors. These receptors are exemplary transmembrane proteins that, through coupling with G-proteins, stimulate or inhibit intracellular signalling pathways. Catecholamine secretion leads to a rapid mobilisation of energy stores (through increased supply of free fatty acids and glucose by glycogenolysis and lipolysis) as well as a down-regulation of less important organ functions (e.g. gastrointestinal tract and reproductive systems). Furthermore, catecholamines have a substantial impact on cardiovascular functioning during stress, increasing heart rate, cardiac output, and blood pressure (Kudielka and Kirschbaum 2007). Noradrenaline also activates the amygdala, the principal brain locus for fear-related behaviours, and enhances the long-term storage of emotional memories in the hippocampus and striatum (Tsigos and Chrousos 2002).

The HPA axis serves as a central control system of an organism, connecting the central nervous system (CNS) with the endocrine system. The HPA axis is vital for the support of normal physiological functioning and enables the organism to maintain homeostasis under acute stress. In the face of challenge, neural stimulation of the hypothalamic paraventricular nucleus of the hypothalamus (PVN) leads to the release of corticotropin-releasing hormone (CRH). After its release into the hypophyseal portal system, CRH initiates the cleavage of pro-opiomelanocortin (POMC) into adrenocorticotropin (ACTH), beta-endorphin, and other peptides and their subsequent release from the anterior pituitary gland. The primary target of ACTH is the adrenal cortex, where it triggers the secretion of glucocorticoids (GCs) and adrenal androgens from the zonae fasciculata and reticularis (Chrousos and Gold 1992). GCs have a wide range of physiological effects. In order to adapt to the increased metabolic demands under acute stress, GCs enhance circulating levels of energy substrates like glucose, free amino acids and free fatty acids, thereby amplifying catabolic processes whilst simultaneously suppressing anabolic processes. This is achieved through their action on a number of enzyme systems in the liver, muscles and fat. In the liver for example GCs enhance gluconeogenesis. Additionally, GCs may increase circulating free fatty acids by inhibiting lipoprotein lipase, initiating lipolysis and mobilising free fatty acids from fat depots (Chrousos and Gold 1992; McEwen 2003). Finally, GCs temporarily dampen immune system activity and processes involved in reproduction and cellular growth, thereby ensuring access to resources essential for coping with challenge.

However, GCs also play a key role in the termination of the stress response, preventing it from being pathologically over-activated (Chrousos and Gold 1992; Herman et al. 2003). Additionally, GCs have important regulatory effects on the cardiovascular system, the regulation of fluid volume and response to haemorrhage as well as on behaviour, appetite control and affective and cognitive processes, like learning and memory (McEwen 2003). The HPA axis is regulated by the negative feedback action of cortisol on receptors in the hippocampus, hypothalamus and pituitary gland. This feedback loop suppresses the secretion of CRH, ACTH and cortisol itself. In humans, the typical cortisol secretion follows a distinct circadian rhythm, with a marked increase (about 50–100 %) during the first hour after morning awakening in the majority of people (Dockray et al. 2008; Wüst et al. 2000) and decreasing levels over the remaining day. Pruessner and colleagues (1997) first suggested that this rise in cortisol after awakening might represent a useful index of adrenocortical activity. In a highly controlled study under sleep laboratory conditions, Wilhelm and co-workers (2007) showed that this elevation in cortisol is a genuine response to awakening, as the transition from sleep to the waking state was found to be a prerequisite for the cortisol awakening rise (CAR) to occur. Very recently, expert consensus guidelines for the assessment of the cortisol awakening response have been established (Stalder et al. 2016).

7.2.2 Allostatic Overload

As long as these allostatic responses are limited to the period of challenge, adaptation and thus protection is ensured. However, the same processes that are adaptive under acute stress conditions, may ultimately promote disease development when occurring chronically (Tsigos and Chrousos 2002; McEwen 2007; Chrousos and Gold 1992). Thus, if allostatic responses are sustained over months and years, the individual reaches the state of allostatic load (AL). Chronic over-activity or inactivity of physiological systems that are involved in the adaptation to environmental challenge result in a wear-and-tear on the body and brain (McEwen 1998b). Four scenarios have been proposed, eventually leading to AL. The first is frequent stress. In especially susceptible individuals, for example, repeated blood pressure surges can trigger myocardial infarctions. Secondly, AL can be caused by a failure to habituate to repeated challenges, leading to the over-exposure to stress mediators. An example for this type of AL is the finding that a minority of subjects fail to habituate to repeated exposures to psychosocial laboratory stress and continue to show high cortisol responses (Wüst et al. 2005). The third origin of AL is the inability to shut off allostatic responses, which could be reflected in a lack of recovery of blood pressure after a mental stressor, leading to the development of atherosclerosis due to hypertension. The fourth scenario is conceptualized as an inadequate allostatic response in one allostatic system, that gives rise to compensatory increases in other allostatic systems. An inadequate hormonal stress response for example allows inflammatory cytokines to become overactive (McEwen 1998a).

To sum up, AL captures the cumulative physiological burden exacted on the body through repeated attempts of adaptation, by postulating a sequential and reciprocal chain of dysregulation in multiple systemic mediators. Stress hormones (cortisol, dehydroepiandrosterone-sulfate (DHEA-S), adrenaline and noradrenaline) in combination with pro- and anti-inflammatory cytokines (such as interleukin-6 or tumor necrosis factor-α) are termed primary mediators (McEwen 2003), as the prolonged secretion of the stress hormones might damage the brain and body (McEwen 2006). Secondary outcomes are changes in metabolic (such as blood lipids (total cholesterol, high density lipoprotein cholesterol, triglycerides), visceral fat, insulin, glucose and glycosylated haemoglobin (HbA1c)), cardiovascular (systolic and diastolic blood pressure), immune (c-reactive protein (CRP)) and coagulation (fibrinogen, D-dimer) parameters on a sub-clinical level, as a result of the compensation for over and/or under production of primary mediators. Allostatic overload is finally reached when physiological dysregulation leads to manifested disease endpoints, referred to as tertiary outcomes.

7.3 The Relationship Between ERI and Health Mediators: Findings from Naturalistic and Experimental Studies

In the remaining part of this chapter, naturalistic studies on the relationship between ERI/OC and physiological stress markers will be reviewed according to the above described taxonomy proposed by McEwen.

7.3.1 Findings on Primary Mediators

7.3.1.1 Cortisol

To-date, at least a handful of studies have investigated associations between components of the ERI/OC model and HPA axis functioning. Most of these studies focused on basal cortisol regulation with only very few studies investigating HPA axis reactivity by the use of psychological stress tasks or pharmacological stimulation procedures (for review see Chandola et al. 2010). Results on basal cortisol measures in relation to ERI/OC are mixed. Several studies could not demonstrate significant associations between ERI/OC and the CAR or cortisol profiles across the day (Hanson et al. 2000; Harris et al. 2007; Bellingrath et al. 2008; Ota et al. 2014). However, other studies report on a higher CAR or higher cortisol day concentrations in relation to some ERI/OC components (Steptoe et al. 2004; Eller et al. 2006, 2011a, 2012; Almadi et al. 2013; Wright 2011; Maina et al. 2009; Marchand et al. 2015). In accordance with these latter studies, Qi et al. (2014) recently observed a significant positive association between the ERI-ratio and cortisol concentrations in hair, as a recently introduced measure of long-term accumulated cortisol concentration. Though, most of the observed associations could only be found in men (Steptoe et al. 2004; Eller et al. 2006, 2011a, 2012), in respective subpopulations (Maina et al. 2009), for the ERI-ratio OR a subcomponent (like effort, reward or over-commitment) but not both (Steptoe et al. 2004; Wright 2011). Only one study reported on a lower CAR as well as lower diurnal secretory activity in individuals scoring higher on ERI (Maina et al. 2009) and in the SALVEO study OC was related to increased awakening cortisol levels and decreased afternoon and bedtime cortisol (Marchand et al. 2015).

Other studies further raise the idea that ERI/OC might not be associated with generally higher versus lower cortisol day activity but with flatter circadian profiles (Karlson et al. 2011; Liao et al. 2013). Typically, such studies are based on small- to medium-sized samples (N = ~50–200 subjects). Only Liao et al. (2013) could analyze a large occupational cohort of N = 2,126 study participants derived from the Whitehall II study. They observed that higher ERI (and lower reward) related to a flatter slope in cortisol across the day. Most importantly, they report that effect sizes for significant findings were relatively small. This could be one major reason why the results picture so far is relatively mixed. However, other reasons for the, in part, inconsistent results could be the heterogeneous occupational study cohorts hampering generalizability across study samples, differences in the saliva sampling protocols, as well as use of different versions of the ERI/OC measure.

In an own study, we aimed at additionally investigating HPA axis negative feedback sensitivity as part of basal HPA axis functioning (Bellingrath et al. 2008). Besides cortisol day profiles across work and leisure days (see above), saliva samples were collected after pre-medication with 0.25 mg of the synthetic glucocorticoid dexamethasone the night before sampling. After DEX administration (only) lower reward from work was significantly related to stronger cortisol suppression. This finding raises the idea of a subtle dysregulation of the HPA axis manifested as heightened negative feedback functioning, even though all subjects were working and in a good health condition. Finally, very few studies investigated HPA axis responsivity to stress. Three of these studies applied a psychological stress task to provoke HPA axis responses. All three studies point to a reduced HPA axis responsivity. While Siegrist et al. (1997) observed a dampened cortisol stress response applying the Stroop task in relation to high ERI, in two studies using the Trier Social Stress Test (TSST), Wirtz et al. (2008) observed reduced salivary cortisol responses in healthy men and, in an own study, we observed HPA axis hyporeactivity in overcommitted teachers (Bellingrath and Kudielka 2008). Finally, two studies applied the combined DEX-CRH-stimulation test. Wirtz et al. (2010) observed unaltered ACTH but enhanced cortisol responses in overcommitted healthy men and women. This pattern of results was interpreted as heightened reactivity of the adrenal cortex but normal reactivity of the anterior pituitary in overcommitted individuals. However, in an own study applying the DEX-CRH-test as well as the Synacthen-test ($ACTH_{1-24}$-test), we could not find any indication for increased adrenal cortex sensitivity in subjects with higher OC by stimulation of the cortex with synthetic ACTH (Wolfram et al. 2013). At the same time, we observed hyporeactive pituitary as well as adrenal cortex responses to the DEX-CRH-test as reflected in reduced

ACTH, total plasma, and free salivary cortisol concentrations in overcommitted teachers.

We hypothesize that such an attenuated HPA axis response is not solely of pituitary and adrenal origin but also likely involves central mechanisms. This interpretation would also be in line with the above reported studies based on psychological stress provocation (Siegrist et al. 1997; Wirtz et al. 2008; Bellingrath and Kudielka 2008). In sum, while studies on basal HPA axis functioning are relatively mixed pointing to no or at least only modest alterations in circadian cortisol regulation, studies on HPA axis responsivity appear to be more consistent raising the idea of HPA axis hyporeactivity, especially related to the component over-commitment. Reasons for inconsistencies could be methodological differences between studies (see above) or some underpowered studies acknowledging the finding that underlying effect sizes might be relatively small. It is also possible that robust effects are only observable when the system is challenged (compare Seeman and Robbins 1994). Besides this, it is reasonable to assume that HPA axis regulation might change over time when human beings are exposed to chronic work stress. According to a time-course (Hellhammer and Wade 1993) or two-stage model (Siegrist et al. 1997), a state of chronic work stress like in the early stage of effort-reward-imbalance (characterized by hyperactivity of the HPA axis) could, in the long run, lead to a hypocortisolemic or hyporeactive state as result of a functional adaptation to excessive exposure to stress hormones. The development and progression of hypocortisolism may be due to reduced biosynthesis or depletion at several levels of HPA axis (CRH, ACTH, cortisol), CRH hypersecretion and adaptive down-regulation of pituitary CRH receptors or changes in receptor sensitivity, increased feedback sensitivity of the HPA axis, and morphological changes (Heim et al. 2000). Consequently, such changes over time could then blur results pattern and hyper- and hypocortisolemic effects in individuals could cancel each other out in group analysis.

7.3.1.2 Catecholamines

Although studies on psychosocial work place stressors and catecholamine excretion exist (for review see Chandola et al. 2010; Hansen et al. 2009), there is still a paucity of data reporting associations between components of the ERI/OC model and adrenaline/noradrenaline concentrations. In a study on various physiological parameters in the framework of allostatic load (see below), we could not find any relationship between ERI/OC and catecholamine levels as measured in overnight urine of schoolteachers. A subsample of these teachers was re-invited to the lab to perform a stress task. Here, we observed marginally higher noradrenaline concentrations ($p=0.06$) across the session in subjects with higher versus lower over commitment scores (von Känel et al. 2009). However, in another study a somewhat contrasting result was reported. Wirtz et al. (2008) observed that higher OC was significantly associated with lower pre-stress baseline levels of noradrenaline. Two studies are available that report on catecholamine responses to acute psychological stress, both pointing to reduced responsivity. Siegrist et al. (1997) observed reduced adrenaline responses to the Stroop task in relation to ERI and Wirtz et al. (2008) found suppressed noradrenaline responses in high versus low overcommitted subjects when exposed to the Trier Social Stress Test (TSST). Considering the scarce evidence so far, a final conclusion on catecholamine concentrations under basal conditions as well as in response to stress in respect to ERI/OC appears not advisable.

7.3.1.3 Inflammatory Cytokines

Although a number of studies have been published that aimed to investigate potential associations between the ERI/OC model and immune functions, studies that focus explicitly on inflammatory cytokines in terms of primary mediators are still rare. The term cytokine refers to a broad group of small proteins that play an important role in the communication and interaction between cells. They act in concert with specific cytokine receptors as well as cytokine inhibitors in order to regulate the human immune response, for example by modulating the balance between humoral and cellular immunity. Franke and colleagues (2010) compared job-related stress in terms of ERI and a set of pro- and anti-inflammatory mediators in a sample of law enforcement officers and a healthy control group. Law enforcement officers showed significantly elevated levels of ERI compared to the control group, mainly due to elevated effort. They also showed approximately two to three times higher levels of interleukin (IL)-1β, IL-6 and tumor-necrosis-factor (TNF)-α. No difference between the two groups was observed with respect to the anti-inflammatory cytokine IL-4, whereas IL-10 levels were significantly lower in the law enforcement officers. However, regression analyses revealed that less than 4 % of the variance in any of the inflammatory markers was explained by job-related stress, suggesting a different mechanism that explains the increased CVD risk in law enforcement officers, due to a pro-inflammatory state. Bellingrath et al. (2010) measured phytohemagglutinin (PHA)-stimulated lymphocyte production of TNF-α, interferon (IFN)-γ, IL-2, IL-4, IL-6 and IL-10, before and after an acute laboratory stressor in 55 healthy individuals. Subjects with higher levels of ERI showed an overall increase in pro-inflammatory activity, with higher TNF-a production at both time points and elevated pre-stress IL-6 production. Additionally, the production of IL-10 decreased after stress in subjects with higher levels of ERI, suggesting an impaired anti-inflammatory break, which could increase the risk of chronic low-grade inflammation.

Furthermore, in a second study changes in lipopolysaccharide (LPS)-induced IL-6 production and inhibition of IL-6 production by dexamethasone in reaction acute psychosocial stress were assessed in 46 healthy schoolteachers (Bellingrath et al. 2013). Higher ERI was associated with an increase in pro-inflammatory potential, reflected in elevated IL-6 production before and after stress and with a lower capacity of dexamethasone to suppress IL-6 production in vitro over all measurement time points (GC sensitivity), suggesting a less effective anti-inflammatory regulation by glucocorticoids in relation to ERI. Already, earlier research has demonstrated that clinical depression is associated with a diminished sensitivity to the anti-inflammatory properties of glucocorticoid hormones, possibly due to elevated resting levels of cortisol (Miller et al. 2005). As high levels of ERI have been established to be a risk factor for the development of depression it can be speculated, that reduced glucocorticoid sensitivity might help to explain how chronic work stress can lead to disease. To conclude, there appears to be preliminary evidence for an association between chronic work stress and a pro-inflammatory state. Due to the small number of studies however a final conclusion seems to be premature.

7.3.2 Findings on Secondary Outcomes

7.3.2.1 Body Weight (BMI) and Blood Lipids

It can be hypothesized that adverse body composition might be related to stressful working conditions. Indeed, epidemiological, longitudinal and cross-sectional studies revealed some evidence for positive, but weak, associations between components of the ERI/OC model and body mass index (BMI) (Kouvonen et al. 2005; Ostry et al. 2006; Berset et al. 2011). It is assumed that the underlying pathways behind a stress – weight gain – relationship are unhealthy eating habits and/or a sedentary behavioral life style. Interestingly, these relatively weak, or only marginally significant, associations might be explained by a bidirectional effect. Data from the Whitehall II prospective cohort study, for example, point to the idea that work strain might further increase body weight in obese men while body weight is decreased in thin men (Kivimäki et al. 2006). Indeed, in line with this reasoning, Takaki et al. (2010) found that ERI is more positively associated with over-eating in men with higher BMIs. There also exist, at least, a handful of studies that investigated blood lipids in order to measure established metabolic risk factors for CHD in relation to chronic work stress.

Thus, such studies capture relevant criteria for the so-called metabolic syndrome (MetS) which is defined by five CVD risk factors, namely obesity, elevated blood pressure (hypertension), high triglycerides, low high-density lipoprotein cholesterol (HDL), and impaired glucose tolerance (hyperglycemia). The MetS is considered a highly potential mechanism linking chronic job stress with incidence of CHD. The majority of the larger studies (for example from the WOLF or the SHISO study) report on unfavorable lipid profiles in relation to components of the ERI/OC model (Xu et al. 2011; Peter et al. 1998b; Irie et al. 2004; Siegrist et al. 1997), though contradictory findings are also available (Vrijkotte et al. 1999; Söderberg et al. 2012). Three further recent cross-sectional occupational studies on a sample of radiologists, in Korean blue-collar workers and in different occupational groups derived from the Mannheim Industrial Cohort Study (MICS) confirm that ERI is related to a significant higher risk of being affected by the metabolic syndrome (Schmidt et al. 2015; Magnavita and Fileni 2014; Hwang and Lee 2014). However, the referenced studies also point to the fact that such associations might be more prevalent in men compared to women as, for example, observed in the Mannheim Industrial Cohort Study (MICS). In this respect, it should also be of note that most of the studied samples are predominantly (or even solely) male and in some studies results in women are actually in the opposing direction (Söderberg et al. 2012; Hwang and Lee 2014). In sum, there appears to be clear evidence for an association between chronic work stress and unfavorable metabolic factors in men, though, it remains somewhat unclear if these associations are comparably valid for women.

7.3.2.2 HbA1c

Since haemoglobin A1c (HbA1c) reflects serum-glucose concentrations retrospectively over the past 4–5 weeks, this parameter has been established as screening marker for diabetes mellitus. To date, available studies on the relationship between elevated HbA1c in serum (in percent of total haemoglobin) on the one hand and adverse psychosocial working environment on the other appears relatively consistent. Several cross-sectional as well as longitudinal studies, including one population-based study, reported increased HbA1c in relation to a negative psychosocial working environment (reviewed in Hansen et al. 2009). So far, studies focusing on ERI/OC and glycemic control are rare. However, we identified at least three studies. All three studies reported at minimum on partially significant associations between chronic work stress and glycosylated haemoglobin (HbA1c) or incidence of diabetes. In a prospective cohort study of 10.308 civil servants aged 35–55 years at baseline, Kumari et al. (2004) observed that in men ERI was related to incidence of diabetes across four follow-up phases (total time span >10 years). Accordingly, Li et al. (2013) observed that higher ERI is related to (pre)diabetes status (verified by HbA1c, fasting plasma glucose and supplementary self-reports) in men while associations in women were weaker and remained non-significant (total N = 2.674, 77 % male). In a Chinese population (N = 680 subjects) from the SHISO study (Stress and Health in Shenzhen Workers), ERI was positively related with HbA1c in women but not men. Finally, Virtanen et al. (2012) tested whether ERI in medical staff is associated with glycemic control among their diabetes patients, though, they could not confirm this transfer effect. However, perceptions of higher levels of procedural justice among medical staff were associated with better glycemic control in patients. In sum, there exists evidence linking chronic work stress in terms of ERI with HbA1c and incidence of diabetes mellitus.

7.3.2.3 Blood Pressure

A growing body of research has investigated associations between psychosocial work factors in terms of ERI/OC and elevated blood pressure as one of the most critical risk factors for the development of CVD. ERI as well as OC have both been related to BP levels and hypertension, however results for ERI seem to be more consistent. In an early investigation by Peter et al. (1998b) only ERI but not OC was associated with hypertension in male but not female participants. Similarly, Vrijkotte and colleagues found (2000) ERI but not OC to be related to ambulatory systolic blood pressure over the workday in male white-collar workers. Steptoe et al. (2004), on the contrary reported higher ambulatory systolic BP levels among men in relation to OC. No significant effects were found for women.

Whether ERI prospectively predicts BP elevation was so far only investigated in one study using ambulatory BP measures (Gilbert-Ouimet et al. 2012). Significant effects of ERI on BP levels and hypertension were only observed in female participants over a follow-up of 3 years. Women younger than 45 years of age, which had high ERI levels at both measurement time points showed significantly higher BP means at follow-up. Women with high ERI levels at both measurement time points and older than 45 years of age on the other hand, showed an increased cumulative incidence of hypertension compared to those with low ERI scores. In a recent review, Gilbert-Ouimet and colleagues (2014) summarized the results of 74 studies that investigated adverse effects of work stress in terms of the demand-control-support (DCS) (64 studies) and the ERI- model (12 studies) on BP and hypertension. The majority of the studies reported significant deleterious effects of work stress on BP outcomes (Peter and Siegrist 1997; Gilbert-Ouimet et al. 2012; Yu et al. 2008; Maina et al. 2011; Peter et al. 1998a; Vrijkotte et al. 2000; Xu et al. 2004). Adverse effects on BP levels or hypertension risk were observed more consistently with respect to ERI compared to OC. It is furthermore noteworthy that overall the adverse effects of ERI/OC were shown to be less contradictory in men than in women (Gilbert-Ouimet et al. 2014). In sum, the evidence points to a link between psychosocial work stress in terms of ERI and BP elevations especially in men.

7.3.2.4 Heart Rate and Heart Rate Variability

Heart rate (HR), HR reactivity and HR variability (HRV) are established indicators of a stress-related activation of the autonomic nervous system (ANS) (Task Force 1996) and have been shown to be independent risk factors for the development of CVD. Under normal conditions, the two branches of the ANS – the sympathetic system, responsible for energy mobilization, and the parasympathetic system, associated with vegetative and restorative functions, are in dynamic balance. However, the activity of the two branches can rapidly change in order to flexibly adapt to environmental demands (Thayer et al. 2010, 2012). Persisting autonomic imbalance, in terms of a hyperactive sympathetic system and a hypoactive parasympathetic system, has been linked to a lack of flexibility and to pathological conditions (Malliani et al. 1994). Low HRV is indicative of sympathetic predominance and a decreased vagal tone and has been repeatedly associated with stress vulnerability (Porges 1992), difficulties in emotion regulation (Souza et al. 2007), stress at work (Chandola et al. 2010) as well as adverse health outcomes such as CVD (Thayer et al. 2010). A recent review by Jarczok and colleagues (2013) including 19 studies summarized the accumulated findings on the relationship between psychosocial workplace characteristics and HRV, showing that a decreased vagally-mediated HRV is indicative of adverse health profiles. Work stress was operationalized in terms of ERI in seven of the reviewed studies. ERI was significantly related to indicators of decreased vagal tone in four studies (Hanson et al. 2001; Hintsanen et al. 2007; Loerbroks et al. 2010; Uusitalo et al. 2011) and to decreased mixed sympathetic and parasympathetic indicators in three studies (Uusitalo et al. 2011; Eller et al. 2011a, b). Garza et al. (2014) recently assessed whether not only ERI but also OC are associated with greater decreases in HRV across a 2-h working period in 91 office workers. The results indicated that higher levels of ERI and OC are associated with a greater decrease in HRV throughout the measurement period.

Loerbroks and colleagues (2010) aimed to determine whether age might modify potential associations between work stress and HRV indicators. ERI was only related to HRV in employees aged 35–44. This finding was explained by age-dependent HRV declines on the one hand as well as a potentially increased susceptibility among those aged 35–44 due to stressors in the work life (i.e. advancing the career) in combination with stressors in private life (marriage, birth of children), which are characteristic for this age group.

Modifying effects of gender became apparent in a number of studies. Performing a gender stratified analysis, Eller et al. (2011a) found significant associations between high levels of ERI to be associated with low HRV only in women. Similarly, Hintsanen et al. (2007) reported an inverse association between ERI and HRV in women, but not in men. Furthermore, in a second study by Eller et al. (2011b) lower HRV in terms of total power was only found in men experiencing higher levels of ERI at work. Interestingly, a status by ERI interaction could be observed. Men with a higher social status and higher ERI levels had an increased HRV compared to men with a lower status and higher ERI. Vrijkotte et al. (2000) investigated vagal tone as well as HR reactivity in relation to ERI/OC in a sample of male white-collar workers on two workdays and one leisure-day. A trend was observed for the high ERI group to have lower vagal tone during all measurement periods. Additionally, a selective increase in HR during work and leisure time after work was observed in subjects with higher levels of ERI, whereas no alterations in HR were found during sleep and during the leisure-day. No significant effects of OC were found with respect to HR or vagal tone.

Finally, Falk et al. (2011) used an experimental design to analyze how perceptions of unreciprocated exchange in a work situation, which is the basic notion of the ERI model, relate to HRV. In a so-called principal agent experiment agents were asked to work on a tedious task, thereby producing revenue. Principals finally decided how to share this revenue between themselves and their agents. Falk and colleagues could show that if an agent received less reward than expected, thus considered the wage too low and thus unfair, a significantly impaired cardiac autonomic control was observed. These results suggest that the repeated perception of unfair exchange at work might affect health outcomes in the long run. To summarize, the available evidence suggests that work stress in particularly in terms of ERI is associated with a lower HRV and this relationship between ERI and HRV is modulated by age and gender.

7.3.2.5 Blood Coagulation Markers

There is relatively clear evidence from population-based studies that an adverse psychosocial working environment is related to unfavorable coagulation markers like fibrinogen (for review see Hansen et al. 2009). Findings on the association between ERI/OC and parameters of the fibrinolytic and coagulation system are yet relatively scarce. However, although the available studies differ markedly in study samples, sample sizes, analyzed hemostatic markers and result patterns, the majority of studies, at least in parts, supports the assumption that chronic stress at work in terms of ERI/OC is associated with unfavorable changes in the blood coagulation system. For example, elevated fibrinogen levels have been related to ERI/OC in different samples (Siegrist et al. 1997; Xu et al. 2012). Though, other studies from different European countries could not confirm this relationship in medium-sized samples (Vrijkotte et al. 1999; Bellingrath et al. 2009) or even in a large cross-sectional sample of the WOLF (work, lipids, fibrinogen) study comprised of 3,427 men and women (Peter et al. 1998a). Beside fibrinogen, Vrijkotte and coworkers (1999) measured tissue-type plasminogen activator activity, tissue-type plasminogen activator tPA antigen, and type 1 plasminogen activator inhibitor antigen PAI-1 and found evidence for an impaired fibrinolytic system associated with overcommitment on their three measurement occasions. In a study by Irie et al. (2004), it was reported that ERI/OC is positively related to hematological values (e.g. red blood cells, hemoglobin, hematocrit). Beside these studies on basal measures, in an own study we investigated if chronic work stress might be reflected in an exaggerated pro-coagulant stress response (von Känel et al. 2009). We measured ERI/OC in schoolteachers at study entry and, after a mean follow-up of 21 ± 4 months when subjects returned to the lab for the stress testing. During recovery from acute stress, OC correlated with D-dimer increase and smaller fibrinogen decease. In sum, we found evidence that OC, but not ERI, is associated with a hypercoagulable state in response to acute psychosocial stress, particularly during the recovery period.

7.3.2.6 Immune System Mediators

Only a few studies so far assessed potential associations between ERI/OC and different immune cell populations. Bosch et al. (2009) were the first to examine the potential influence of ERI/OC on immunosenescence. To assess two components of an aging immune risk phenotype, the number and proportion of late-differentiated (CD27-CD28-) CD8 T cells (CTLs) as well as the CD4:CD8 ratio were measured in 537 factory workers. Lower reward and higher ERI were associated with a significantly lower CD4:CD8 ratio. Furthermore, higher overall levels of psychosocial work stress were associated with increased numbers in CD27-CD28-CTLs. These results suggest that psychosocial work stress may contribute to immunological aging. In an own study we investigated lymphocyte subset counts before and after acute stress in 55 healthy schoolteachers. High levels of ERI and OC were associated with lower numbers of natural killer (NK) cells (CD16+/56+) whereas only high levels of OC were related to a lower increase in T-helper cells (CD4+) after stress, suggesting a dampened innate immune defense in relation to ERI/OC (Bellingrath et al. 2010). In line with this, Nakata and colleagues (2011) found NK cells to be significantly associated with ERI but only in male participants. Also, effort and reward but not OC were related to NK cells numbers. Finally, higher levels of reward were positively associated with NK cell cytotoxicity and inversely associated with B cells.

Secretory immunoglobulin A (sIgA), which can be found abundantly in saliva, is considered to be the best marker for mucosal immunity. SIgA acts as the first line of innate immune defense by preventing viral pathogens, which are mainly responsible for upper respiratory tract infections, entering the body via mucosal tissue. The relationship of mucosal immunity with the general immune defense, however, is not entirely clear and overall findings on the effects of stress on the sIgA response are contradictory so far. Bathman et al. (2013) observed significant associations between ERI and OC and sIgA in a sample of male dairy farmers (N = 66). In simple regressions where efforts, rewards and OC were entered as singular predictors of sIgA concentration, all components of the ERI model were significantly related to sIgA. Furthermore, Wright (2011) found effort and reward, entered together in linear regression analysis, to predict sIgA levels in a medium-sized sample of disability workers.

The association between pro-inflammatory biomarkers and CVD as well as metabolic syndrome has been shown in numerous studies during the past decade. Especially (high sensitivity) C-reactive protein (CRP), indicating not only acute inflammatory processes but also chronic low grade-inflammation, has been established to be an independent predictor for coronary artery disease (Danesh et al. 2004). In two studies, Almadi and colleagues (2012, 2013) investigated associations between ERI and CRP in male Jordanian employees. In the first study, ERI was shown to account for 5 % of the variability in CRP levels, when only the centrally obese subjects were considered and secondly, the odds of suffering from metabolic syndrome were observed to be significantly higher in centrally obese men with both higher ERI scores and higher CRP levels. Similarly, Xu et al. (2015) reported ERI to be positively related to hsCRP and reward to be inversely related to hsCRP in a sample of Chinese workers. Bellingrath et al. (2009) however did not observe a relationship between ERI and CRP levels in a solely female sample of German schoolteachers (N = 104). In line with this, Hamer and colleagues (2006) found no relationship between ERI and circulating levels of hsCRP in a sample of middle-aged healthy men. Subjects with higher levels of ERI however exhibited a significantly stronger increase in hsCRP in response to acute laboratory stress (speech task and mirror tracing) after adjustment for age, BMI, and baseline CRP levels. To sum up, ERI has repeatedly been associated with alterations in immune system functioning, ranging from a dampened innate immune defense, increased risk for immunosenescence as well as chronic low-grade inflammation. However, due to the variety of immunological biomarkers that have been implicated in the studies so far, general conclusions seem to be premature.

7.3.2.7 Oxidative Stress

Recently, researchers raised the idea that oxidative stress might be one possible pathway linking job stress with coronary heart disease since a critical amount of reactive oxygen species (ROS) can lead to oxidative DNA damage. Research on this topic is still extremely scarce. However, one study by Takaki (2013) points to a significant positive relationship between ERI-ratio in men (but not women) and urinary H_2O_2 (hydrogen peroxide), though, other studies did not observe significant associations between the ERI-model and other biomarkers of oxidative DNA damage, like 8-hydroxy-2′-deoxyguanosine (8-OHdG) or oxidative metabolites (Inoue et al. 2009; Irie et al. 2004). Further research is necessary to elucidate the potential role of oxidative biomarkers in chronic work stress.

7.3.2.8 Intima Media Thickness and Vascular Health

The vessel's intima media thickness (IMT) as well as the progression of the IMT are established indicators for cardiovascular health. There is few but reasonably consistent evidence pointing to an association between chronic work stress in terms of ERI on the one hand and IMT on the other. For example, in a large cross-sectional study, Xu et al. (2010) performed high-resolution carotic ultrasonography in 734 Chinese workers without coronary heart disease (508 men and 226 women). In women, effort, ERI-ratio, and OC were positively and reward negatively related to IMT (controlling for relevant covariates). In men, however, such associations rendered non-significant if controlling for covariates. In a longitudinal study across 4 years, Eller and Netterstrom (2007) assessed the relationship between psychosocial factors and the progression of intima media thickness (IMT) in 95 healthy volunteers. In the same vein, they found that different ERI-model components serve as significant independent predictors of IMT progression in men as well as women. In line with this, Fischer et al. (2009) set out to investigate whether ERI/OC is associated with numbers in circulating progenitor cells assessed by flow-cytometry in industrial employees. Progenitor cells are involved in the maintenance of vascular integrity and were found to be decreased in subjects with high cardiovascular risk. ERI was independently associated with lower progenitor cell counts, furthermore a significant interaction effect between smoking and ERI was observed. Such results strengthen the view that chronic work stress in terms of ERI/OC might promote atherosclerotic processes.

7.3.3 Findings on an Allostatic Load Summary Index

The allostatic load summary index has been used to establish relationships between work stress and health-related outcomes. Although there exist several studies on allostatic load in different occupational settings, almost no studies investigated the association between adverse psychosocial working environment in terms of ERI/OC and a cumulative measure of physiological wear-and-tear. In almost all available studies, single parameters were analyzed although multiple parameters were collected (for reviews see Mauss et al. 2015; Hansen et al. 2009). A least in an own study, Bellingrath et al. (2009) assessed the relationship between indicators of work-related chronic stress in school teachers and disease risk not only with respect to single mediators but with a cumulative measure of physiological wear-and-tear prior to the onset of a manifest clinical disease, as suggested by McEwen and Seeman (1999). In this study, ERI/OC and a summary allostatic load index were assessed in 104 female teachers. Allostatic load was first analyzed according to McEwen's classical model comprised of ten parameters including cortisol, adrenaline and noradrenaline, dehydroepiandrosterone-sulfate (DHEA-S), waist/hip-ratio (WHR), HbA1c, high density lipoprotein (HDL), total cholesterol/HDL-ratio as well as systolic and diastolic blood pressure. To additionally account for immunological, blood coagulation, and metabolic processes, it was furthermore extended by TNF-α, CRP, fibrinogen, D-dimer, percent-body-fat, triglycerides, and glucose. Both composite AL-indices were significantly higher in women with higher ERI levels, reflecting subtle dysregulation across multiple stress-sensitive systems. Despite the limitations of a cross-sectional analysis in a relatively small, solely female study sample, these findings potentially underline an advantage of a composite AL score in quantifying future disease risk in apparently healthy and working cohorts, compared to a confined investigation of single biological risk factors.

7.4 Outlook

Taken together, the existing studies investigating the mechanisms which underlie the associations between job-related stress and negative health outcomes suggest that already healthy subjects with elevated ERI/OC show subtle changes in multiple psychobiological stress markers before a potential disease manifestation.

Advancing our knowledge about psychobiological mechanisms could help to develop prevention programs, based on the theoretical framework of the ERI-model, that complement the well-evaluated techniques of relaxation, meditation or stress inoculation, by focusing on the modification of dysfunctional work-related attitudes regarding achievement and commitment and the ability to gain mental distance from work-related obligations (Aust et al. 1997). Stress management interventions based on the ERI model could help to improve individual coping skills, such as declining inappropriate demands, developing a realistic appraisal of personal resources and to establish multiple sources of self-esteem, not only with regard to work-related achievement. An intervention study explicitly based on the ERI model by Limm and colleagues (2011) is especially encouraging as it could show that perceived stress reactivity after 1 year was significantly reduced in the intervention group. In recent years there has been growing research activity that aims to investigate the effects of stress management interventions not only on behavioral outcome measures and subjective stress ratings but also on physiological stress markers, especially cortisol (Gaab et al. 2003; Storch et al. 2007; Flook et al. 2013; Hammerfald et al. 2006). In the above mentioned intervention study by Limm et al. (2011) however no effect on cortisol levels was found, whereas with respect to salivary α-amylase, an index for sympathetic activity and dysregulation of the autonomic nervous system, a trend could be observed for a stronger decrease in the intervention group (area under the daytime curve and daytime slope) compared to the control group.

Furthermore, a precise knowledge about psychobiological pathways from ERI/OC to health impairments is not only relevant for person-oriented interventions, it should also encourage the implementation of structural and organizational changes that target the communication and reward culture at the work place as well as organizational climate and organizational justice in order to improve psychosocial workplace characteristics. Finally, alternative methods of measuring stress in daily life, such as ambulatory assessment, that allow the investigation of subjective experiences linked to a particular time and context, could help to advance knowledge on psychobiological pathways to stress-related disease vulnerability due to job-related stress (Conner and Barrett 2012; Kudielka et al. 2012).

With this, the usefulness of the ERI/OC model in the area of psychobiological stress research is at least twofold. First, this work stress model helps us to gain a better understanding of the concrete mechanistic pathways leading from work stress to adverse health effects. Furthermore, the model helps us to identify person- as well as organizational-oriented targets for prevention– and with this, helps us to implement a salutogenic approach to face (chronic) stress at work.

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Part III
The Context of Economic Globalization

Chapter 8
Work Stress and Health: The Case of Japan

Akizumi Tsutsumi

8.1 Work Stress and Policy Responses in Japan: A Brief Overview

The Japanese Ministry of Health, Labour, and Welfare has conducted a representative survey of companies and employees in Japan every 5 years since 1982. Currently, more than 50 % of employees in Japan report strong worry, anxiety, or stress at work or in their working life. The number of suicides among employees increased from about 6000 per year in 1997 to about 9000 per year in 1998 and remained stable until 2009. However, there has been a declining trend in recent years. In 2014, a total of 1456 claims were submitted requesting worker compensation for work-related mental disorders, and among these, 213 were suicide-related. Yet, only 497 claims for mental disorders were approved for compensation in 2014. The number of claims for mental disorders increased almost five times during the last 14 years. At the macro level, some calculations of the economic burden of mental health problems were conducted. Assuming there were neither suicides nor depressive disorders in Japan, the economic benefit for a single fiscal year was estimated to amount to 26 billion USD. Likewise, an increase of GDP by some 16 billion USD within 1 year (2010) was estimated (Ministry of Health, Labour and Welfare 2010). Another estimation of the annual national cost of major depressive disorder among adults 20 years and older in Japan showed that the economic burden of depression was approximately 11 billion USD (Okumura and Higuchi 2011). Worker compensation for work related physical health problems due to psychosocial risk have been monitored, too. In 2014, 763 claims were submitted and 277 cases were compensated due to cerebro-cardiovascular disorders.

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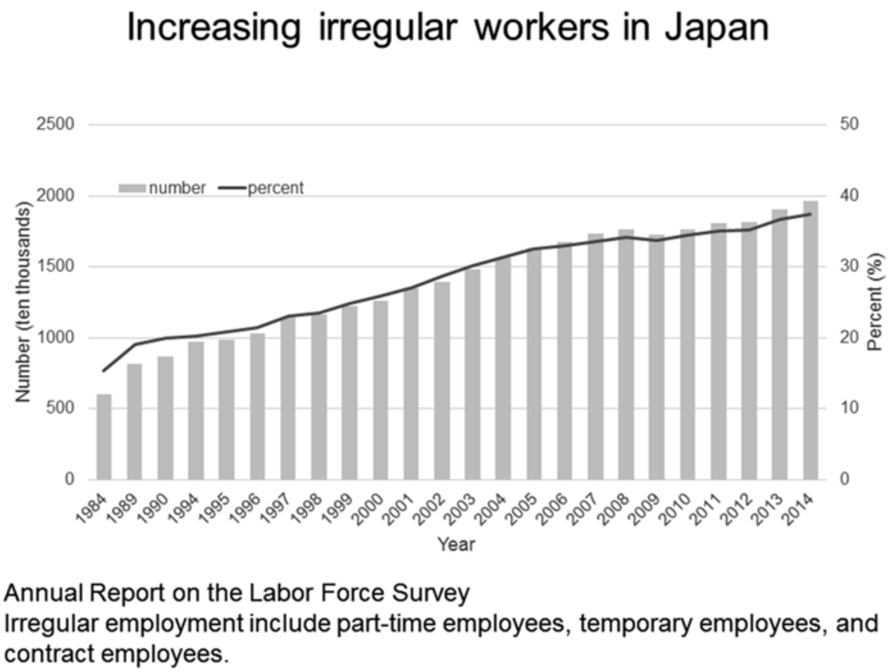

Fig. 8.1 Increasing irregular workers in Japan

The number of workers in atypical or irregular employment has steadily increased. To date, 40 % of the entire workforce belong to this category, as showed in Fig. 8.1, thus contributing to widening income inequalities in this country. Moreover, according to OECD data Japan was among the countries ranking on the top of all OECD countries with regard to long working hours. As a result, the combination of a high amount of overtime work with atypical employment and low pay has been considered a serious cause of workers' distress. As shown later, this stress-enhancing combination is captured by the model of effort-reward imbalance at work.

Japanese legislation on health and safety at work to some extent addresses psychosocial health risks. The Japanese Industrial Health and Safety Law states that employers are responsible for protecting the health and safety of their employees, and this responsibility includes preventing health-adverse psychosocial work environments. To enhance effectiveness of the law, the government released several guidelines. In 1999, the Labor Standard Bureau released an official standard for judging the work-relatedness of psychiatric diseases, which has been updated in 2009 and 2012 by adding "harassment at work" as a possible cause. Consequently, the 'Guideline for Promotion and Maintenance of Mental Health of Workers' and the 'Guideline for Return-to-Work of the Mentally Ill' were released and updated several times.

Among the guidelines, the ‘Guideline for Promotion and Maintenance of Mental Health of Workers’ is of core relevance. It is not mandatory for employers to follow the Guideline. However, recent court decisions refer to it as a standard practice in mental health care at the workplace. This latter development has motivated several large-scale companies to apply the Guideline to their employees. More specifically, the Guideline requires employers to establish procedures to maintain and improve the mental health of workers at particular workplaces, based on a participatory approach including the employer, employee representatives, and occupational health professionals belonging to the safety and health committee of the workplace. These procedures should implement evaluations, thus contributing to continuous improvement of processes. Furthermore, the system and plan should ensure that “four types of care” are provided, requiring that each one of the following four groups of personnel (employees, managers/supervisors, occupational health professionals, and service providers external to the workplace) meets the demands and responsibilities described in the Guideline. The Guideline emphasizes the importance of protecting the health information and privacy of employees in activities related to workplace mental health.

In this country, a fundamental law on the prevention of suicide was issued and enforced in 2006, addressing the whole population, not just working people. Detailed measures were developed in 2007 and revised in 2012. Although there has been a trend of declining suicide rates, these rates are still rather high, and of special concern is an increasing recent rate of suicides among younger people aged 20–40’.

A further important law concerns preventive measures against Karoshi (death from overwork). It was enforced on Nov 1, 2014. This law aims to create a society where people can be free from threats of Karoshi and can continue to work productively in good health, with a reasonable work-life balance. There are four pillars to guarantee that the aims of the law are met: (1) to encourage research on the causes and mechanisms of Karoshi; (2) to strengthen education to better understand, identify, and prevent the danger of Karoshi; (3) to establish counseling services for workers at risk of work overload; and (4) to support nongovernmental organizations to raise awareness through preventive activities and campaigns.

The Industrial Safety and Health Law has been amended several times. Important amendments related to psychosocial factors at work include the ‘Doctor’s Interview of Workers with Long Working Hours’. This amendment issued in 2006 targeted specifically the prevention of job stress-related diseases, such as cerebro-cardiovascular diseases and depressive disorders. Accordingly, employers are obliged to refer those employees who accumulated 100 or more hours of overtime work and complained of fatigue, to a professional consultation and health checkup with a physician if they asked for a respective activity.

Most recently, in 2014, this law was extended to include a Stress Check Program where regular yearly screenings of high psychosocial stress in the workplace is mandatory in enterprises with 50 or more employees. The program requires an employer to (1) provide a survey of psychosocial stress of workers, (2) report the individual’s result to each worker, (3) arrange an interview by a physician with a worker with high stress at the worker's request, and (4) follow the recommendations of the physician by respective improvement of adverse working conditions.

Taken together, Japan by now has a set of regulations and laws to protect the working people's health and wellbeing, addressing specifically the growing problem of work-related psychosocial stress. It remains to see to what extent these regulations are observed in practice and to what extent they may contribute towards reducing the burden of work-related diseases.

8.2 Relevance of Effort-Reward Imbalance for Working People in Japan

The Japanese economic background briefly described and several widely prevalent behavioral patterns and attitudes of Japanese workers are very closely related to the core notions of the effort-reward imbalance (ERI) model. Japan has suffered from a prolonged economic recession which forced companies to restructure their business, especially so around the late 1990s, following the burst of an economic bubble and the challenges of economic globalization. Many Japanese workers lost their feeling of job security that they had enjoyed for a long time (Kawakami and Haratani 1999; Tsutsumi et al. 2015). Precarious work has been increasing, and even workers in regular employment with more secure jobs were threatened by occupational instability (Tsutsumi et al. 2015). Contrary to many Western societies, a solid safety net against unemployment has not been established in Japan (Kawahito 2014). Due to the current situation of increasing job insecurity a large number of Japanese workers are suffering from this threat, given the fact that they enjoyed permanent employment and were rarely exposed to forced mobility for a long period (Brinton 2010).

Over-commitment reflects a cognitive-motivational pattern of coping with demands based on elements of Type A behavior. The concept of over-commitment has some elements in common with the conceptualization of a 'Japanese coronary-prone behavior' as described in a Japanese multi-center study (Hayano et al. 1997). This behavioral pattern is characterized by a job-centered lifestyle and a strong social dominance, in some analogy to the excessive job involvement inherent in the concept of 'over-commitment'. It is therefore likely that this latter concept may contribute to the explanation of work-stress related health risks in Japanese workers.

As clearly stated in Chap. 1 of this book, the model of effort-reward imbalance at work maintains that failed contractual reciprocity in terms of high cost and low gain is often experienced by people who have no alternative choice in the labor market, by those exposed to heavy job competition, and by those who are overcommitted to their work. We repeatedly demonstrated that this assumption also holds true in the Japanese setting and that health consequences are particularly pronounced under these conditions (Tsutsumi et al. 2002b). Despite the national development described above, the recent amendment of the Worker Dispatching Act concerning the prevention of work-related stress has not gone far enough in its analysis and intervention. It has therefore provoked a vivid public debate. The Government party insisted that the enforcement of the law would have beneficial effects by increasing the number of regular workers. However, the opposite parties and labor organizations claimed that the law would prevent irregular workers from becoming regular workers. Given these latter restrictions, those irregularly employed workers who are striving to get a permanent job may be particularly susceptible to the continued experience of effort-reward imbalance at work.

8.3 Reviewing Research on the ERI Model in Japan

8.3.1 Validation of the ERI Model

In accordance with the development and revision of the original ERI questionnaire, the Japanese versions of the ERI questionnaire have been developed and updated several times. The original ERI questionnaire was developed through a back-translation process (Tsutsumi et al. 2001a). Since then, the ERI model has been tested in many studies, and a high internal consistency of the ERI scales was confirmed throughout the studies. Validation studies on the Japanese ERI questionnaire are ample (Tsutsumi et al. 2002a). The ERI indices including over-commitment were associated with several health outcomes, strengthening their validity. Confirmatory factor analyses replicated the theory-driven factorial structures of the scales (Tsutsumi 2004), and explanatory factor analyses resulted in comparable findings (Tsutsumi et al. 2001a). Furthermore, the dynamic responsiveness of the ERI measures to a series of organizational changes occurring over time was demonstrated (Tsutsumi et al. 2002a). In a longitudinal analysis of 543 employees who experienced several measures of organizational restructuring in terms of exposure to more competitive work environments exhibited a respective substantial increased of their ERI measures over time.

The reliability and validity of the short version of the ERI questionnaire were also confirmed (Kurioka et al. 2013). The internal consistency and test-retest reliability were acceptable. It was also confirmed that the ER-ratio was associated with an elevated risk of psychiatric disorder. However, the ER ratio based on the short version is not strongly correlated with the ER ratio based on the original questionnaire and runs the risk of producing a high number of false-positive cases.

Several Japanese studies showed that the over-commitment scale was internally reliable (Tsutsumi et al. 2002a). The over-commitment scale was also validated in several Japanese settings. One of the validations was done by examining the theoretical association between the person-specific model component and a measure of motivational behavior at workplace, using a path analytic approach as well as showing the standard psychometrics (Tsutsumi et al. 2008b). In this study, motivation was significantly and positively associated with over-commitment, and over-commitment was significantly and *positively* associated with psychiatric disorder measured by the GHQ, whereas motivation was significantly *negatively* associated with the GHQ score.

8.3.2 ERI at Work and Health Outcomes

In the first part of this section, I review a summary of research published so far on ERI at work and health outcomes in Japan from three perspectives: (1) health outcomes; (2) subjects studied; and (3) causality of reported associations. Following this, findings regarding the associations of ERI/over-commitment with other occupational stress components and with socioeconomic status are summarized, and a few findings on the interaction of ERI with over-commitment are added.

A variety of studies examined associations between ERI and *psychological distress* in various occupations. *Depression* is the health measure most often studied in association with the ERI model (Kikuchi et al. 2010; Sakata et al. 2008; Tsutsumi et al. 2001b, 2012), including over-commitment (Kikuchi et al. 2010). The relative risks shown in these studies range from 2.8 to 8.8 for the ER ratio (or single scales), and from 1.3 to 2.6 for the scale over-commitment. Other than depression, ERI was found to be associated with general psychological distress (Inoue et al. 2010), and with fatigue (Takaki et al. 2006). As for an objective outcome, Inoue et al. (2011) showed in their study of 756 permanent and fixed-term male workers that ERI was associated with increased utilization of the company's clinic for mental health concerns.

Musculoskeletal disorders were also well studied (Tsutsumi et al. 2001a; Yokoyama et al. 2014), in particular among employees engaged in the jobs with physically strenuous work in combination with high psychological strain. Dental technicians are a profession characterized by this combination as their work is characterized by constant posture over a long time period and by psychological demands, such as meeting deadlines, working overtime, and working with high precision and responsibility. In addition, there are socio-emotional stressors given an obvious discrepancy between high amounts of work spent and low monetary rewards received in turn. Tsutsumi et al. (2001a) revealed a significantly elevated risk of musculoskeletal symptoms in dental technicians exhibiting a high level of over-commitment (Odds ratio (OR) = 4.6; 95 % CI 1.4–12.6). A large physical burden among eldercare workers is well known. Yokoyama et al. (2014) showed a high ERI prevalence among eldercare workers and an association of ERI with low back pain (OR = 1.96; 95 % CI 1.02–3.77).

In a cross-sectional study of 1198 male and female workers, Nakagawa et al. (2014) showed that reward at work significantly enhanced *job performance*, using the WHO-HPQ measurement. This is a new finding with potential policy impact. Furthermore, ERI was shown to be negatively associated with health-related quality of life. Watanabe et al. (2008) conducted a cross-sectional study of 1057 male workers using the SF-8 scale and showed that ERI was associated with the *poor health functioning*, as indicated by a physical and a mental summary score, and that these associations remained significant after adjustment for relevant confounding factors.

Health-related behaviors define another category of relevant outcome measures. In this respect, ERI was associated with several health-damaging behaviors. Takaki et al. (2010) found that *over-eating* was more frequent among people with work stress (ERI), and an interactive effect of ERI and body mass index on over-eating was suggested. *Angry driving* in traffic may be health-damaging as well, and a study by McLinton and Dollard (2010), using the Driving Anger scale, concluded that ERI may spillover to driving anger among Japanese workers. Concerning a further, very important health-related behavior, *smoking cessation*, it appears however that ERI has no respective effect. Ota et al. (2010), in their 2-year follow-up study of 579 male smokers, did not find that ERI was associated with smoking cessation at follow-up.

Other cross-sectional studies showed that ERI was related to *insomnia* (Ota et al. 2005; Utsugi et al. 2005). Of particular relevance are the results obtained from a prospective study where Ota et al. (2009) followed 1022 workers for 2 years. The authors observed that ERI had a significant association with the persistence of insomnia (adjusted OR = 2.40; 95 % CI 1.13–5.10). Moreover, over-commitment was significantly related to future onset of insomnia (OR = 1.75; 95 % CI 1.16–2.66). In this study, occupational stress factors other than ERI were also tested, but ERI showed the relatively strongest impact on insomnia, followed by work social support (OR = 2.00; 95 % CI 1.18–3.40).

Compared with the job demand-control (DC) model, evidence on ‘hard’ health outcomes based on the ERI model is rather scarce in Japan. While ERI was found to be associated with unfavorable *lipid profiles* (Irie et al. 2004; Kobayashi et al. 2005), an association with a respective clinically relevant outcome measure, *arterial stiffness*, was not found (Utsugi et al. 2009).

Finally, several investigations explored the role of ERI in association with *biological markers* that are suspected to be involved in stress mechanisms. In one such investigation, Irie et al. (2004) studied employees of a recently downsized manufacturing company where they found that ERI was associated with increased GPT and that over-commitment was associated with elevated blood glucose. However, these changes were not associated with cortisol and biopyrrins. Inoue et al. (2009) found no association between ERI and urinary 8-OHdG. As some types of oxidative biomarkers may mediate the association of ERI with coronary heart disease, their study offers an interesting new perspective. Takaki (2013) showed in a study of 567 male and female workers that ERI is associated with urinary H_2O_2, but not with 8-OHdG.

In summary, while substantial evidence on associations of ERI with a variety of health markers has been reported in recent research from Japan, it seems premature to draw firm conclusions, given the paucity of prospective studies and the limited knowledge on psychobiological pathways.

8.3.3 Subjects Included in the Studies

ERI was often tested to have stronger impact among workers with economically disadvantageous status than among those with more favorable socioeconomic circumstances. In a cross-sectional study of a medium-sized manufacturing company, the two complementary models of ERI and of job strain were simultaneously tested (Tsutsumi et al. 2001b). ERI was found to be more frequent among employees in lower socioeconomic positions, defined by indirect support tasks that were at risk of being downsized. Among these workers, a high prevalence of depressive symptoms was observed. After adjustment for several confounding factors, ERI was significantly associated with depression, and this association was particularly strong in the subgroup suffering from potential job loss.

ERI and health problems were often studied among medical professionals in Japan. There is evidence suggesting that the prevalence of ERI among them is higher than is the case among other professions (Tsutsumi et al. 2002a, 2012). In addition, in these professions the relationships of ERI with adverse health seem to be particularly strong (Sakata et al. 2008; Tsutsumi et al. 2012).

While a majority of studies addressed employed populations, there is very limited research available on the effect of occupational stress among self-employed people, as well as among administrators involved in management. Private practice physicians are one such self-employed group exposed to severe market competition and economic fluctuation. In a study of private practice physicians, 57 % of physicians were exposed to stressful work in terms of high ERI (Tsutsumi et al. 2012). In this professional group, high effort in combination with low organizational reward was most often experienced, and the effect of this imbalance on depression was clearly more pronounced than the effects of the two remaining reward components (see Fig. 8.2 and discussion). This finding underlines the importance of considering employment contexts both in terms of scientific knowledge and implications for practical intervention.

8.3.4 Causality of Associations

Scarce knowledge based on prospective studies obtained so far in Japan precludes any assessment of potential causal links between ERI and health outcomes. However, two panel studies addressed this problem and provided some interesting insights. In a three-wave panel study of 211 male workers, Shimazu and de Jonge (2009) analyzed and discussed reversed effects of employees' adverse health on ERI. They pointed to a possible mechanism by which reduced health may contribute to changes in the perception of effort and reward at work. At the same time, stressful work may also affect their health, thus resulting in a reciprocal relationship between ERI and health. The second investigation was performed by Oshio and his colleagues (2015). They confirmed a robust association between ERI and

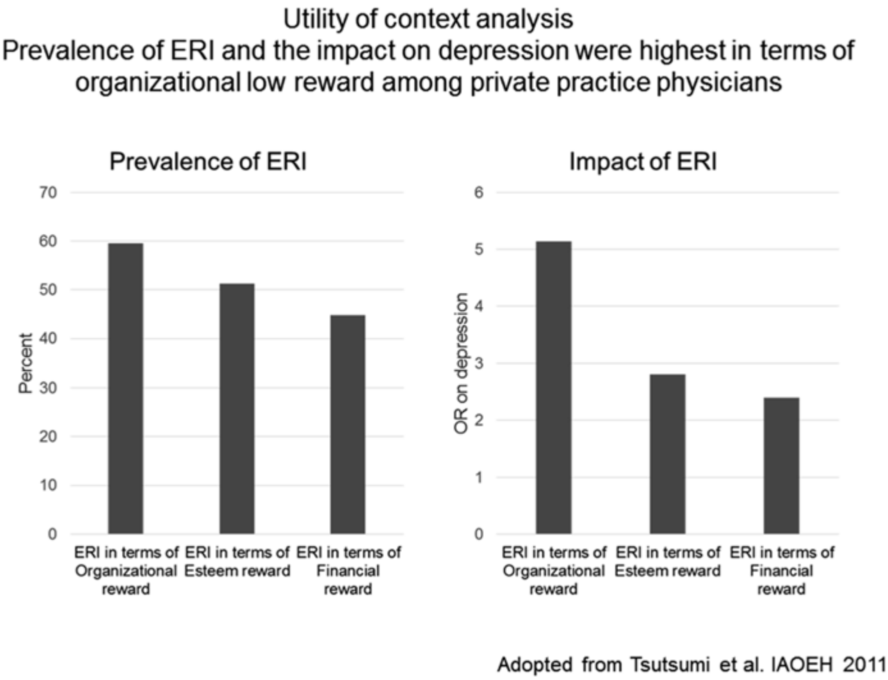

Fig. 8.2 Utility of context analysis prevalence of ERI and the impact on depression were highest in terms of organizational low reward among private practice physicians

psychological distress that was independent of employees' personality traits such as neuroticism and negative affectivity. Using panel data from three to four waves of an occupational Japanese cohort survey, focusing on 31382 observations of 9741 individuals who participated in at least two consecutive waves, they estimated mean-centered fixed effects models to explain psychological distress by ERI indicators. Mean-centered fixed effects models reduced the magnitude of the association between ERI and psychological distress of those observed from pooled ordinary least squares substantially. However, the association remained highly significant even after controlling for unobserved time-invariant confounders.

8.3.5 Associations of ERI with Other Components

Associations of ERI or over-commitment with other occupational stress models were well tested in several Japanese studies. As described in the former section, Tsutsumi et al. (2001b) suggests a complementary association between the ERI and DC models. Utsugi et al. (2005) observed in their large-scale cross-sectional study (6997 male and 1773 female workers) that ERI was related to insomnia and short sleep for men and women and the associations were stronger than in case of

DC. Oshio et al. (2014) demonstrated that workplace social capital had mediate or moderate effects on the association between ERI and psychological distress. Watanabe et al. (2004) showed that workplace social support mediated the association between ERI and depression. On the positive side of the ERI model's predictions, Inoue et al. (2010), in a cross-sectional analysis of 243 men and women, observed that r*eward at work* significantly mediated associations of procedural and interactional justice with psychological distress. Although there are scarce studies showing the interaction between ERI and over-commitment, Takaki et al. (2006) found an interactive association between ERI and over-commitment. They studied 94 overtime workers and found that ERI was associated with fatigue, and increase of fatigue accompanying the increase of ERI was greater in individuals with high over-commitment than in those with low over-commitment.

Despite some evidence the observation of a *social gradient of ERI* does not necessarily hold true for every working population, assuming that work stress is more prevalent among lower SES groups than higher SES groups. One reason of inconsistent findings may be that high levels of effort are often more prevalent among higher SES groups (Inoue et al. 2011; Tsutsumi 2004, 2010). However, evidence did show that the impact of ERI was different across occupational classes (Kawaharada et al. 2007), such that the effect on health was stronger among lower than higher SES groups (Tsutsumi et al. 2001b; Yoshioka et al. 2013). Using a big database of 6423 male and 1606 female workers, Kawaharada et al. (2007) examined occupational class and occupational stress models. They found that ERI and the DC indices provided different results with regard to occupational class groups with high stress level and concluded that ERI and DC played a complementary role in predicting health effects. Yoshioka et al. (2013) conducted a cross-sectional study of 5951 male employees of local governments where they found that ERI, Job strain and employment levels were each associated with insomnia. More specifically, a significant relative excess risk due to the interaction between employment level and ERI components (ERI and over-commitment) was observed. Further analyses revealed an interaction with employment level and ERI/over-commitment that was not observed for the job strain model. Inoue et al. (2011) demonstrated different aspects of adverse psychosocial work environments according to the workers' status. In their study, permanent workers exhibited a higher amount of distress about job pressure or unrewarded efforts in their job, whereas fixed-term workers were more distressed by job insecurity and the lack of job promotion prospects. These latter findings suggest that the inclusion of employment contexts into the analysis of work stress and health may enrich future findings.

8.4 Discussion and Conclusion

The ERI model defines an effective approach towards elucidating adverse working conditions in current Japan. Recent economic circumstances and job insecurity have strengthened this conclusion. In addition to the environmental aspects, the coronary-prone behavioral pattern of Japanese workers characterized as 'job-centered life-style' (i.e., devoting oneself to work) shares some basic notions with the concept of over-commitment. As Karoshi provides an extreme problem where workers devote themselves too much to work, whether forced or not, the evidence produced by the ERI model could offer some guidance on how to reduce the risk of Karoshi.

A series of Japanese research efforts produced unique, internationally relevant contributions to the methodology, especially to the problem of scaling of ERI. It is difficult to develop completely compatible scales between areas with culturally different background. However, application of a new test theory such as item response theory could give us the clue to fine-tune the differences (Tsutsumi et al. 2008a, 2009). Accordingly, validation studies have been performed from several Asian countries (Buapetch et al. 2008; Li et al. 2012).

Although prospective studies are scarce and studies with hard outcome such as cardiovascular diseases are limited, there have been important studies in Japanese settings. Psychological distress including depression was consistently found to be associated with ERI and over-commitment, and their robust associations were confirmed by panel studies. So far, there are no definite studies showing associations of ERI with hormonal dysregulation such as excretion of cortisol (Irie et al. 2004; Ota et al. 2014). Moreover, an association between ERI and oxidative damage reported from other places was not observed in Japanese studies (Inoue et al. 2009; Takaki 2013). Therefore, further studies in this field are required. Importantly, a newly detected association of ERI with job performance (Nakagawa et al. 2014) can have direct policy implications by motivating employers to improve their work environment along the principles inherent in the ERI model.

In the recently enforced Stress Check Program, the government's recommendation on the surveillance (screening) tool in order to screen workers with high psychosocial stress in the workplace is based on the job demand-control model. As three dimensions (demand, control and support) cannot appropriately cover the wide range of psychosocial occupational hazards, we need more relevant tools to cover them. Considering the reflection on current working situations as well as the predictive value of the ERI model with regard to health outcomes, the ERI questionnaire may be a prominent candidate to strengthen respective screening and preventive efforts. More intervention studies would certainly be useful to convince potential users of the suitability of this approach. Beneficial effects of organizational-level environmental improvements of work settings according to the ERI model were demonstrated in a relevant study from Canada (Bourbonnais et al. 2011; Tsutsumi and Kawakami 2004), and such intervention needs employers' approval and commitment because organizational-level interventions are necessary. Interestingly, in a recent study in Japan, high reward was found to be associated with high job performance (Nakagawa et al. 2014). As mentioned, this finding may motivate employers to adopt workplace improvement according to the ERI model. We also need to conduct cost-benefit studies to provide a convincing case to employers.

Although environment-level improvement is the first line to prevent occupational stress-related disorders, the ERI model offers an interpersonal and an individual level of intervention as well. Irie et al. (2003) administered an ERI questionnaire to employees of a production company. They then selected those 69 employees who had reported long working hours, and they conducted individual counseling to modify the Type A behavior pattern. Comparisons between intervention and control groups 1 year following the intervention suggested that an individual approach towards modifying Type A behavior leads to a reduction in over-commitment, self-reported sleepiness, dullness, and the frequency of burnout symptoms.

Several pathways through which ERI leads to health outcomes provide entry points for intervention. Workplace social capital could mediate/moderate the effect of ERI on psychological distress (Oshio et al. 2014), and workplace social support was shown to mediate the association between ERI and depression (Watanabe et al. 2004). Additional measures complementing the ERI model might be instrumental in developing favorable working environments in terms of *social capital at work*. Combining research on ERI with research on personality traits could offer new knowledge of scientific and practical interest. Kikuchi et al. (2013) conducted a cross-sectional analysis of 296 female nurses and showed that temperament predicted part of the variance of ERI ratios (18–27 %). Temperament may exert an influence on over-commitment as well. Tei-Tominaga et al. (2009) showed that temperament explained 36 % of the variance of over-commitment (the variance was more than that of working hours); temperament explained 27 % and 14 % of the variance of Effort and Reward, respectively. As cognitive-behavioral therapy may assist workers in adopting more constructive coping patterns when exposed to stressful work circumstances, as well as in helping them to reflect on the motivations underlying their need to be over-committed (Preckel et al. 2005), mental health practitioners might offer intervention strategies in accordance with the client's individual temperament (Kikuchi et al. 2013). The same study also revealed that long working hours had a strong impact on high effort (Tei-Tominaga et al. 2009), which suggests that reduction of overtime work is an important approach in decreasing high effort (Tsutsumi and Kawakami 2004). McLinton and Dollard (2010) discussed the hypothesis that ERI exerts an indirect effect on driving anger through its mediating influence on trait anger. Anger control could therefore to some extent reduce the adverse effects of ERI on health.

Finally, according to my personal view, the ERI model can play a unique role in emphasizing intervention dimensions that reach beyond single workplaces. This characteristic is unique as other established work stress models are more limited in this regard. Importantly, this model includes three different reward factors where salaries and job promotion/job security address regional or even national policy frameworks. At least one study included in this review elucidates this latter aspect. A cross-sectional questionnaire study of 1103 private practice physicians involved in management and exposed to severe market competition and economic fluctuations demonstrated that ERI in terms of low organizational reward was most relevant and most strongly associated with depression (Tsutsumi et al. 2012). Additional qualitative analyses confirmed that respondents proposed an increase in remuneration of medical services as a priority measure.

In *conclusion*, ERI is particularly important for Japanese workers because of the current economic situation and their behavioral attitudes towards work. A large number of empirical studies showed robust associations between ERI and psychological distress, but stronger evidence derived from prospective studies with hard outcomes and from studies examining biological mechanisms is desirable. As is the case for other work stress models as well, intervention studies bridging theory with practice are badly needed. Because the ERI model has a promising potential to include broader policy dimensions beyond single workplaces it should be addressed by those who are responsible for work-related health in a societal perspective.

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Chapter 9
Psychosocial Safety Climate as a Multilevel Extension of ERI Theory: Evidence from Australia

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9.1 Psychosocial Risk Surveillance in Australia and the Effort-Reward Imbalance Model

Work-related stress is a prevalent issue in Australia as well as globally. The European Agency for Safety and Health at Work (2014) estimates the cost to Europe of work-related depression to be €616 billion annually due to employee productivity loss, sickness absence, health care and social welfare payments. Australia is witnessing a steady increase of psychological injury claims, which are incurring the largest proportion of cost in relation to all work compensation claims (Safe Work Australia 2013). In the literature on work-related stress, several important theoretical contributions explain how work-related stress develops and consequently inform how to prevent and intervene to reduce work-related stress outcomes. In particular, the Effort-Reward Imbalance model (ERI; Siegrist 1996), and Psychosocial Safety Climate theory (PSC; Dollard and Bakker 2010) are two well-evidenced theoretical contributions to the field of work-related stress. Currently, the ERI model and PSC theory provide separate contributions to the issue of work-related stress. However, we propose to extend the ERI model to incorporate multilevel PSC theory, where PSC emanating at an organizational level predicts the interaction between efforts and rewards within the ERI, and consequent negative effects of work stress on worker health (emotional exhaustion, depression, psychological distress, and physical health problems), and organization factors (engagement, job satisfaction). The merging of these two approaches to work-related stress should provide a more

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comprehensive multilevel understanding of the issue, providing advanced knowledge for the prevention of the devastating effects of work-related stress, such as depression (McTernan et al. 2013).

9.2 National Policy and Work Stress in Australia

Until recently each Australia state set their own laws and regulations in relation to health and safety practices at work. In 2008 the Workplace Relations Ministers Council mooted a national model for legislation to harmonise work health and safety laws across Australia (Safe Work Australia 2011). Consultation Australia wide on relevant policy and practice resulted in the development of a model Workforce Health and Safety (WHS) Act which has since been implemented in most Australian states and territories.

The Model Work Health and Safety (WHS) Act 2011 clearly states that employers are responsible for providing a "working environment that is safe and without risk to health" (Safe Work Australia 2012a, p. 7). This definition of 'health' as determined by the Act encompasses both the 'physical' and 'psychological' health of workers (Safe Work Australia 2012a, p. 4). To meet this standard of safe and risk free working environments, the Act requires that employers provide an adequate "provision of information, instruction, training or supervision to workers needed for them to work without risks to their health and safety" (Safe Work Australia 2012a, p. 7). The Act also requires that the "health of workers and the conditions of the workplace are monitored to prevent injury or illness" (Safe Work Australia 2012a, p. 7). If these requirements are not met, Australian workers are legally covered by a worker's compensation system should they suffer injury or illness at work, entitling them to seek financial compensation, recover health costs, and receive rehabilitation. In addition, if these requirements are not met, the organisation/s are breaking WHS laws and subsequently may be issued fines of up to AUD$3,000,000 for a corporation, and up to AUD$600,000 and/or 5 years jail for an individual (Safe Work Australia 2012a). Therefore, it is in the financial interests of employers to conduct risk assessment at the organisational level to meet their legal requirements, and for governing bodies to conduct regular surveillance of risks and hazards at the industry, state, and national levels for the purposes of injury prevention and intervention.

In the 2008–2009 financial year, workplace injuries were estimated to cost AUD$60.6 billion per annum or 4.8 % of Australia's gross domestic product (GDP; Safe Work Australia 2012b). Compared to other kinds of compensation claims, such as those from physical injury, the claims made in that year in relation to stress had one of the highest average costs with median payments of AUD$20,400 compared to AUD$8,200 overall median costs for all serious claims (physical injury) (Safe Work Australia 2013). In addition to the compensation cost of stress claims, stress-related productivity loss was estimated to cost the Australian economy AUD$14.8 billion per annum or 1.78 % of the nation's GDP (Econtech 2008).

Further contributing towards the cost of productivity loss is a higher number of sick days taken by workers experiencing poor psychological health. For example, Australian researchers estimate that workers with moderate and severe symptoms of depression take four times more sick days compared to employees with no clinical symptoms (McTernan et al. 2013). With the growing costs and productivity loss associated with psychological injury, work contexts, such as psychosocial factors, found to have a significant impact on worker mental and physical health, are being incorporated within some national health and safety frameworks (e.g., PRIMA-EF in Europe, Mental Health Commission in Canada, Health and Safety Executive in the United Kingdom).

Psychosocial factors at work refer to aspects of job design, and the social, organisational, and management contexts of work that have the potential to cause psychological or physical harm (Cox and Griffiths 2005). In major work stress models these psychosocial factors are more broadly defined as job demands (e.g., work pressure, emotional labour), and job control (e.g., skill discretion, decision authority) in the Job Demands-Control theory (Karasek 1979; Karasek and Theorell 1990), as job demands and job resources (e.g., rewards, supervisor and co-worker support) in Job Demand-Resources theory (Demerouti et al. 2001), and as effort and rewards (social, esteem, status) in Effort-Reward Imbalance theory (Siegrist 1996). Other work context risk factors well-known for their impact on worker health include bullying and harassment (Law et al. 2011), work-life balance, and PSC (Dollard and Bakker 2010).

Best practice in the field of psychosocial risk management states that these factors need to be regularly measured so that risks can be targeted for prevention, and hazards can be identified for intervention (Houtman et al. 2007). Many countries, in particular those across Europe, Northern America, and Australia, have implemented national surveillance systems in order to measure and control psychosocial factors. The results can then be used to inform evidence-based practices that will be most effective in improving worker health and wellbeing outcomes (Dollard 2007) and thus reduce costs associated with work related injury, illness, and productivity loss.

9.3 Surveillance and the AWB

The Australian Workplace Barometer (AWB) is a national workplace surveillance system developed by the Asia Pacific Centre for Work Health and Safety (APC WHS; formerly Centre for Applied Psychological Research) and supported by funding from the Australian Research Council, Safe Work Australia, and SafeWork SA. Telephone surveys were conducted between 2009 and 2011 collecting data from 5,743 Australian workers across most states and territories, with repeated measures 12 months later from 1,529 workers. A further round of Australia wide data collection has recently concluded. The survey tool is based on highly regarded psychometric scales, for example the Job Content Questionnaire 2.0 (www.jcqcenter.org), QPSNordic (Lindström et al. 2000) and the ERI (Siegrist 1996). The AWB identifies a wide range of psychosocial factors that impact on people's wellbeing and effectiveness at work, such as Psychosocial Safety Climate (PSC), job demands, control, resources and supports, bullying and harassment, and work life balance.

The results from the AWB have been used in a variety of forums beneficial to academics, industry regulators, and practitioners. Reports have been presented to various regulatory and industry bodies (Safe Work Australia, SafeWork SA, WorkCover, Australian Parliament, and several unions), international agencies and at expert meetings, highlighting levels of psychosocial risks across Australian states, territories, and industries. Some of the major findings include identifying that workers aged 25–34 years have the poorest psychological health, women are 1.5 times more likely to report high strain jobs than men, and industries at highest risk differed between states except for transport and storage; accommodation, cafes and restaurants; and health and community services which had consistently high levels of risk across the states and territories warranting national intervention (Dollard and Bailey 2014). In addition, approximately 7 % of Australian workers reported bullying at work, which is substantially higher than international rates using the same definition. For instance, a European study of over 40,000 workers found 3.9 % of workers had experienced bullying (Eurofound 2010). The symptoms of depression that result from bullying and job strain, cost Australian employers approximately AU$8 billion per annum (McTernan et al. 2013). Several publications from the data have extended current knowledge about work stress models in particular the PSC framework which is the underlying theory behind the AWB with practical implications (Dollard and Bailey 2014).

9.4 Work Stress Models and the AWB

The PSC framework has been applied as an extension to the well-known Job Demands-Resources (JD-R; Bakker and Demerouti 2007; Demerouti et al. 2001) model for worker health and wellbeing. According to the JD-R model, two psychosocial risk factors, job demands and job resources, can be found in every occupation and contribute towards workers' physical and psychological health (Demerouti et al. 2001). For example, exposure to high levels of demands, such as work pressure, taxes personal coping resources leading to poor health outcomes, such as emotional exhaustion, whereas, exposure to inadequate resources reduces workers' motivation and engagement (Demerouti et al. 2001). PSC extends this JD-R model, as it is theorised to be a predictor of the psychosocial risk factors, demands and resources, and is therefore viewed as the 'cause of the causes' of work stress (Dollard and Bakker 2010).

PSC reflects management philosophy and values in relation to worker psychological health and basic psychological needs. PSC encompasses "organizational policies, practices, and procedures for the protection of worker psychological health and safety" (Dollard and Bakker 2010, p. 580). Workers' perceptions of senior managements' performance of PSC is determined by management and organisational performance on four underlying domains. These PSC domains canvas, the commitment of senior management to stress prevention, the management prioritisation of worker mental health above productivity outcomes, how worker mental health risks are communicated throughout the organisation, and the participation of senior management and all levels of the organisation in the protection of worker mental health.

Results from the AWB have provided consistent evidence that PSC acts as a distal antecedent to health outcomes via workplace demands, and motivational outcomes via resources (Bailey et al. 2015a; Law et al. 2011). For instance an AWB subsample of 220 workers from 30 organisations showed PSC at the organisational level was negatively associated with demands, specifically workplace bullying and harassment, that in turn related to psychological health problems, and was positively associated with workplace resources (e.g., rewards) that in turn related to work engagement (Law et al. 2011). Using longitudinal data from 1,095 AWB participants, Bailey et al. (2015a), found PSC at the individual level (individual worker perceptions about the organisation's climate for psychological health) was a precursor to psychosocial risks (e.g., harassment, violence, bullying and work pressure). These psychosocial risks in turn were related to emotional exhaustion and muscular skeletal disorders, which then led to increased workers' compensation claims.

Additional longitudinal data from the AWB analysed by Bailey et al. (2015b) was used to assess the antecedents and consequence of job strain as conceptualised by the Job Demand-Control (JD-C) model for work stress. The well-known JD-C model categorizes jobs according to level of demand (e.g., workload and time pressure) and level of control (decision authority and skill discretion) (Karasek 1979). This interaction of demands and control results in four categories of job strain; low-strain jobs (low demands and high control), passive jobs (low demands and low control), active jobs (high demands and high control), and the condition associated with the poorest health, high-strain jobs (high demands and low control) (Ahola et al. 2006; Lerner et al. 1994; Häusser et al. 2010; Karasek 1979). Bailey et al. (2015b) were able to establish that PSC was a significant predictor of job strain and in turn depression amongst 1,081 participants from the AWB. Additional cross sectional data ($N=2{,}097$ and $N=1{,}043$) from the AWB was used by Bailey et al. (2015b) to create benchmarks for organizational PSC (range 12–60) at low-risk (PSC at 41 or above), moderate risk (PSC above 37 and below 41), and high-risk (PSC at 37 or below) for employee job strain and depressive symptoms. Using the newly created benchmarks the population attributable risk (PAR) showed that improving PSC in organizations to above 37, could reduce 14 % of job strain and 16 % of depressive symptoms in the Australian working population (Bailey et al. 2015b). These results provide national standards that organizations and regulatory agencies can utilize to promote safer working environments, and lower the risk of employee illness or injury.

9.5 PSC as a Theoretical Extension of ERI

Prior research has yet to consider the addition of PSC theory to the understanding of the Effort Reward Imbalance model (ERI; Siegrist 1996), specifically how PSC can foster environments that produce either a balance or imbalance between efforts and rewards. Considering the importance of work stress for the working Australian population in relation to national strategies, risk prevention, and intervention, this oversight needs to be addressed.

The ERI model, as detailed in Chap. 1, is receiving increasing amounts of recognition within the literature, as it is considered to reflect current changes in the nature of employment across numerous regions around the world. The ERI model consists of two psychosocial dimensions at work, effort and rewards, and an individual level component, over-commitment. However, it is the rewards component of this model that has become salient in context of the current changes in the workforce. In the past few decades we have witnessed changes to the world of work through various factors including globalisation, a rise in new technologies, increased flexibility in the workplace, and economic recession (Dollard 2007). These changes in addition to rising competition, have led to organisational downsizing and restructuring, overemployment (increased work intensity for longer amounts of time), underemployment (underutilisation through increased reliance upon technologies) and job insecurity (Dollard 2007; Dollard et al. 2014). These changes are concerning to Australia, with neo-liberal policies and a weakening of the welfare state regime (Kawakami et al. 2014). Workers are reliant upon the labor market (Kawakami et al. 2014), and with the changes to the workplace through the aforementioned macro-level influences such as economic globalisation, workers may be externally motivated to remain in high effort working conditions. The rewards component of the ERI model addresses job security and career promotion, which are important and relevant in the context of instability of the labour market in countries such as Australia.

9.6 PSC and ERI Case Study

The ERI model is commonly used to understand the impact of psychosocial work conditions on various health outcomes. However, there is limited evidence investigating what factors contribute to the development of the psychosocial work conditions (efforts and rewards) identified by the ERI model of work stress (i.e., the causes of the causes). The current study addresses this oversight by extending the ERI model to incorporate PSC. As previously stated, PSC theory proposes that the origins of workplace stress begin further upstream than job design components, emerging at the organizational level (Dollard and Bakker 2010). Previous research has confirmed PSC as a multilevel extension of the JD-R model, where organisational level PSC predicted job design aspects (demands and resources) perceived at the individual level (Dollard and Bakker 2010). Since ERI offers a more specific theory about how demands and rewards interplay to predict employee health and wellbeing and workplace outcomes it is important to test the functional multilevel relationship of PSC to ERI.

Hypothesis 1: Organisational and individual level PSC will be negatively associated with workers perceptions of ERI.

Previous research on the ERI model has found that the imbalance between effort and reward increases workers' experience of depression (Kikuchi et al. 2010; Tsutsumi et al. 2012), psychological distress (Shimazu and de Jonge 2009), emotional exhaustion (Bakker et al. 2000; de Jonge et al. 2000), and poor general health concerns (Niedhammer et al. 2004; Weyers et al. 2006). We expect PSC will trigger the ERI model and its corresponding poor health outcomes. Therefore, as an organizational level factor, that determines the levels of psychosocial risk factors within the workplace, we expect that PSC will indirectly impact upon these health concerns through its relationship with the interaction between efforts and rewards. We propose a multilevel PSC extended model of ERI whereby:

Hypothesis 2: Organisational and individual level PSC will negatively affect workers' health via organisational and individual level ERI.

Little research on the ERI has explored the consequences of a poor imbalance between effort and rewards in the organisational context. The little that has been done has found that ERI predicts workers' low job satisfaction (Calnan et al. 2000; de Jonge et al. 2000; van Vegchel et al. 2001), and low engagement (Kinnunen et al. 2008). Consistent with the health outcomes research, we expect that PSC will trigger the working conditions that lead to the imbalance between efforts and rewards, and as such indirectly impact upon workers' job satisfaction and engagement.

Hypothesis 3: Organisational and individual level PSC will positively affect workers levels of workplace engagement, and job satisfaction, via a negative relationship with organisational and individual level ERI.

The current case study does not incorporate the individual-level component of the model, over-commitment, as it is an intrinsic risk factor, and as such not part of the working environment and was not measured by the AWB. Although it is important to consider individual level factors, in this study we have a broader focus on organisational level factors and their impact on working environments.

9.7 Effort-Reward Imbalance Interaction Term

A secondary aim of the study was to evaluate the interaction term showing the best explanatory power of the ERI model. The original conception of ERI in the paper by Siegrist (1996) recommended calculating the imbalance between the workers' efforts and rewards using a ratio interaction term. However, van Vegchel et al. (2005) bring into focus two other terms that could be considered when measuring the ERI; multiplicative and relative excess. The most commonly used interaction term, the ratio term (Effort/(Reward*correction factor)), reflects the proportion of rewards received to match the efforts expended. The multiplicative term (Effort*Reward) implies that organizational rewards modify the effect of expended efforts. The third alternative interaction term, relative excess (Effort – Reward + constant), refers to a situation in which effort represents a standard by which rewards are compared to. The larger the deviation of rewards from effort spent represents a greater stressful experience. Although the ratio term is more commonly implemented in research, van Vegchel et al. (2005) found more support for the multiplicative formulation in relation to adverse health outcomes. Our study continues this investigation into theoretical and methodological representations of the imbalance and focuses on four separate health variables; emotional exhaustion, psychological distress, depression, and general physical health, which have all found to be significant outcomes of the ERI, using multilevel analysis with PSC at the organisational and individual level. In addition we investigate the impact of ERI in relation to workers' job satisfaction and engagement.

9.8 Method

9.8.1 Participants and Procedure

Data were drawn from the national surveillance tool, the AWB, incorporating various industries and occupations. Data were matched according to employer, allowing us to solely include organisations with at least four participants. This resulted in 119 organisations and 850 participants. There were 319 male (1) and 531 females (2) with ages ranging from 18 to 76 (M = 47.31, SD = 10.66). The participants were located in six different states in Australia; Australian Capital Territory (ACT, $n = 85$), New South Wales (NSW, $n = 134$), Northern Territory (NT, $n = 37$), South Australia (SA, $n = 269$), Tasmania (TAS, $n = 120$), and Western Australia (WA, $n = 205$).

Participants were contacted using computer assisted telephone interviewing (CATI) via the Electronic White Pages. Potential participants were sent an introductory letter detailing the study as well as advising them they will be contacted via telephone. After the CATI, the data were weighted based on age, sex, number of phone numbers in the white pages, and number of members of the household. This assisted in establishing the representativeness of our sample.

9.8.2 Measures

The measures used in the study were drawn from the scales in the Australian Workplace Barometer (AWB), developed at APC WHS, University of South Australia (Dollard et al. 2009).

9.8.2.1 Effort

Effort was measured using the psychological demands sub-scale from the Job Content Questionnaire (JCQ) 2.0 www.jcqcenter.org. This scale consisted of six items, such as "My job requires working very hard". These items were measured on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). High scores on this scale corresponded with high levels of effort invested by the worker.

9.8.2.2 Rewards

Organizational rewards were measured using the rewards sub-scale from the Effort Reward Imbalance questionnaire (Siegrist 1996). This scale consisted of four items, measured on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Consistent with the effort scale, high scores represent higher levels of rewards received. An example of an item "Considering all my efforts and achievements, I receive the respect and prestige I deserve at work".

9.8.2.3 PSC

PSC was measured using the 12-item four factor Psychosocial Safety Climate scale (PSC-12; Hall et al. 2010). The four factors consisted of three items each. The four factors are (1) Management support and commitment towards stress prevention, an example item is "Senior management acts decisively when a concern of an employee's psychological status is raised" (2) Management priority of worker wellbeing over productivity, an example item is "Senior management considers employee psychological health to be as important as productivity" (3) Communication between all members of the organization, an example item is "There is good communication here about psychological safety issues which affect me" and (4) Participation and involvement of all members of the organization an example item is "Employees are encouraged to become involved in psychological safety matters". All items were measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). High scores reflected high levels of PSC within an organization.

9.8.2.4 Emotional Exhaustion

Emotional Exhaustion was measured using the matching sub-scale of the Maslach Burnout Inventory (MBI; Schaufeli et al. 1996). An example of one of the five items in the scale is "I feel emotionally drained from my work". The items were measured on a 7-point Likert scale ranging from 1 (never) to 7 (always). High scores indicated high levels of emotional exhaustion.

9.8.2.5 Depression

Depression levels were measured using the nine items from the Patient Health Questionnaire (PHQ-9; Spitzer et al. 1999). An example of one of the items is "During the last month, how often were you bothered by feeling down, depressed or hopeless?" Items were measured on a 4-point Likert scale ranging from 1 (not at all) to 4 (nearly every day). High scores reflected higher levels of depression.

9.8.2.6 Psychological Distress

Psychological distress was measured using the Kessler 10 (K10; Kessler and Mroczek 1994), which consisted of ten items. An example item is "In the past 4 weeks, about how often did you feel nervous?" Items were measured on a 5-point Likert scale ranging from 1 (none of the time) to 5 (all of the time). High scores on this scale indicated high levels of psychological distress.

9.8.2.7 General Physical Health

General physical health was measured using the 12 items from the General Health Questionnaire (GHQ-12; Goldberg 1978). An example item is "Lost much sleep over worry". These items were measured on a 4-point Likert scale ranging from 1 (not at all) to 4 (much more than usual). High scores on this scale suggests poor general health.

9.8.2.8 Engagement

The nine items from the Utrecht Work Engagement Scale – Shortened Version (UWES-9; Schaufeli et al. 2006) were used to measure workers' engagement with their workplace. The scale consistent of three subscales each consisting of three items; vigour, dedication, and absorption. An example item of vigour is "At my work, I feel bursting with energy", dedication "My job inspires me", and absorption "I get carried away when I am working". Items were measured on a 7-point Likert scale ranging from 1 (never) to 7 (every day). High scores on this scale suggest high levels of engagement in the workplace.

9.8.2.9 Job Satisfaction

Job satisfaction was measured using the single global item from the Job Satisfaction scale (Warr et al. 1979); "Taking everything into consideration, how do you feel about your job as a whole?" The item was measured on a 7-point Likert scale ranging from 1 (never) to 7 (everyday). A high score on this scale represented high job satisfaction.

9.8.3 Data Analysis

To test the hypothesis we used Hierarchical Linear Modelling (HLM) with the HLM 7.0 software, and a Monte Carlo test to verify the mediation pathways. We used a two-level HLM model with the individual workers (N = 850) nested within organisations (N = 119). We used Statistical Package for the Social Sciences (SPSS) v22, to create two data files to use in HLM. The Level 1 data file was at the individual level. The Level 2 data file was aggregated at the organisational level. Data were matched from the two files according to their organisation.

This contribution also aimed to test the three ERI interactions; ratio, multiplicative and relative excess. The following calculations were used to create the interaction terms. Ratio was calculated in accordance with the original conception of ERI by Siegrist (1996) (effort/(rewards*correction factor)). The correction factor (5/4) in this formula addresses the unequal numbers of items in the separate scales for effort and rewards. The second interaction term is multiplicative, and is based on the formula effort*rewards. To calculate the final interaction term, relative excess, we used the formula |effort-rewards + constant|. The constant in this formula was set at 1.5, consistent with the paper by van Vegchel et al. (2005).

To test PSC and ERI at the upper level, we aggregated the individual level scores by organisation. One-way ANOVAs showed significant between group variance for PSC, $F\ (118, 146.56) = 2.37$, $p < 0.001$, ERI ratio, $F\ (118, 171.95) = 1.61$, $p < 0.01$, and ERI relative excess, $F\ (118, 171.76) = 1.56$, $p < 0.01$. No significant between organisation variance was found for ERI multiplicative, $F\ (118, 172.02) = 0.90$, $p = 0.73$. The ICC scores for PSC, ERI ratio, and ERI relative excess were 0.04, 0.03, and 0.05, respectively. Although these ICC scores are fairly low, the fact that PSC predicts between group variance in the ERI measures suggests there is a multilevel effect to be predicted. Also, we expect low ICC since we only have three members per organisation, and since this is a population based study we expect large heterogeneity between organisational members where they are drawn from multiple organisational sites, compared to study designs where organisational climate is assessed at one organisational site.

To test the hypotheses we first assessed the relationship between the independent (PSC) and the mediator (ERI) terms (path a). Next we assessed the relationship between the dependent measure and the outcomes. Finally, in two steps, we assessed the mediator terms with the outcomes (health and organisational), and then added the dependent measure to the model (path b). We used the parameters from path a and b to determine the mediated effect using a Monte Carlo analysis.

9.9 Results

9.9.1 Descriptive Statistics

Means, standard deviations, and correlations between the variables of interest are presented in Table 9.1. At the individual level the correlation analysis reveals, as expected, significant negative correlations between PSC and the ERI interaction terms (ratio, multiplicative, and relative excess), and between PSC and the participants health outcomes (emotional exhaustion, psychological distress, depression, and general health). The analysis also revealed as expected, significant positive correlations between PSC and workplace outcomes (engagement and satisfaction).

All three ERI interaction terms, ratio, multiplicative, and relative excess, demonstrated significant correlations with all health outcomes. Only ratio and relative excess had significant negative correlations with both work outcomes (engagement and satisfaction). ERI multiplicative only had a significant correlation with satisfaction. The correlation between ERI multiplicative and engagement was not significant.

Age was significantly associated with PSC, emotional exhaustion, psychological distress. In that, participants who were older had poorer PSC in their workplace, while also reporting better emotional exhaustion and psychological distress. In relation to gender, there were significant associations with ERI ratio and relative excess, emotional exhaustion, psychological distress, and general health. The results indicate that women had higher levels of ERI (ratio relative excess), and had poorer health outcomes, with higher levels of emotional exhaustion, psychological distress, and poor general health, compared to men.

9.9.2 Hypothesis Testing

Using HLM as anticipated, we found PSC at the organisational or upper level (PSC_{UL}) and PSC at the individual or lower level (PSC_{LL}) were significantly related to all three ERI interaction terms in expected ways (ratio, multiplicative, and relative excess; refer to Table 9.2). PSC at both levels simultaneously predicted lower levels of ERI; PSC at the organisational level accounted for significant between-group variance in ERI; PSC at the individual level accounted for significant between-person variance in ERI. Hypothesis 1 was supported.

If PSC at the organisational level explains variance in lower level entities, strictly speaking the variance due to organisational factors is between-organisational variance. To test the mediation Hypothesis 2, we first need to consider whether ERI can explain between- and within-group variance in the outcomes. We considered the effect of ERI at the organisational and individual level on the four health outcomes; emotional exhaustion, psychological distress, depression, and physical health, over and above the variance explained by efforts and rewards alone. It was found that

Table 9.1 Means, standard deviations, and correlations between variables (N = 850)

	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Age	47.31	10.66															
2. Gender	1.62	0.48	0.02														
3. Employment status	1.57	0.84	−0.05	0.18***													
4. Income	6.08	2.19	0.02	−0.33***	−0.46***												
5. PSC	39.45	10.74	−0.11**	−0.05	−0.02	−0.06											
6. Effort	32.42	5.90	0.01	0.12**	−0.14***	0.19***	−0.35***										
7. Rewards	11.44	1.82	0.00	−0.12**	−0.16***	0.18***	0.44***	−0.25***									
8. ERI (ratio)	0.99	0.34	−0.01	0.15***	0.01	0.02	−0.48***	0.71***	−0.77***								
9. ERI (multiplicative)	−2.65	13.58	0.02	−0.02	−0.02	−0.01	0.14***	−0.06*	0.25***	−0.43***							
10. ERI (relative excess)	16.81	6.95	0.01	0.15**	−0.06	0.09**	−0.46***	0.92***	−0.59***	0.89***	−0.19***						
11. Emotional exhaustion	16.46	7.95	−0.12**	0.08*	−0.12***	0.15***	−0.40***	0.49***	−0.31***	0.48***	−0.11**	0.53***					
12. Psychological distress	1.52	0.52	−0.08*	0.08*	−0.01	0.02	−0.34***	0.30***	−0.33***	0.41***	−0.16***	0.38***	0.59***				
13. Depression	3.75	3.95	−0.07	0.12**	−0.03	0.01	−0.30***	0.27***	−0.29***	0.36***	−0.12***	0.34***	0.57***	0.78***			
14. General health	14.36	4.71	−0.03	0.16***	−0.02	−0.05	−0.16***	0.15***	−0.16****	0.21***	−0.10*	0.19***	0.30***	0.40***	0.45***		
15. Engagement	51.31	9.63	0.07	0.02	0.02	0.04	0.35***	−0.04	0.28***	−0.20***	0.06	−0.14***	−0.37***	−0.32***	−0.35***	−0.20***	
16. Satisfaction	5.36	1.25	0.03	0.01	−0.00	0.01	0.46***	−0.23***	0.40***	−0.41***	0.15***	−0.35***	−0.49***	−0.41***	−0.36***	−0.22***	0.59***

*p < 0.05; **p < 0.01; ***p < 0.001

Table 9.2 HLM modelling: the association between individual PSC and organisational PSC on effort, rewards, and ERI

	Effort			Reward			Ratio			Multiplicative			Relative excess		
	γ	SE	t	γ	SE	t	γ	SE	t	γ	SE	t	γ	SE	t
PSC_{LL}	–0.20	0.02	–10.69***	0.07	0.01	12.29***	–0.02	0.00	–14.27***	0.14	0.05	2.88**	–0.30	0.02	–14.17***
PSC_{UL}	–0.15	0.05	–3.15***	0.09	0.01	6.73***	–0.02	0.00	–6.25***	0.32	0.10	3.17**	–0.29	0.06	–5.20***

*$p<0.05$; **$p<0.01$; ***$p<0.001$: N = 850 employees in 119 organisations

individual level ERI, $ERI_{LL,}$ was positively associated with all four health outcomes for the interaction term, ratio (refer to Table 9.3). Although ERI_{UL} was related to psychological distress (step 1), with PSC in the model (step 2) this relationship dissipated. For the interaction term multiplicative, ERI_{LL} was only negatively linked with psychological distress, however, with PSC in the model, was related to both psychological distress and depression (refer to Table 9.3). Finally, for relative excess, ERI_{LL} was positively associated with workers' emotional exhaustion, psychological distress, and depression; for relative excess we saw only one example where ERI_{UL} was positively linked with health, and it was physical rather than psychological (refer to Table 9.3). However, this relationship dissipated with PSC in the model (step 2). No significant associations were found for ERI_{UL} on workers' psychological and physical health. Therefore, these results provide good support for ERI interaction terms on workers' psychological distress and physical health at the individual level.

It was proposed that ERI would mediate the negative association between PSC and workers' health; emotional exhaustion, psychological distress, depression, and physical health. First, we checked for an association between PSC and the health outcomes. The results showed a negative association between *both* PSC_{UL} and PSC_{LL}, and the four health outcomes (refer to Table 9.3). An interim observation is that as upper level phenomena, PSC is a stronger predictor of health outcomes compared with ERI factors.

With regard to the interaction terms for ERI, ratio and relative excess, Table 9.3, demonstrates that $ERI_{LL,}$ with PSC_{LL} in the model, remained a predictor of the health outcomes emotional exhaustion, psychological distress, depression, and physical health. Specifically, ratio ERI_{LL} explained additional variance in the four health outcomes, even with PSC_{LL} in the model. Multiplicative ERI_{LL} explained additional variance in relation to workers' psychological distress and depression, above that explained by PSC_{LL}. Finally, relative excess ERI_{LL} explained additional variance in workers' emotional exhaustion, psychological distress, and depression, with PSC_{LL} in the model.

Accepting the ratio term as the best representation of ERI to predict the psychological and physical outcomes, and referring to Table 9.5, using the Monte Carlo method with 95 % confidence interval we found that PSC_{LL} had a significant indirect effect on the four health outcomes (emotional exhaustion, psychological distress, depression, and physical health).

At the upper level, the results indicate no significant impact of ERI_{UL} onto the four health outcomes. However, there is a pattern whereby $Effort_{UL}$ is positively related to workers' emotional exhaustion, and physical health, after controlling for PSC_{UL} (refer to Table 9.3). However referring to the model using the best ERI representation for health outcomes, the ratio model, $Effort_{UL}$ mediates the association between PSC_{UL} and emotional exhaustion and physical health outcomes. Using the Monte Carlo method with 95 % confidence interval we found that PSC_{UL} had a significant indirect effect via $Effort_{UL}$, on emotional exhaustion and physical health (refer to Table 9.5).

As proposed by Hypothesis 3, we expected ERI would mediate the positive association between PSC and engagement and between PSC and satisfaction. To begin, we tested the association between PSC and the work outcomes. PSC_{LL} and PSC_{UL} were positively associated with engagement and satisfaction (refer to Table 9.4).

Table 9.3 HLM modelling: the association of effort, rewards, ERI, and PSC on workers' psychological and physical health

			Emotional exhaustion			Psychological distress			Depression			Physical health		
			γ	SE	t	γ	SE	t	γ	SE	t	γ	SE	t
		PSC_{LL}	–0.32	0.03	–12.21***	–0.02	0.00	–10.00***	–0.12	0.01	–9.11***	–0.07	0.02	–4.15***
		PSC_{UL}	–0.22	0.05	–4.11***	–0.02	0.00	–4.28***	–0.07	0.03	–2.65**	–0.10	0.04	–2.83**
Ratio	Step 1	$Effort_{LL}$	0.53	0.05	10.13***	0.01	0.01	1.48	0.05	0.04	1.14	–0.04	0.06	–0.66
		$Reward_{LL}$	–0.60	0.22	–2.74**	–0.03	0.02	–1.70*	–0.17	0.15	–1.12	0.08	0.21	0.71
		ERI_{LL}	2.76	1.30	2.13*	0.39	0.15	2.64**	2.97	1.13	2.64**	3.47	1.62	2.14*
		$Effort_{UL}$	0.47	0.18	2.59**	–0.01	0.02	–0.47	0.07	0.12	0.54	0.29	0.13	2.21*
		$Reward_{UL}$	–0.31	0.72	–0.43	0.02	0.06	0.38	–0.28	0.44	–0.64	–0.78	0.41	–1.89*
		ERI_{UL}	2.20	5.44	0.41	0.85	0.46	1.87*	1.94	3.59	0.54	–3.31	3.46	–0.96
	Step 2	PSC_{LL}	–0.16	0.03	–5.16***	–0.01	0.00	–4.29***	–0.07	0.02	–4.39***	–0.02	0.02	–1.27
		$Effort_{LL}$	0.50	0.06	9.09***	0.01	0.01	1.09	0.03	0.04	0.65	–0.05	0.06	–0.84
		$Reward_{LL}$	–0.28	0.23	–1.22	–0.01	0.02	–0.63	–0.00	0.16	0.13	0.13	0.20	0.65
		ERI_{LL}	2.15	1.30	1.66*	0.39	0.15	2.69**	3.01	1.13	2.65**	3.49	1.43	2.45*
		PSC_{UL}	–0.13	0.05	–2.58**	–0.01	0.00	–2.37*	–0.03	0.03	–0.83	–0.06	0.04	–1.45
		$Effort_{UL}$	0.41	0.21	2.00**	–0.00	0.02	–0.23	0.06	0.13	0.48	0.33	0.16	2.00*
		$Reward_{UL}$	0.08	0.81	0.09	0.04	0.06	0.62	–0.18	0.48	–0.37	–0.70	0.59	–1.17
		ERI_{UL}	3.36	6.35	0.53	0.76	0.48	1.57	2.41	3.94	0.61	–3.81	4.90	–0.78
Multiplicative	Step 1	$Effort_{LL}$	0.62	0.04	14.22***	0.02	0.00	6.76***	0.14	0.02	6.01***	0.08	0.03	2.77**
		$Reward_{LL}$	–0.91	0.14	–6.29***	–0.08	0.01	–7.38***	–0.50	0.08	–6.35***	–0.32	0.10	–3.27***
		ERI_{LL}	–0.02	0.02	–0.89	–0.00	0.00	–1.98*	–0.02	0.01	–1.59	–0.02	0.01	–1.22
		$Effort_{UL}$	0.53	0.10	5.44***	0.02	0.01	2.76**	0.13	0.05	2.46**	0.20	0.07	2.92**
		$Reward_{UL}$	–0.42	0.33	–1.28	–0.05	0.02	–2.27*	–0.38	0.18	–2.12*	–0.31	0.23	–1.34
		ERI_{UL}	–0.02	0.05	–0.51	–0.01	0.00	–1.60	0.00	0.02	0.05	0.01	0.03	0.24

	Step 2	PSC_{LL}	–0.16	0.03	–6.07***	–0.01	0.00	–4.91***	–0.07	0.01	–4.81***	–0.03	0.02	–1.81*
		$Effort_{LL}$	0.58	0.05	12.27***	0.02	0.00	5.59***	0.12	0.03	4.69***	0.07	0.03	2.17*
		$Reward_{LL}$	–0.52	0.16	–3.30**	–0.05	0.01	–4.76***	–0.32	0.09	–3.73***	–0.26	0.11	–2.34*
		ERI_{LL}	–0.01	0.02	–0.75	–0.00	0.00	–2.37*	–0.02	0.01	–1.77*	–0.02	0.01	–1.17
		PSC_{UL}	–0.13	0.06	–2.22*	–0.01	0.00	–2.17*	–0.03	0.03	–0.89	–0.06	0.04	–1.37
		$Effort_{UL}$	0.51	0.10	5.21***	0.02	0.01	2.80**	0.14	0.05	2.48**	0.22	0.07	3.09**
		$Reward_{UL}$	–0.20	0.37	–0.54	–0.03	0.03	–1.33	–0.34	0.21	–1.66*	–0.21	0.26	–0.79
		ERI_{UL}	–0.00	0.05	–0.06	–0.00	0.00	–0.91	0.01	0.03	0.36	0.02	0.03	0.65
Relative excess	Step 1	$Effort_{LL}$	0.19	0.15	1.24	0.01	0.01	0.89	–0.02	0.05	–0.38	0.07	0.03	2.16*
		$Reward_{LL}$	–0.29	0.26	–1.14	–0.06	0.01	–6.30***	–0.29	0.10	–2.97**	–0.33	0.08	–3.94***
		ERI_{LL}	0.45	0.15	2.96**	0.02	0.01	2.26*	0.17	0.06	2.91**	0.01	0.05	0.25
		$Effort_{UL}$	0.40	0.23	1.74*	0.00	0.05	0.08	0.30	0.29	1.01	–0.68	0.48	–1.41
		$Reward_{UL}$	–0.26	0.55	–0.48	–0.04	0.08	–0.48	–0.63	0.47	–1.35	1.05	0.74	1.41
		ERI_{UL}	0.13	0.25	0.52	0.02	0.05	0.31	–0.17	0.29	–0.58	0.89	0.48	1.85*
	Step 2	PSC_{LL}	–0.16	0.03	–5.38***	–0.01	0.00	–4.14***	–0.07	0.02	–3.49***	–0.03	0.02	–1.62
		$Effort_{LL}$	0.13	0.12	1.07	0.00	0.01	0.09	–0.05	0.04	–1.07	0.05	0.04	1.33
		$Reward_{LL}$	0.12	0.25	0.48	–0.03	0.01	–2.73**	–0.11	0.11	–1.00	–0.25	0.10	–2.66**
		ERI_{LL}	0.46	0.12	3.72***	0.02	0.01	2.27*	0.17	0.05	3.27***	0.02	0.05	0.29
		PSC_{UL}	–0.13	0.05	–2.41**	–0.01	0.00	–2.72**	–0.03	0.03	–0.78	–0.05	0.04	–1.30
		$Effort_{UL}$	0.18	0.27	0.67	0.00	0.05	0.01	0.21	0.29	0.74	–0.67	0.54	–1.23
		$Reward_{UL}$	0.30	0.66	0.46	–0.07	0.08	–0.09	–0.46	0.49	–0.93	1.15	0.84	1.36
		ERI_{UL}	0.33	0.29	1.16	0.02	0.05	0.38	–0.08	0.29	–0.27	0.89	0.54	1.65

*$p<0.05$; **$p<0.01$; ***$p<0.001$ (one-tailed): N = 850 employees in 119 organisations

Table 9.4 HLM modelling: the association of effort, rewards, ERI, and PSC on workers' engagement and satisfaction

			Engagement			Satisfaction		
			γ	SE	*t*	γ	SE	*t*
		PSC_{LL}	0.32	0.03	10.40***	0.05	0.00	13.72***
		PSC_{UL}	0.27	0.09	3.13**	0.05	0.01	5.99***
Ratio	Step 1	$Effort_{LL}$	−0.00	0.10	−0.01	−0.01	0.01	−0.65
		$Reward_{LL}$	1.30	0.37	3.52***	0.16	0.05	3.42***
		ERI_{LL}	−1.55	2.69	−0.58	−0.83	0.34	−2.45**
		$Effort_{UL}$	0.07	0.36	0.21	0.02	0.04	0.44
		$Reward_{UL}$	2.93	1.32	2.22**	0.16	0.15	1.07
		ERI_{UL}	9.91	10.77	0.92	−0.81	1.18	−0.69
	Step 2	PSC_{LL}	0.27	0.04	7.62***	0.04	0.00	8.18***
		$Effort_{LL}$	0.07	0.10	0.72	0.00	0.01	0.15
		$Reward_{LL}$	0.76	0.37	2.06*	0.10	0.05	2.06*
		ERI_{LL}	−0.70	2.63	−0.26	−0.73	0.33	−2.20*
		PSC_{UL}	0.27	0.10	2.68**	0.04	0.01	4.39***
		$Effort_{UL}$	0.12	0.37	0.32	0.03	0.04	0.89
		$Reward_{UL}$	2.47	1.34	1.84*	0.07	0.14	0.51
		ERI_{UL}	12.01	11.21	1.07	−0.68	1.15	−0.59
Multiplicative	Step 1	$Effort_{LL}$	−0.05	0.06	−0.94	−0.04	0.01	−5.12***
		$Reward_{LL}$	1.43	0.19	7.60***	0.25	0.02	10.32***
		ERI_{LL}	−0.00	0.02	−0.02	0.00	0.00	1.41
		$Effort_{UL}$	0.36	0.17	2.17*	−0.00	0.02	−0.25
		$Reward_{UL}$	1.80	0.55	3.28***	0.21	0.06	3.63***
		ERI_{UL}	−0.09	0.08	−1.17	0.01	0.01	0.93
	Step 2	PSC_{LL}	0.27	0.03	7.68***	0.04	0.00	8.47***
		$Effort_{LL}$	0.05	0.06	0.77	−0.02	0.01	−2.93**
		$Reward_{LL}$	0.83	0.20	4.12***	0.17	0.03	6.67***
		ERI_{LL}	−0.01	0.02	−0.27	0.00	0.00	1.54
		PSC_{UL}	0.29	0.10	2.99**	0.04	0.01	4.37***
		$Effort_{UL}$	0.48	0.17	2.93**	0.01	0.02	0.88
		$Reward_{UL}$	1.05	0.61	1.73*	0.12	0.06	1.99*
		ERI_{UL}	0.13	0.08	−1.68*	−0.00	0.01	−0.22
Relative excess	Step 1	$Effort_{LL}$	−0.40	0.20	−1.95*	−0.01	0.03	−0.17
		$Reward_{LL}$	1.94	0.36	5.45***	0.21	0.05	4.42***
		ERI_{LL}	0.36	0.20	1.75*	−0.03	0.03	−1.04
		$Effort_{UL}$	1.40	1.27	1.10	0.43	0.11	3.98***
		$Reward_{UL}$	0.12	2.05	0.06	−0.44	0.19	−2.39**
		ERI_{UL}	−1.04	1.29	−0.81	−0.44	0.11	−4.00***

(continued)

Table 9.4 (continued)

			Engagement			Satisfaction		
			γ	SE	t	γ	SE	t
	Step 2	PSC_{LL}	0.27	0.04	7.09***	0.04	0.00	7.80***
		$Effort_{LL}$	−0.35	0.18	−1.93*	0.02	0.02	1.10
		$Reward_{LL}$	1.41	0.34	4.16***	0.11	0.04	2.98**
		ERI_{LL}	0.41	0.19	2.18*	−0.05	0.02	−2.08*
		PSC_{UL}	0.26	0.10	2.59**	0.04	0.01	3.43***
		$Effort_{UL}$	2.00	1.31	1.53	0.32	0.07	4.33***
		$Reward_{UL}$	−1.30	2.10	−0.62	−0.34	0.13	−2.57**
		ERI_{UL}	−1.53	1.31	−1.17	−0.31	0.08	−4.02***

*$p<0.05$; **$p<0.01$; ***$p<0.001$ (one-tailed); $N=850$ employees in 119 organisations

With regard to the interaction terms, ERI_{LL} ratio, with PSC_{LL} in the model, was significantly related to satisfaction. For ERI_{LL} relative excess, ERI_{LL} is a predictor of the workplace outcomes, engagement and job satisfaction, with PSC_{LL} in the model. No significant impact was found for ERI_{LL} multiplicative.

Relative excess ERI_{LL} was the best ERI formulation to predict workers' engagement and job satisfaction, with PSC_{LL} in the model. As can be seen in Table 9.5, using the Monte Carlo method with 95 % confidence interval we found that PSC_{LL} had a significant indirect effect on engagement and job satisfaction, via ERI_{LL}.

No association was found for ERI_{UL} ratio and the two workplace outcomes, engagement and satisfaction (refer to Table 9.4). For the multiplicative interaction term, only ERI_{UL} was significantly associated with the workplace outcome engagement, but only when PSC_{UL} had been entered into the model (refer to Table 9.4). Relative excessive (ERI_{UL}), was negatively associated with satisfaction, above the variance explained by efforts and rewards at the upper level, and PSC (refer to Table 9.4).

At the upper level ERI_{UL} relative excess was the best representation of ERI to reflect the expected relationships with work outcomes. Using the Monte Carlo method with 95 % confidence interval however we found that the only PSC_{UL} had a significant indirect effect on satisfaction via ERI_{UL} relative excess (refer to Table 9.5). There is some evidence that PSC at the organisational level, predicts between group variance in ERI that in turn relates to worker satisfaction.

In addition, we found that $Rewards_{UL}$ also explained additional variance in workers' job satisfaction, via PSC_{UL}. Using effects from the relative excess model (since this is likely the best measure for testing work outcomes) testing the mediation formally using the Monte Carlo method with 95 % confidence interval showed that PSC_{UL} had a significant indirect effect upon satisfaction via $Rewards_{UL}$ (refer to Table 9.5).

Table 9.5 The indirect effects of PSC on workers' psychological and physical health, and workplace outcomes

	Emotional Exhaustion		Psychological Distress		Depression		Physical Health		Engagement		Satisfaction	
	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL
PSC_{LL} via $Effort_{LL}$	**-0.169**	**-0.106**	**-0.007**	**-0.004**	**-0.049**	**-0.025**	**-0.032**	**-0.007**	0.008	0.056	0.007	0.015
PSC_{LL} via $Reward_{LL}$	-0.129	-0.073	-0.009	-0.005	-0.060	-0.033	-0.042	-0.014	**0.080**	**0.144**	**0.016**	**0.026**
PSC_{UL} via $Effort_{UL}$	**-0.161**	**-0.035**	-0.008	-0.001	-0.054	-0.007	**-0.072**	**-0.011**	-0.093	0.019	-0.001	0.012
PSC_{UL} via $Reward_{UL}$	-0.160	-0.032	-0.012	-0.003	-0.085	-0.019	-0.089	-0.014	0.026	0.203	**0.009**	**0.031**
PSC_{LL} via ERI_{LL} (Ratio)	**-0.221**	**-0.137**	**-0.012**	**-0.008**	**-0.081**	**-0.051**	**-0.058**	**-0.025**	0.074	0.140	**0.020**	**0.030**
PSC_{LL} via ERI_{LL} (Multiplicative)	-0.019	-0.002	**-0.002**	**-0.000**	**-0.011**	**-0.001**	-0.009	-0.000	-0.000	0.017	0.001	0.003
PSC_{LL} via ERI_{LL} (Relative excess)	**-0.227**	**-0.154**	**-0.012**	**-0.007**	**-0.080**	**-0.049**	-0.054	-0.021	**0.064**	**0.135**	**0.018**	**0.029**
PSC_{LL} via ERI_{UL} (Ratio)	-0.229	-0.081	-0.015	-0.005	-0.097	-0.027	-0.107	-0.025	-0.054	0.124	0.007	0.029
PSC_{UL} via ERI_{UL} (Multiplicative)	-0.065	0.009	-0.006	-0.000	-0.026	0.009	-0.029	0.014	-0.073	0.032	-0.000	0.012
PSC_{UL} via ERI_{UL} (Relative Excess)	-0.011	-0.083	-0.013	-0.004	-0.088	-0.025	-0.105	-0.029	-0.057	0.102	**0.005**	**0.025**

9.10 Discussion

This study used PSC theory to foreground and expand ERI theory in a multilevel way. Empirically, we found in an Australian context that ERI can be conceptualised at both the organisational and individual level. Moreover, the PSC construct preceded the interaction between efforts and rewards, the core component of the ERI model, which in turn influenced workers' psychological and physical health, and outcomes in the workplace. That is, workplaces high in PSC facilitate environments that promote a healthy balance between efforts and rewards leading to better productivity and health outcomes. Improving work related health outcomes is important in Australia, as we are experiencing rising rates and costs associated with worker's compensation claims for psychological and physical injuries. Therefore, the PSC extended ERI model can be implemented to evaluate work related stress issues in order to prevent and reduce associated detrimental health effects on workers and injury compensation costs.

While prior investigations of the ERI model have mostly been outside Australia, this study demonstrates that the ERI model can add to the current understandings of work stress among Australian workers. For example, we found that Australian workers that invest high amounts of effort without receiving adequate rewards (high ERI) consequently report poor psychological, emotional and physical health problems, along with poor engagement and job satisfaction. Our findings are consistent with Allisey et al. (2012) who reported that an imbalance between high efforts and low rewards, leads to high levels of psychological distress among Australian police officers. Our research extends that of Allisey et al. (2012), by finding, in a population based study, a significant impact of ERI among Australian workers from various industries upon more than just psychological distress, but also emotional exhaustion, depression, general physical health, along with engagement and job satisfaction. Our findings that effort-reward imbalance leads to workers' psychological and physical health and workplace outcomes are also consistent with international research on the ERI model (Bakker et al. 2000; de Jonge et al. 2000; Kikuchi et al. 2010; Niedhammer et al. 2004; Weyers et al. 2006). As such, we have demonstrated that Australian workers share a similar experience to other cultures in relation to the process and impact associated with the ERI model.

An important addition from this study is that our research indicates we can understand the ERI model at the organisational level. This is significant as it means poor ERI reflects more than just an individual level problem; it reflects an organisational problem to be tackled from a more macro level perspective. Consistent with Calnan et al. (2000), de Jonge et al. (2000), and Niedhammer et al. (2004) we demonstrated that the interaction between efforts and rewards, at the individual level, is linked with workers' health and workplace outcomes. However, we also found that poor ERI clustered at an organisational level, being the shared experience of demands and resources within an organisation, was associated with workers' poor job satisfaction. The shared perceptions of ERI explained additional variance over and above the variance explained by ERI at the individual level on workplace outcomes. We also found that the separate components of ERI, efforts and rewards, clustered at the organisational level explained additional variance over individual efforts and rewards in relation to workers' health and wellbeing, and workplace outcomes. Therefore, ERI theory conceptualised at the organisational level provides a unique contribution to the deterioration of workers' health, and workplace outcomes, separate to the influence of individual perceptions of ERI. As such, this research suggests a multilevel adaption to the ERI model is needed to capture a more accurate portrayal of the factors that influence worker health and wellbeing.

The multi-level approach is further illuminated by the results identifying PSC both at the individual and organisational level as a leading indicator of job-related demands and resources, whereby PSC predicts efforts and rewards, and the interaction between efforts and rewards. Our findings not only identified the association from individual and organisational PSC to the various aspects of the ERI model; efforts, rewards, and the ERI interaction, we also identified that PSC triggered the ERI model as can be seen in Figs. 9.1 and 9.2. For instance, individually perceived PSC has a significant relationship with psychological, emotional and physical health outcomes, and workplace outcomes, engagement and satisfaction via its relationship with the interaction between efforts and rewards.

At the upper level PSC was related to ERI but because ERI was not related to health outcomes at the upper level, the direct effect of PSC on health could not be mediated by ERI. The direct PSC to health (emotional exhaustion, physical health) relationship was however partly mediated by effort alone. PSC was the only organisational influence on psychological distress. For work outcomes, we found that PSC led to job satisfaction, partially, via rewards and ERI. As such, rewards appear to be an important explanatory mechanism at the upper level for satisfaction, much like effort for workers' health. For engagement, influence at the upper level was only from PSC.

At the upper level separate and distinct pathways demonstrate a health erosion process for efforts (refer to Fig. 9.1) and a motivational process for rewards (refer to Fig. 9.2), consistent with the JD-R model framework (Demerouti et al. 2001). The results are also consistent with the PSC framework acting as an extension of the JD-R model (see Dollard and Bakker 2010) further adding to the evidence that PSC acts as a leading indicator of work stress models that explain the relationships between psychosocial factors, worker health and productivity outcomes. It should be noted that the direct effect between PSC and the outcome measures could be explained by other unmeasured demands (e.g. emotional demands) and resources (e.g. job control), and their combinations (e.g., Job Demand-Control model).

Further, we have provided support for PSC being more than just a distal predictor of workers' health and motivational outcomes, but also a proximal predictor of ERI. Moreover PSC provided additional explanatory power of workers outcomes above that of ERI. Both individually perceived and shared perceptions of PSC had a significant impact upon workers' psychological and emotional health (refer to Fig. 9.1). Moreover, PSC was able to explain additional variance in worker satisfaction, above that explained by organisational and individual, rewards and ERI, as can be seen in Fig. 9.2, both at the organisational level and individual level. As such,

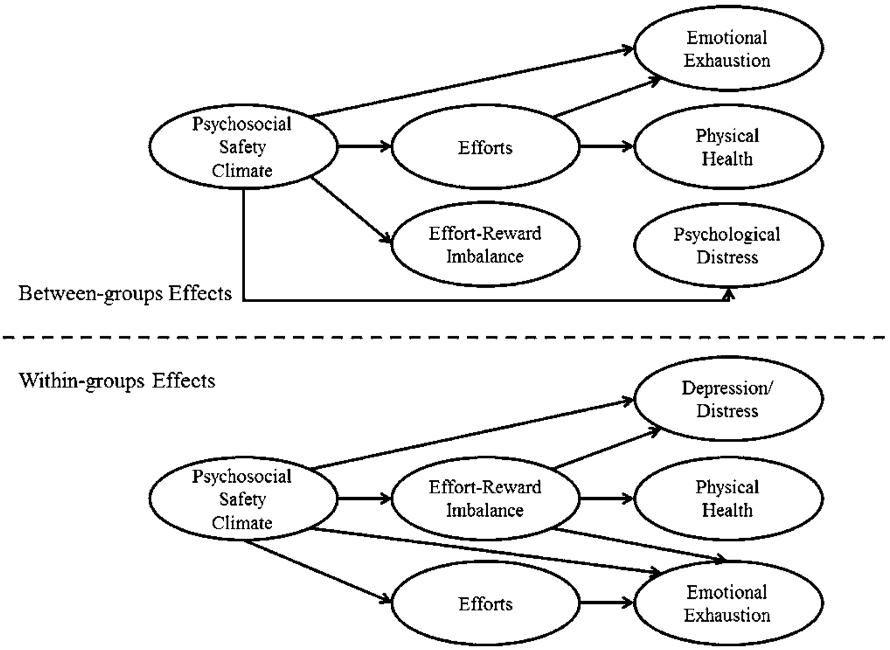

Fig. 9.1 The PSC extended ERI model, investigating the pathway from PSC to physical and psychological health outcomes via Efforts and ERI (ratio model)

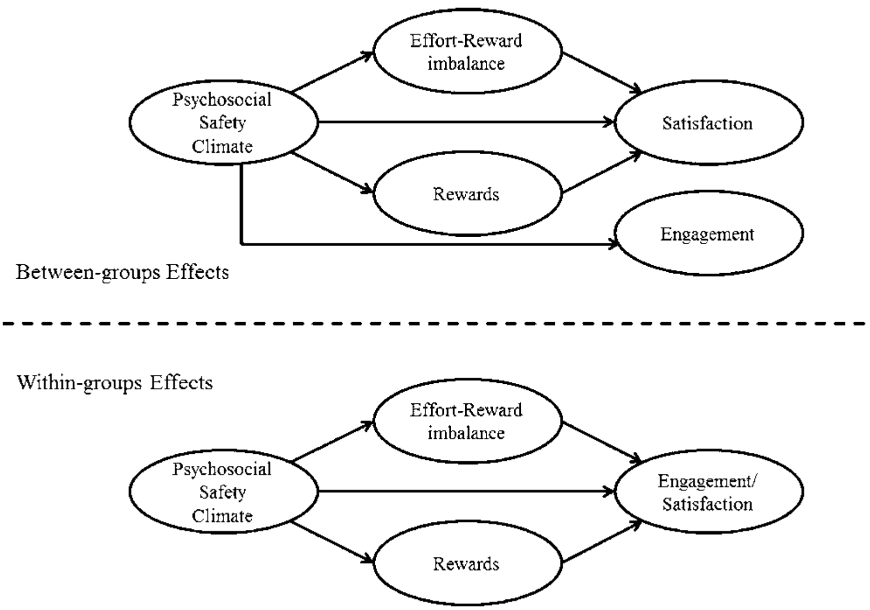

Fig. 9.2 The PSC extended ERI model, investigating the pathway from PSC to workplace outcomes via Rewards and ERI (relative excess model)

PSC is a strong predictor of workers' motivational and health outcomes, with higher levels of PSC not only promoting lower organisational and individual efforts, and higher organisational and individual rewards, but also promoting higher job satisfaction and better health outcomes for workers. These findings demonstrate the importance of including PSC into the understanding of work related stress issues, due to its predictive capabilities for both working conditions, and workers' health and organisational outcomes.

Prior research has solely explained the impact of PSC on working conditions either at the individual level or at the organisational level (Hall et al. 2013; Law et al. 2011) but until now had not tested the combined effect simultaneously. Our study extends the extant literature on PSC, by exploring individual and organisational PSC simultaneously, as well as exploring the impact PSC has upon the interaction between two types of working conditions, efforts and rewards. The research revealed that individual PSC explained additional variance over and above organisational PSC in relation to working conditions, efforts and rewards, and the interaction between efforts and rewards. Therefore, workers' individual perceptions of how their senior management team performs in relation to PSC, as well as the shared perceptions surroundings the performance by senior management on PSC, separately determine levels of demands placed on workers and the amount of resources that are provided in compensation, and the interaction between the workers' efforts and rewards. As such, it is important to consider the impact of both individually perceived PSC, as well as the shared perceptions of organisational PSC.

Further, we demonstrated that the PSC extended ERI model at the organisational level. Specifically we found that high organisational PSC indirectly improved job satisfaction, via organisational levels of ERI. Thus PSC predicts priority towards promoting a balance between efforts and rewards for workers at the organisational level. The results suggest that in high PSC organisations senior management will set reasonable demands and promote the recognition of high effort with appropriate compensatory rewards. Both organisational PSC and organisational ERI address the psychosocial health and safety of the workers. However, while organisational PSC addresses broad psychosocial health and safety concerns, organisational ERI is a facet specific climate directly related to overall expectations and attitudes towards setting demands and allocating resources. The results from this study indicate that starting with a broad focus on psychosocial health and safety concerns of the workers (PSC) will lead to a more balanced focus on the specific climate represented by ERI.

The results suggest that organisations with high PSC will promote an acceptable balance of organisational ERI. For example they would likely provide financial and non-financial rewards to their employees appropriate to the level of efforts invested by the workers. As such, workers would be given long-term contracts in contrast to short-term or casual contracts creating a sense of job security, which is an important reward within cultures like Australia that adhere to punitive welfare systems. In addition, organisations would pay above minimum wage to reward workers efforts and provide in-house promotions rather than hire outside the company, thus creating financial and esteem rewards. Finally, over-time workers would be rewarded with non-financial benefits, such as paid time off work in compensation for their high effort investment. This new understanding of PSC extended ERI at the organisational level provides an important theoretical advance, as it adds a multilevel adaption to the previously established individual level ERI model.

This research has also addressed an issue raised van Vegchel et al. (2005) regarding how ERI interaction terms should be calculated for workplace stress models. The results by van Vegchel et al. (2005) demonstrated more support for the multiplicative term in contrast to the widely used ratio term for the ERI model. They found that both the ratio and relative excess terms had no significant impact upon the various health and occupational outcomes. In contrast, we found few significant associations with ERI multiplicative and the various health outcomes that are generally well-known for their association with the ERI model. Instead, we found that ratio was the best predictor of workers' health outcomes, and relative excess was the best predictor of organisational outcomes. This difference in findings could be a result of several factors. For instance the sample from van Vegchel et al. (2005) was comprised of workers from the Netherlands compared to workers from Australia as in our study. As previously noted, Australia has a punitive welfare system making workers livelihood reliant upon having a job, in contrast to the Netherlands where their welfare system provides more support and flexibility to their citizens. This difference is important as it could affect how workers value and/or perceive rewards. In addition, van Vegchel et al. (2005) only investigated one industry (nursing home workers), while we looked at workers from at least 16 different industries. Finally, in our study we used the psychological demands scale, also referred to as workload, from the JCQ 2.0 scale, while van Vegchel et al. (2005) used the ERI scale to measure efforts. These variances could have affected the way workers react to the efforts and rewards, causing the difference in results between the findings from van Vegchel et al. (2005) and our study. Therefore, we would suggest that it is important to consider all three interaction terms, ratio, multiplicative, and relative excess, when using the ERI model to analyse workplace stress and its associated impacts.

9.10.1 Limitations

This research was only cross-sectional, and as such we are unable to make causal claims. However, prior longitudinal research has demonstrated that PSC influences task level risk factors, such as demands (i.e., effort) as proposed in the ERI model (Dollard and Bakker 2010) and various resources (Dollard and Bakker 2010; Dollard et al. 2012). In addition prior research has found that ERI affects employee health outcomes (Niedhammer et al. 2004). Therefore, we have theoretical support for our supposition that PSC influences the ERI model, which in turn affects employees' health and organisational outcomes. Some of the problems associated with self-report research such as common method effects that prevail in cross-sectional research as accounted for in many respects in between-groups analysis. However, future research should endeavour to use longitudinal data to test the PSC extended ERI model in an Australian context to tease out causal and reciprocal effects.

9.10.2 Conclusion

This chapter has filled some very important gaps in the research on the ERI model. We have provided further evidence that the ERI model can be applied within an Australian population to understand employee health and organisational outcomes. This is important, as this model reflects important issues in Australia regarding poor working conditions that are impacting upon productivity and employee health outcomes including the rising costs of work-related injury compensation claims. In addition, we have added an organisational component to the current conceptualisation of ERI in that worker wellbeing outcomes are influenced by perceptions of efforts and rewards at the individual and organisational levels. Therefore, future research should consider both a multi-level approach to better understand employee health and wellbeing, and organisational outcome. We also extended ERI theory adding PSC to the model where by PSC acts as a leading indicator of efforts and rewards suggesting management values and philosophy of worker health underpinning PSC levels in an organisation, are a significant influence on the determination of demands placed on workers and allocation of resources. This is an important contribution, as it reflects a shift away from task level and individual level psychosocial risk factors towards organisational level factors in understanding workplace stress. Combined approaches towards psychosocial risk prevention and interventions will therefore likely yield more positive health and work benefits. Our research demonstrates that researches and practitioners need to include both individual and organisational measures, and utilise the extended ERI by incorporating PSC to achieve a more comprehensive approach towards understanding factors influencing health and productivity outcomes in the workplace.

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Chapter 10
Working Conditions and Health in China: Evidence on the ERI Model

Jian Li

10.1 Economic Globalization, Working Conditions, Population Health in China

Globalization has a double effect on health. On one hand, absolute economic growth has been shown to improve the health of people (Cornia 2001); on the other hand, flexible market and enlarged social inequalities adversely affect the health of working populations (Kawachi 2008). China is a typical case illustrating this ambivalence.

As the largest developing country in the world, China has a population exceeding 1.3 billion, and the employed population in China exceeds 0.7 billion, accounting for more than one tenth of the world's population. The dramatic economic change occurring over the last 30 years in China is probably unprecedented in human history. As an illustration, for a longer period of years, there has been an exceptional annual GDP growth of about 8 %. This profound, rapid transition has had, and continues to have, substantial impact on many aspects of employment and people's wellbeing, in particular on occupational health. There is no doubt that physical working conditions and general health of the Chinese population (such as longer life expectancy and lower mortality) have been greatly improved (Zhang et al. 2010; Wang and Li 2014). However, as will be documented below, significant work-related health risks continue to define challenges to occupational public health. Moreover, in a broader perspective, international comparative data indicate that, while absolute income levels improved, income inequality has been growing. This is the case in several rapidly developing countries (Múјica et al. 2014; Ravallion 2014), and clearly in China as well (Gao et al. 2002). Accordingly, growing income

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inequality exerts adverse effects on health and wellbeing, not surprisingly, in these lower-income countries (Jorm and Ryan 2014).

International research indicates that rapid socioeconomic change results in an increase of stress-related mental disorders (Kopp et al. 2007; Bobak and Marmot 2009). According to epidemiologic surveys conducted in China over the last five decades (1960–2010) the lifetime prevalence of any mental disorder increased from an initial very low level (overall no more than 3.3 %) to a level as high as 21.9 %. This change is mainly due to an increase in depression and anxiety disorders (Guo et al. 2011). Additional data support this trend as 20 % of working people were found to suffer from mental disorders according a recent report (Zhang et al. 2010), and as a large-scale survey in China showed that 36.8 % of adults were severely stressed (Yang et al. 2012). This latter result is supported with an earlier finding from our own research where 32.4 % of all participating working persons reported a high or very high level of stressful work (Li and Jin 2007).

Based on the official statistics of China (see Table 10.1), we clearly see an upward trend of absolute income, with a five-time increase since 2001. However, taking a closer look, individual wealth remains almost unchanged, as indicated by the stable Engel coefficient (i.e. the proportion of income spent on food), and

Table 10.1 Work and employment-related statistics in China

	2001	2003	2005	2007	2009	2011	2013
Total population (×10,000)	127,627	129,227	130,756	132,129	133,450	134,735	136,272
Employed population (×10,000)	72,797	73,736	74,647	75,321	75,828	76,420	76,977
Gross domestic product (GDP) growth (%)	8.3	10.0	11.3	14.2	9.2	9.3	7.7
Health expenditure (% of GDP)	4.6	4.8	4.7	4.4	5.2	5.2	5.6
Weekly working hours in urban areas	44.9	45.4	47.8	45.5	44.7	46.2	46.6
Registered unemployment rate in urban areas (%)	3.6	4.3	4.2	4.0	4.3	4.1	4.1
Annual salary in urban areas (Yuan)	10,834	13,969	18,200	24,721	32,244	41,799	51,483
Engel coefficient in urban areas (%)	38.2	37.1	36.7	36.3	36.5	36.3	35.0
Ratio of average income between the richest 20 % and the poorest 20 % in urban areas	3.8	5.3	5.7	5.5	5.6	5.4	4.9

Data source: China Statistical Yearbook 2014; China Labor Statistical Yearbooks 2002–2014

Table 10.2 Prevalence rates of diseases (1/1000)

	1998	2003	2008
All diseases during the past 2 weeks			
Among total population	149.8	143.0	188.6
Among employed population	136.9	144.7	167.9
Sickness absence days from work per 1,000 employees	308	194	90
Selected chronic diseases			
Hypertension	15.8	26.2	54.9
Diabetes	3.2	5.6	10.7
Heart diseases	14.2	14.3	17.6
Cerebrovascular diseases	5.9	6.6	9.7

Data source: China Health Statistical Yearbook 2013

income inequality (assessed as the ratio between the richest 20 % and the poorest 20 %) has been growing. It is remarkable to note that Chinese people have the longest working hours worldwide, and that this trend continues to increase. At the same time, the registered unemployment rate is also getting higher.

Turning to the population health in China (see Table 10.2), crude official statistical data report an increase in prevalence rates of several diseases (including chronic diseases) since the year 1998, and accordingly an increase in health expenditures. Data also point to a substantial reduction in sickness absenteeism from work. If further substantiated this latter trend might result in increased sickness presenteeism and its adverse effects, mainly due to fears of salary reduction or even job loss.

It is thus important to link the recent socioeconomic and occupational developments in this country with working people's health. In this context, the application of the effort-reward imbalance (ERI) model (Siegrist 1996) seems promising as this model focuses on health-adverse effects of heavy psychosocial work pressure in combination with threats to core work-related rewards, including job security, fair wages, and promotion prospects. In addition, China offers a special case of demonstrating a rapid transition from a state-planning-oriented economy to a market-driven economy with high flexibility and mobility, fixed contracts and increased job insecurity.

10.2 Evidence of ERI at Work and Health in China

10.2.1 Measurement of ERI: The Chinese Version

Interest in applying the ERI questionnaire in Chinese workers started briefly after the year 2000. Meanwhile, the standard version and the short version of the ERI questionnaire have been validated in China. The first validation study of the standard version was conducted among female factory workers (Xu et al. 2004), another independent validation study of the standard version was reported shortly thereafter among both male and female healthcare workers (Li et al. 2005). These two pioneering studies provided the initial evidence that the ERI questionnaire is applicable to Chinese working population, with satisfactory reliability and validity. Later on, the psychometric properties of the short version were also assessed in a large sample of a general working population (Li et al. 2012) (for details, please see Chap. 2).

10.2.2 An Overview of Research Findings

In order to summarize the findings of effort-reward imbalance at work and health, a literature search was conducted, using the following criteria: (1) time of publication: January 2004–August 2015; (2) peer-reviewed article with original data; (3) English literature by MEDLINE (Medical Literature Analysis and Retrieval System Online) and Chinese literature by CAJD (China Academic Journal Network Publishing Database); (4) medical subject headings and key words: effort-reward imbalance or over-commitment.

Thirty-two records were identified for English publications, and they were all included in this chapter. One hundred sixty-seven records were identified for Chinese publications. After careful review, nine Chinese papers with adequate research quality and special research focus were included in this chapter, in addition to the English publications. In total, this overview is based on 41 papers. Among them, a majority applied a cross-sectional design, while three reports were based on a case-control design (Xu et al. 2009, 2010b, 2011b; Ling et al. 2010; Yu et al. 2010b), and two publications resulted from prospective cohort studies (Li et al. 2013; Loerbroks et al. 2015). The study populations included various occupations, such as healthcare workers, teachers, railways workers, correctional officers, coal miners, power plant workers, etc. All the associations were examined by multivariable regression models adjusted for relevant covariates (see Table 10.3).

Mental Health Fifteen papers reported cross-sectional associations between effort-reward imbalance at work and mental disorders, mainly depressive symptoms and burnout. These studies showed that ER-ratio was associated with 1.7–3.3 times higher odds of mental disorders, while over-commitment was associated with 1.6–3.2 times higher odds of mental disorders.

Cardiovascular Diseases In the first respective study in China, Liying Xu et al. (2004) found that ER-ratio was associated with a small, but significant increase of 3.0 mmHg in systolic blood pressure among working women. Moreover, a combined effect of work stress and family stress resulted in a blood pressure increase that was twice as high. A different research team led by Weixian Xu at Peking University provided a series of reports on work stress and cardiovascular risk based on two studies, a case-control study of patients with coronary heart disease and controls, and a study of several hundred men and women free from distinct cardiovascular or metabolic disorders. In the case-control study Xu et al. (2009, 2010b,

Table 10.3 Summary of major publications on effort-reward imbalance at work and health in China (2004 January–2015 August)

Authors	Year	Sample	Health outcomes	Major results				
				Effort	Reward	ER-ratio	OC	ER-ratio×OC
			Mental health					
Yang and Li†	2004	928 healthcare workers	Depressive symptoms	–	–	★	★	–
Yu et al.†	2008b	878 thermal power plant workers	Depressive symptoms	★	★	★	☆	☆
Gao et al.†	2012b	1,437 female hospital nurses	Depressive symptoms	–	–	☆	★	–
Yu et al.†	2013b	5,338 workers	Depressive symptoms	★	★	★	★	–
Sui et al.†	2014	1,494 male correctional officers	Depressive symptoms	–	–	★	★	–
Liu et al.†	2014	1,936 male underground coal miners	Depressive symptoms	–	–	★	★	–
Shang et al.†	2015	2,457 general working population	Depressive symptoms	–	–	★	–	–
Xie et al.†	2011	527 female hospital nurses	Burnout	★	★	★	★	–
Wu et al.†	2013	1,202 hospital physicians	Burnout	★	★	–	★	–
Wu et al.†	2014	1,478 female hospital nurses	Burnout	★	★	–	★	–
Wang et al.†	2014	457 hospital physicians	Burnout	★	★	★	★	–
Wang et al.†	2015	559 school teachers	Burnout	★	★	★	★	–

(continued)

Table 10.3 (continued)

Authors	Year	Sample	Health outcomes	Major results				
				Effort	Reward	ER-ratio	OC	ER-ratio×OC
Hu et al.†	2015	1,769 correctional officers	Burnout	★	★	★	★	–
Gu et al.†	2009	1,679 female railway workers	Psychological distress	–	–	★	–	–
Gao et al.†	2012a	1,437 female hospital nurses	Anxiety symptoms	–	–	☆	★	–
			Cardiovascular disease					
Xu et al.†	2004	421 female workers	Blood pressure	–	–	★	–	–
Xu et al.#	2009	292 cases, 96 controls	Coronary heart disease	★	★	★	★	★
Xu et al.#	2010b	227 cases, 93 controls	Coronary atherosclerosis	★	★	★	★	★
Xu et al.#	2011b	292 cases, 96 controls	Coronary heart disease	★	★	★	★	–
Xu et al.†	2010a	734 workers (508 men and 226 women)	Carotid intima-media thickness	★♀	★♀	★♀	★♀	–
Xu et al.†	2011a	544 workers	Dyslipidemia	★	★	★	★	–
Xu et al.†	2012a	680 workers (465 men and 215 women)	Glycosylated hemoglobin	★♀	★♀	★♀	☆	–
Xu et al.†	2012b	732 workers (506 men and 226 women)	Fibrinogen	★♂♀	★♂♀	★♂♀	★♂♀	–
Xu et al.†	2013	734 workers	Hypertension	–	–	★	★	★

Xu et al.[†]	2015	731 workers (506 men and 225 women)	High-sensitivity C-reactive protein	★♂	★♂	★♂♀	★♂♀	–
Loerbroks et al.[§]	2015	785 university staff	Metabolic syndrome	☆	☆	★	☆	–
			Musculoskeletal disorders					
Wu et al.[†]	2008	1,329 female hospital nurses	Back-neck pain	–	–	★	☆	–
Yu et al.[†]	2013a	5,338 workers (3,632 men and 1,706 women)	Neck, shoulder and wrist symptoms	★♂	☆	★♂♀	★♀	–
			Reproductive health					
Zhou et al.[†]	2010	1,642 female railway workers	Menstrual disorders	–	–	★	–	–
Ling et al.[#]	2010	240 cases, 228 controls	Missed abortion	–	–	★	☆	–
			Health functioning					
Li et al.[†]	2006	522 hospital physicians (256 men and 266 women)	Physical and mental health	★♀	★♀	★♂♀	★♂	–
Li et al.[†]	2012	1916 general working population	Physical and mental health	★	★	★	★	–
Liu et al.[†]	2015	373 psychiatrists	Physical and mental health	–	–	★	★	–

(continued)

Table 10.3 (continued)

Authors	Year	Sample	Health outcomes	Major results				
				Effort	Reward	ER-ratio	OC	ER-ratio×OC
			Turnover and work ability					
Li et al.[§]	2013	1,251 female hospital nurses	Intention to leave profession	☆	★	★	☆	–
Loerbroks et al.[†]	2014	436 school teachers	Intention to leave profession	★	★	★	–	–
Xu et al.[†]	2014	689 public health workers	Work ability	★	★	★	★	–
			Biomarkers					
Yu et al.[#]	2010b	58 cases, 58 controls	Hypertension, gene polymorphisms of β_2-AR	–	–	★	–	–
Yu et al.[†]	2008a	122 traffic policemen	Plasma interleukin-6	☆	★	☆	☆	–
Yu et al.[†]	2010a	50 male assembly line workers	Salivary lysozyme	☆	★	–	☆	–
Qi et al.[†]	2014	39 female kindergarten teachers	Hair cortisol	☆	☆	★	–	–

♂: male; ♀: female; *ER-ratio* effort-reward ratio, *OC* over-commitment
–: not tested; ☆: tested with non-significant association; ★: tested with significant association
[†]Cross-sectional design
[#]Case-control design
[§]Prospective cohort design

2011b) observed that all single components of the ERI model were significantly associated with coronary heart disease (odds ratios ranged 2.0–2.8), and the ratio between effort and reward was associated with a 2.5-time elevated odds of coronary heart disease. Moreover, the interaction term of the ER-ratio with over-commitment resulted in a higher risk estimation (odds ratio = 5.5), indicating a potentially synergistic effect. In the study of men and women who were free from manifest cardiovascular or metabolic disorders, associations of ER-ratio and over-commitment with a variety of clinical risk factors were observed (2010a, 2011a, 2012a, b, 2013, 2015). As indicated in Table 10.3, this was the case for carotid intima-media thickness, dyslipidemia, glycosylated hemoglobin, fibrinogen, hypertension, and high-sensitivity C-reactive protein. Notably, a prospective study of a several hundred staff members of a university in Kunming City with 2-year follow-up data indicated that high ER-ratio was associated with a 20 % excess risk of developing an incident metabolic syndrome (Loerbroks et al. 2015).

Musculoskeletal Disorders Two cross-sectional studies focused on musculoskeletal disorders (Wu et al. 2008; Yu et al. 2013a). The results indicated that ER-ratio was associated with 1.5–3.1 times higher odds of symptoms at different body sites, while the odds ratios by over-commitment were elevated in arrange from 1.2 to 1.4.

Reproductive Health One cross-sectional study found that ER-ratio was associated with 1.2-time higher odds of menstrual disorders in working women (Zhou et al. 2010); while another case-control study indicated that ER-ratio might be a risk factor to missed abortion (odds ratio = 1.8) (Ling et al. 2010).

Health Functioning Three studies examined the effects on health functioning (including physical health and mental health) (Li et al. 2006, 2012; Liu et al. 2015), indicating that ER-ratio was associated with 1.8–2.9 times higher odds of poor health functioning. Similar associations were observed for the intrinsic component of over-commitment (odds ratios 1.5–2.5).

Turnover and Work Ability A cross-sectional study among school teachers found that ER-ratio was associated with a 2.3 times elevated odds of an intention to leave one's profession (Loerbroks et al. 2014). Furthermore, a prospective study with 1-year follow-up confirmed this finding (odds ratio = 2.1) (Li et al. 2013). Finally, a recent cross-sectional study demonstrated striking associations between ER-ratio and work ability, with odds ratios of 5.1 for moderate work ability and 11.6 for poor work ability (Xu et al. 2014).

Biomarkers A case-control study found a significant interaction effect between ER-ratio and gene polymorphisms of β_2-AR on hypertension (Yu et al. 2010b). Three cross-sectional studies indicated that either the reward component or the ER-ratio were associated with selected endocrine-immune system-related indicators (plasma interleukin-6, salivary lysozyme, hair cortisol) (Yu et al. 2008a, 2010a; Qi et al. 2014).

Intervention Study Importantly, one intervention study applying a randomized trial should be mentioned that conducted a 6-month intervention aiming at reducing employees' stress by implementing organizational level-changes of the work environment and by offering individual level-stress management training (Wu et al. 2012). Findings of this trial demonstrated significant improvements of the reward and over-commitment components of the ERI model as well as a significant decrease of burnout and depressive symptoms at the end of the intervention.

Taken together, research evidence from China using the effort-reward imbalance questionnaire as a measure of stressful work supports the validity of this approach in a different cultural and socioeconomic context. It is of interest to note that single scales as well as their theoretically justified combinations exerted the observed effects. However, a note of caution is needed as the majority of results are based on cross-sectional studies, as authors sometimes used the same dataset for different publications with different health indicators, and as publication bias is likely, given a majority of significant findings.

10.2.3 Comparing ERI with Other Work Stress Models

In China, as in other countries, work stress has been studied using different measurement instruments that are based on complementary theoretical concepts. Two such concepts are particularly prominent, the Demand-Control-Support (DCS) model and the Organizational Justice (OJ) model. The DCS model claims that stress-related ill health results from the combined effect of high job demand and low job control, while social support at work may buffer adverse effects of job strain on health (Karasek and Theorell 1990). The OJ model focuses on employees' perceptions of fairness in the workplace, generally including procedural justice and interactional justice (Colquitt et al. 2001). Both models were widely tested in modern Western countries (Kivimäki and Kawachi 2015; Theorell et al. 2015; Kraatz et al. 2013; Elovainio et al. 2010; Ndjaboué et al. 2012). Therefore, it was of interest to apply them in the Chinese context as well (Li et al. 2004; Loerbroks et al. 2014), and to compare their explanatory contribution with the one provided by the ERI model.

Results so far show that effects on health in general are more pronounced in case of ERI than in the remaining cases, after respective mutual adjustment (Li et al. 2006, 2013; Ling et al. 2010; Xie et al. 2011; Xu et al. 2011b; Gao et al. 2012a, b; Yu et al. 2013a; Wu et al. 2013, 2014; Wang et al. 2014, 2015; Loerbroks et al. 2014). It is unclear how to interpret this finding as the effect sizes of the three complementary models are usually well comparable in studies conducted in Western societies. Of course, methodological effects cannot be ruled out, but it is tempting to suggest a more substantial interpretation.

Interpretation: Here, I propose an explanation using a well-accepted theory, Maslow's hierarchy of human needs (Maslow 1943). The hierarchy of needs is conceptualized as a pyramid with the largest, most fundamental and material human needs of self-preservation at the bottom and the more highly developed psychological needs of personal self-development at the top. According to Maslow, basic need satisfaction precedes the meeting of needs located at higher levels. Although debated, Maslow's hierarchy was widely acknowledged, and its fundamental notion seems to match a universal human condition (Su et al. 2013).

Assuming that reducing a high level of stressful work, and even more so promoting health-conducing favorable work may meet basic human needs one can compare the three work stress models with regard to their capability of need fulfillment. It is obvious that the DCS and OJ models focus on need satisfaction at higher, rather cognitive and emotional than material levels, such as personal control, autonomy, fairness, and social support. In contrast, as depicted in Fig. 10.1, the ERI model, and in particular its central component of reward, covers a broader range of needs to be met, including the more basic motivations of security of one's occupational status and financial survival. In modern Western welfare states, these basic needs are addressed by specific social welfare regulations and labor market policies. Although threats to one's job security are now of growing concern (see Chap. 1 in this book) several reports indicate that adverse health effects of stressful, precarious work outmatch the effects attributable to job loss in these countries (Grzywacz and Dooley 2003; Lindström 2005; Butterworth et al. 2010, 2013). Hence, the more basic needs related to employment status and security did not receive primary attention in the general awareness and they were not considered as a core concern by the DCS and OJ models. However, in the ERI model, these aspects are included. Here, it is suggested that these latter aspects addressing threats to basic needs matter much more in a rapidly developing country like China, where respective protective social and labor market policies are only poorly developed (Li et al. 2008). This may be the reason why low reward and related high cost/low gain conditions at work are more strongly associated with negative health among Chinese workers than is the case with regard to the components of the DCS or OJ models. There is some preliminary evidence in support of this hypothesis from an earlier study conducted in China. Using Maslow's need concept as an interpretation Xie found a significant association of job control with mental health among more qualified white-collar workers, but not among blue-collar workers employed in more precarious conditions (Xie 1996).

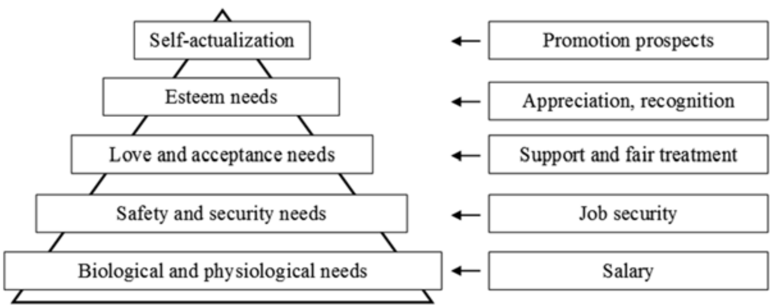

Fig. 10.1 Comparing Maslow's hierarchy of human needs with the reward components of Siegrist's ERI model

10.3 Conclusions and Future Directions

This chapter provides a summary of recent developments of working and employment conditions in China in times of economic globalization, and it emphasizes the promise of the ERI model in explaining associations of stressful work with adverse health in this context. Importantly, as this model addresses basic concerns of occupational wellbeing, such as threats to the continuity of one's social status and financial security in addition to relevant cognitive and emotional needs, it may be particularly well suited to capture aspects that significantly contribute to the burden of work-related diseases in this country.

Despite these merits, future research using this model should address the following suggestions. First, there is still a substantial lack of established, well functioning national surveillance systems of harmful psychosocial risk factors at work in China (Dollard et al. 2007). The few regional surveys conducted by scientists so far do not adequately reflect the general working and employment conditions across the whole of the country. Thus, implementing surveillance tools and analyzing respective data would be an important future task. Second, the quality of evidence of research on work stress and health needs to be improved. In particular, cohort studies and intervention trials should supplement the available knowledge that is mainly based on cross-sectional investigations. Third, large and rapid mobility processes of migrant workers from rural areas to urban agglomerations are currently taking place. These populations are usually poorly qualified and are forced into precarious, often dangerous jobs with cumulative physical, chemical, biological and psychosocial hazards at work. Research should pay more attention to these high risk groups, addressing the health impact of cumulative adversity (Mou et al. 2013). Finally, China is facing the challenges of a rapidly ageing society. According to census data from 2010, about 119 million people aged 65 and older are living in this country. Obviously, future research should address the special problems of an ageing workforce and the role of stressful work among older workers (Zhao et al. 2014). Clearly, a more comprehensive research approach might produce additional insights that need to be disseminated to policy makers with an intention to result in sizeable improvements of current working and employment conditions in China.

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Chapter 11
Working Conditions and Effort-Reward Imbalance in Latin America

Viviola Gómez Ortiz and Arturo Juárez-García

11.1 Introduction

According to the World Health Organization (2007), both globalization and recent changes in the nature of work are probably worsening work related stress issues in Latin America. When this WHO document was published in 2007, very few studies on work stress in Latin-American countries had been carried out and no mandatory rules or risk standards had been implemented to promote good practices at the workplace against psychosocial risk exposure. However, a recent study showed that occupational health and safety priorities in the region have changed during the last decade pointing to the need to monitor psychosocial hazards and to address work-related stress, violence, harassment, unhealthy behaviors, and other workplace hazards (Kortume and Leka 2014).

The Pan American Health Organization (2015) asserts that the labor force in the Americas is made up of 484 million people, almost half of the total population. The organization also affirms that Latin America and the Caribbean contribute 62.3 % of the labor force in the region, equivalent to more than 300 million people many of them "exposed to dangerous work conditions ranging from exposure to chemical agents, to physical and biological dangers, ergonomic and psychological stressors, and unsafe conditions" (pp. 1).

In the context of economic globalization, Effort-Reward Imbalance (ERI) at work has been used as an indicator of psychosocial work-related stress in many

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countries around the world. Research using the ERI model and questionnaire in Latin America could help us understand how economic globalization and the changing working conditions are affecting workers' health in this part of the world. It could also help clarify whether economic, social and cultural characteristics of the region modify the impact of ERI on occupational health.

To contextualize the description and analysis of studies undertaken in Latin America that look into some health conditions and their relationship to ERI, this chapter first introduces a brief description of the work conditions to which workers in this subcontinent have been subject to over the last 8–10 years. We have considered it pertinent to highlight data that may serve as indirect indicators of effort and rewards. In addition, we consider it is interesting to offer a brief overview of health conditions in the sub region in order to allow readers to observe how such conditions are beginning to acquire a similar pattern to the one observed in developed countries, whereby chronic and stress-related diseases have been documented and how they are becoming increasingly associated with morbidity and mortality in the working-age population.

According to the above, the goals of this chapter are to:

(a) Provide a short general characterization of the labor market and working conditions in Latin America (in particular those related to the concepts of effort and reward), of existing legislation and regulations associated with psychosocial risk and stress, supplemented by some core data on health and wellbeing of people of working age.
(b) Undertake a systematic review and characterization of the studies published with samples from Latin America, which have assessed work stress using the ERI model. In addition to describing the prevalence of ERI as reported in the papers, and its association with the health of Latin American workers, in this chapter we undertake a critical analysis of published studies in order to identify their strengths and weaknesses, and offer suggestions for future research on the topic, in particular as far as based on the Effort-Reward Imbalance model.

11.2 Working Conditions and Employment in Latin America

Even though the information on the particular working conditions in this region is scarce, its link to the economic situation offers an approach to understanding such conditions. In this sense, the history of the changes of economic indicators in Latin America (rises and falls) is becoming increasingly similar to the patterns seen in the global economy. This is due to the fusion of the global financial markets and growing globalization in general, even though it is clear that indicators of economic growth have been lower than those of industrialized economies, especially since the 1980s. Weller (2011) mentions that during the first decade of 2000 and especially between 2003 and 2004 strong economic growth was reported that seemed to benefit the region, opening a path to a more favorable context for job creation and better job quality, at the same time as it tried to re-regulate the labor market. However, the financial crisis of 2008–2009 interrupted this process of improvement, causing a decline in the indicators, whereby some of them, such as the unemployment rate, went back to levels similar to those present in the 1990s.

Weller (2011) describes four types of employment exclusion in the region: during the 1980s, exclusion from the labor market (e.g., lack of female incorporation) and from productive employment (lack of jobs in highly productive sectors) prevails, thus increasing urban informal employment; beginning in the 1990s and up until now, exclusion from employment (e.g., typical unemployment) and from good quality employment (e.g., precarious work) has expanded.

In agreement with these ideas, a report from the International Labor Organization (ILO) in 2012 for the Latin American region (International Labor Organization 2012) concluded that despite the apparent economic growth, there are still important shortcomings in available decent work as a result of precarious employment, including income insecurity, a decline in social protection, and high labor turnover. More recently, the report on work in Latin America and the Caribbean (International Labor Organization 2014) describes that the situation is marked by a deceleration of economic growth, where uncertainty and concern prevail. More vulnerable groups have worse working conditions. Indeed, the unemployment rate is 30 % higher for women, and youths aged between 15 and 24 face unemployment rates that are two to four times greater than those of adults. The urban unemployment rate reaches an annual average of 6.1 % for Latin America and the Caribbean, representing 15 million people unemployed, only counting urban areas. It is important to note that Guatemala, Panama and Brazil have the lowest unemployment rates, whereas the Bahamas, Jamaica and Belize have the highest, with no great changes over the past few years (Fig. 11.1).

The report of the ILO (2014) recognizes that global crises affect this region in a particular manner, and that there are problems beyond that of unemployment. These problems include that of employment quality, when we consider that there are 130 million people working in informal employment, which generally implies precarious working conditions with no kind of social protection. As is well known, the average rate of informal workers in the whole region is of 47.7 %, although there seem to be substantial differences between countries. For example, countries such as Honduras, Bolivia or Peru approach a 70 % rate, whereas Chile, Venezuela and Argentina have between 40 % and 50 %: all highly alarming rates (International Labor Organization 2012).

In the report about Decent Work in the Americas (ILO 2006), the ILO points out that the labor market structure in Latin America is typically fragmented. For example, almost a third of the total labor market is found in the rural areas, whereas 50 % of the total is taken up by independent and domestic workers, unpaid family workers, or salaried workers in micro companies (with up to five staff) who tend to represent the greatest concentration of poverty, informality and the lack of decent work.

On the other hand, although informal work seems to be a particular factor of precariousness that characterizes the labor force in Latin America, formal work also

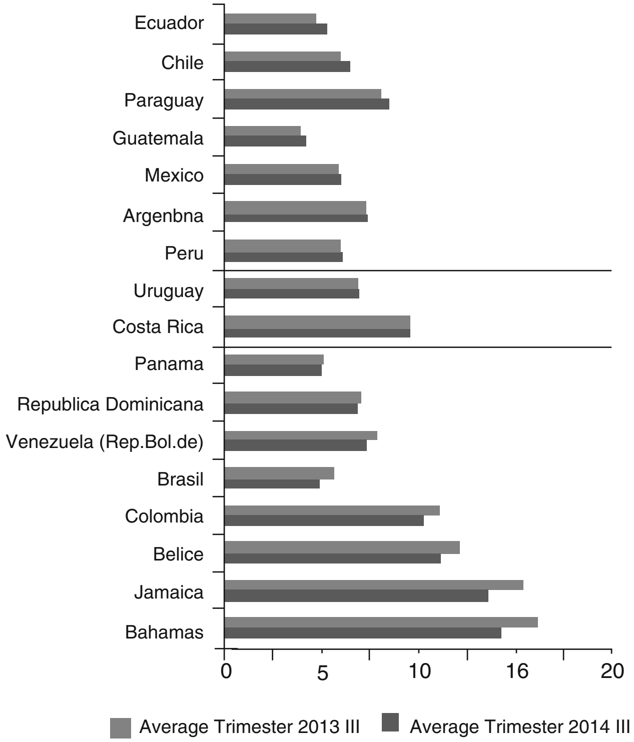

Fig. 11.1 Percentage of urban unemployment in Latin American countries between January 2013 and September 2014 (Source: ILO 2014)

has a number of very particular characteristics if we analyze the productive models and work organization systems typical to the region. For example, whereas developed countries have gradually abandoned the inherent forms of deeply entrenched hierarchical and rigid division of labor, known as Taylorism, and mass production has been transformed by means of automation and technological and communications advances into hugely flexible models of labor known as Toyotism, Total Quality Management, etc., in Latin America work organization systems continue to follow the old style Taylorist-Fordist tradition. They do, however, coexist with practices pertaining to labor flexibility and Toyotism models of the developed world which cannot fully materialize due to the technological lag in Latin America. This fosters types of particular mixed productive experiences that determine employment quality in the region (Rodríguez and Mendoza 2007), a combination that also establishes a mixture of stressful demands within each system, leading to psychosocial exposures that may be unique to Latin America and require further study.

Evidently, the employment quality indicators link up directly to the concepts pertaining to the effort/reward model, and are reflected in issues such as work overtime, long work hours, salaries, and job insecurity, among others. There are some data available that provide a complementary picture of such working conditions in

Latin American countries. For example, according to data from the Organization for Economic Cooperation and Development (2015), the three Latin American countries that are members of this organization have the longest working days of all. Mexico, in first place with 2228 h; Costa Rica in second place, with 2216 h; and Chile in fourth place, with 1990 h, whereas respective numbers in Western modern economies are substantially lower (e.g. USA 1789, Japan 1729, Sweden 1609, or Germany 1371 h). Similarly, a global survey on the percentage of workers that work overtime shows Peru as top of the list, with more than 50 % of its labor force working 48 h of overtime a week, whereas Argentina and Mexico present around 30 % (International Labor Organization 2007).

The above demonstrates not only that it is no longer the Asians that work the longest hours (please note that not all Latin American countries are included in the OECD's comparative studies), but also that globalization has encouraged developed countries to export work processes with particular demands to Latin America. For example, since 2010, Mexico occupies first place in terms of average hours worked per year, at the same time as the Mexican government highlights a significant economic growth in the industry (Expansión 2013).

With respect to wages, the trend is exactly the opposite of that for hours worked. The comparative study of salaries in countries that have been members of the OECD since 2013 shows that Mexico and Chile pay the lowest hourly rate (OECD 2015). As for 2013 hourly minimal wages in US Dollars are 0.62 and 2.32 respectively, compared e.g. to 3.02 in Turkey, 4.93 in Spain or up to 15.61 in Australia. This trend has come about in recent years and is consistent with other international surveys in which more Latin American countries take part. For example, a global salaries survey (adjusted by parity and purchasing power) applied by the International Labor Organization in 72 countries, shows that a number of Latin American countries, in particular Argentina, Chile, Brazil, Colombia and Mexico, pay wages that are located far below the median of the distribution of average global wage across the countries which is 1480 US Dollars per month (BBC 2012).

As for fundamental labor rights in Latin America, there are huge uncovered gaps in terms of freedom of union association and collective negotiation, forced labor, child labor and discrimination. For example, the region is host, according to the ILO, to 5.7 % of the global cases of complaint over freedom of union association, 29 % of the cases regarding layoffs against freedom of union association, 10 % of forced labor, 5.1 % of global child labor, and higher rates of gender or ethnic discrimination (ILO 2006).

Finally, although the global numbers of work accidents have diminished in general, there are only two exceptions: China and Latin America, where the number of fatal work accidents increased between 1998 and 2001. Workers with less protection tend to work in micro-enterprises, the informal economy and sectors such as agriculture, fishing, mining and construction (ILO 2006). In 2006 7.6 million work accidents were reported in the region, representing an area of opportunity for improvement with regards to working conditions in Latin America and the Caribbean (see Fig. 11.2).

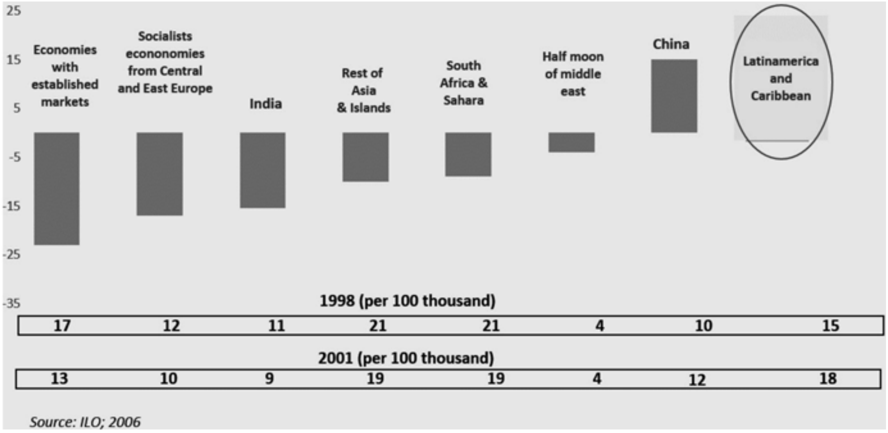

Fig. 11.2 Evolution of fatal work accidents in the world in the 1998–2001 period (percentage variation) (Source: ILO 2006)

In accordance with the above, the conclusions of a report recently published by the Organizacion Panamericana de la Salud-OPS (Pan American Health Organization-PAHO) point out that the conditions of employment (salary, unemployment, social protection, among others) and work (dangers and risks in the workplace)—both considered social determinants of health—have been transformed over the past 15 years due to the changes that have taken place in the world of work, increasing the multiple inequities in terms of workers' health in Latin America (Organización Panamericana de la Salud [OPS], 2013).

11.3 Progress in Legislation for Psychosocial Risk and Stress in Latin America

Despite the aforementioned areas of opportunity, all the mandatory labor laws or regulations in Latin America indubitably include the right to dignified work (which is free of health risks). Moreover, over the past 10 years, much progress has been observed in the regulations and legislation in the specific topic of the psychosocial risk of stress and the organization of work. The growing body of research on the topic of psychosocial risk in the international arena, together with the research undertaken in the Latin America region, as well as the changes in the policies and recommendations made by worldwide organizations such as the International Labor Organization (ILO) and the World Health Organization (WHO), may have had important influences on this progress.

Basically, the regulations have evolved in two ways. On the one hand, there are those regarding health and safety hazards, which as well as physical and chemical risks, and which finally also include psychosocial risks in some cases. On the other hand, independent regulations now refer to the risks associated with psychological harassment at work (bullying). In particular, the latter has enjoyed the greatest legislative progress, not just because there seem to be more laws on the topic having been implemented in more countries, but also because the criteria for determining such harassment and its prevention seem increasingly more widely disseminated. For example, there are countries which have no legislation concerning psychosocial risk in general, but where they do have laws on harassment at work (Table 11.1).

Insofar as the regulations identified, these have a marked focus towards prevention and vigilance against psychological risk factors at work. Also the most common risks that appear among these regulations are the different types of job demands, control, participation or autonomy at work, interpersonal relationships among workmates and supervisors, leadership, organizational justice, rewards or recognition, work-family balance, and job security, among others. The theoretical base to which some of these regulations allude (for example, in Colombia and Mexico), point directly to the demand/control model or the effort/reward imbalance model as its conceptual base, although dimensions from other theoretical models and some that are not part of any of the models are also incorporated.

11.4 Health and Well-being in the Latin-American Region

Given that the relationship between income inequality and psychiatric disorders has been documented in both developed and developing countries (Wilkinson and Pickett 2006; Patel and Kleinman 2003), to describe the general health conditions in the Latin American region, we consider it pertinent to offer data on psychiatric/mental disorders. It is also important to describe not just some data on these disorders among the Latin American population, but also some of the other health indicators that could be related to the current labor market and its new stressful demands such as: cardiovascular diseases, other non-communicable diseases (chronic degenerative conditions), as well as mortality in general (Kivimäki et al. 2012; Landsbergis et al. 2013; Leka and Jain 2010; WHO 2003).

To begin with, it is worth pointing out that even though Latin America is not the world's poorest region, it is one of the least equitable, most unjust, and it has the most unequal distribution of wealth, which clearly leads to a bad "distribution" of health (CEPAL 2015). Using the historic register of the "Gini index" as an indicator of global inequality, some analyses point out that with the exception of some African countries and China, in general, the American continent seems to be the most unequal, especially Latin American countries and the United States (Hillebrand 2009; Ginni Coefficient 2015; Quandl 2015). Insofar as mental health, the World Mental Health (WMH) Survey Initiative, by the World Health Organization, reports studies in which highly unequal countries as measured by the GINI index such as Colombia, Mexico, and the United States show a prevalence of mental disorders that is among the highest of the 14 countries studied in 4 continents (17.8 %, 12.2 % and 26.3 % respectively). However, it is interesting to point out that some less

Table 11.1 Laws, articles and decrees related to psychosocial factors in Latin America

Country	Mandatory rule or regulation	Year	Topic included	References
Colombia	1010–2006	2006	Work harrasment	Congreso de Colombia. (2006). Ley 1010 de 2006. Recuperado de http://www.secretariasenado.gov.co/senado/basedoc/ley_1010_2006.html
	Resoluciòn 2646	2008	Psychosocial risks	Ministerio de la Protección Social. (2008). Resolución 002646 de 2008. Diario official 47059. Recuperado de http://www.alcaldiabogota.gov.co/sisjur/normas/Norma1.jsp?i=31607
Argentina	Ley No. 13168	2003	Work violence	Senado y Cámara de Diputados de la Proviencia de Buenos Aires. (2003). Ley 13168. Recuperado de http://www2.mp.gba.gov.ar/intranet/Legislacion/ley13168_violencialaboral.doc
Chile	La Ley 20.607	2012	Work harrasment	Dirección del Trabajo. (2012). Ley N°20.607. Diario Oficial. Recuperado de http://www.dt.gob.cl/consultas/1613/w3-article-99176.html
	Resolución 218	2013	Psychosocial risks assesment	Departamento de Salud Ocupacional del Instituto de Salud Pública de Chile. (2013). Resolución 2018. Biblioteca del Congreso Nacional de Chile. Recuperado de http://www.leychile.cl/Navegar/index_html?idNorma=1048620
Uruguay	Ley N° 18.561	2009	Work violence	Senado y Cámara de Representantes de la República Oriental del Uruguay. (2009). Ley N°18.561. *Publicada D.O. 21 set/009 – N° 27819*. Recuperado de http://www.parlamento.gub.uy/leyes/AccesoTextoLey.asp?Ley=18561&Anchor=
Puerto Rico	Proyecto	2014	Work harrasment	http://www.elnuevodia.com/negocios/consumo/nota/aboganporaprobaciondeleycontraacosolaboral-1792674/
Brasil	Ley 2.120 (Ubatuba)	2001	Work harrasment	Cámara Municipal de Ubatuba. (2001). Ley N° 2.120. Recuperado de http://www.assediomoral.org/spip.php?article227
	12.561 (Rio gde do sul)			Asamblea Legislativa de Rio Grande de Sul. (2006). Ley Complementaria 12.561. Recuperado de http://www.assediomoral.org/spip.php?article256

Venezuela	Art. 56.5 LOPCYMAT	2005	Psychosocial risks	Asamblea Nacional de la República Bolivariana de Venezuela. (2005). Ley Orgánica de Prevención, Condiciones y Medio Ambiente de Trabajo, Art. 56.5. Recuperado de http://www.medicinalaboraldevenezuela.com.ve/archivo/LOPCYMAT.pdf
			Work harrasment	
Perú	Decreto: N° 005-2012-TR.Ley N° 29783	2012	Psychosocial risks	Ley de Seguridad y Salud en el Trabajo. (2012). Modificación del Reglamente de la Ley N°29783 por Decreto Supremol N° 005-2012-TR. Recuperado de http://www.mintra.gob.pe/normaCompletaSNIL.php?id=3601
México	Supreme court articles	2012	Work harrasment	Coordinación de Derechos Humanos y Asesoría de la Presidencia/Suprema Corte de Justicia de la Nación. (2012). Manual de Buenas Prácticas para Investigar y Sancionar el Acoso Laboral y/o el Acoso Sexual en la Suprema Corte de Justicia de la Nación. Recuperado de: https://www.scjn.gob.mx/Documents/MANUAL%20DE%20BUENAS%20PRACTICAS.pdf
	Occupational health mandatory rules	2013	Psychosocial risks	
	Official Mexican Norms (in progress)	2015	Psychosocial risks	Secretaría de Gobernación. (2014). Reglamento Federal de Salud y Seguridad en el Trabajo. Recuperado de http://www.dof.gob.mx/nota_detalle.php?codigo=5368114&fecha=13/11/2014

unequal countries like France and Holland, also present a high prevalence of such disorders (18.4 % and 14.8 %) (Demyttenaere et al. 2004; Kessler et al. 2009).

With respect to mental health, it is necessary to point out that in all Latin American countries, mental or neuropsychiatric disorders are the most prevalent. Depressive disorders have been increasing across the globe, so much so that the WHO forecasts that by 2020, they will be the second leading cause of sick leave after complications such as heart attacks, coronary insufficiency or strokes. Mental problems are also an important cause of disability that we know is stress-related (DeVries and Wilkerson 2003;WHO and ILO 2000; Stansfeld and Candy 2006). For instance, a recent study by Kohn and Rodríguez (2009) indicates that neuropsychiatric disorders make a substantial contribution to the total number of life years lost or lived with disability in all Latin American countries, with estimated percentages ranging from 15,1 % in Bolivia to 30,5 % in Chile.

There are also considerable differences in the main causes of mortality between Latin America and other regions of the world. Compared to other countries of the American continent with different development conditions, such as the United States and Canada, among working-age people, ischemic heart disease causes less deaths in Latin America than in Canada and the United States (8,96 % vs. 13.12 % respectively). However, chronic problems such as diabetes, cerebrovascular disease and hypertensive diseases cause more deaths in Latin America than in the USA and Canada (3.27 %, 3.51 %, and 2.18 % respectively) (PAHO 2012). In fact, a recent comparative study undertaken by the OECD on diabetes among adults aged 20–79, shows that the only two Latin American member countries of OECD (Mexico and Brazil) occupy first and second place with the highest prevalence (15.9 % and 10.4 % respectively). Similarly, these countries have a 10-year lower life expectancy at birth than developed countries (73 years). Moreover, Mexico, in particular, occupies second place in terms of obesity at international level, only second to the United States (OECD 2013). The same survey shows that when comparing ischemic heart disease between countries, although Mexico doesn't present the highest death rate for this cause, it does show the greatest percentage of change in the trend from 1990 to 2011, which means that this disease seems to be increasing significantly in the region (OECD 2013).

Likewise, given that unhealthy lifestyle habits and work stress play an important role in their origin, non-communicable diseases may be a good indicator of the health of Latin American workers. As we can see in Table 11.2, the prevalence of non-communicable diseases, among them hypertension and type II diabetes in adults, varies notably between countries. Guatemala seems to be an extreme case in which all percentages are low, whereas Argentina, Chile, Mexico and Uruguay show higher statistics in general that are probably closer to those found in European and North American countries.

It is a well-known fact that not enough studies have been carried out to explain the difference in the prevalence of non-communicable diseases among Latin American countries and the rest of the world. We could speculate that the socially and culturally determined eating patterns may play a relevant role, given that Mexico, Argentina, Chile and Uruguay are among the countries that consume the

Table 11.2 Mortality according to age for all non-communicable diseases (NCD), percentage of deaths caused by them, and prevalence of hypertension and type II diabetes in Latin-American adults

Countries	Normalized mortality rate according to age for all NCDs (per 100.000 inhabitants in 2008)		Percentage of deaths caused by NCD	Prevalence of hypertension in adults (percentage)		Prevalence of type II diabetes in adults (percentage)	
	Men	Women		Men	Women	Men	Women
Central America							
Costa Rica	431	333	81	26	25	8	8
El Salvador	539	449	67	21	19	9	7
Guatemala	503	421	47	13	14	9	8
Mexico	543	412	78	32	31	20	
South America							
Argentina	613	366	80	32	33	8	10
Brazil	614	428	74	22	25	5	6
Chile	501	313	83	29	25	8	10
Colombia	438	351	66	28	19	3	2
Ecuador	434	336	65	43	35		
Peru	408	339	60	38	31		
Uruguay	651	378	87	33	31	6	5

Source: Adapted from Baldwin et al. (2013)

most calories per-capita in the region (Bermudez and and Tucker 2003). Despite the fact that it is not possible to make clear conclusions regarding the origin of such problems, these data are presented in this context because it is worth remembering that work stress has been associated not only with obesity but with unhealthy eating habits and low levels of physical activity as well as with both hypertension and type II diabetes (Roos et al. 2007; Devine et al. 2003; Kearney et al. 2004; Lowden et al. 2010).

11.5 Systematic Review: Studies Using the Effort-Reward Imbalance Model in Latin America

Within the context of the aforementioned precariousness of work conditions, over the last decade, some Latin American researchers have begun to think about the impact that these conditions could have on workers' health, especially in terms of chronic problems, mental health indicators or on their ability to work. We followed the method described below to characterize the studies that have used the ERI model and questionnaire to study work-related stress in workers in Latin America, and its impact on their health.

11.5.1 Methodological Strategy

The authors of this chapter followed two paths to identify the studies that could be included in this review. The first was to write to a number of Latin American colleagues that work in the field and ask them to send information on any studies they may have undertaken using the ERI model. The second, consisted in a literature search based on the following criteria:

1. Empirical studies published up to July 2015 in any peer-reviewed journal.
2. Studies undertaken involving populations from any of the Central or South American countries.
3. Studies that used the ERI model and its instrument for data gathering and interpretation.

The article search was undertaken using the following databases or indexes: Scielo, ISI, Redalyc, Scopus, Dialnet, Lilacs, Psicodoc, Pubmed. The key words used for the search were ERI, esfuerzo-recompensa, effort-reward imbalance, estrés laboral, job stress, factores psicosociales laborales, psychosocial working conditions, psychosocial risk factors.

The first search procedure allowed us to receive information on a large number of works, some of which are as yet unpublished, and others are in the process of being prepared for publication (for example, thesis work, and studies only presented at congresses). Our final decision was to limit ourselves, for this chapter, to articles that had been published in peer-reviewed journals or peer-reviewed chapters of books, in order to guarantee a minimum level of quality insofar as the studies we used. This decision also allowed us to be fair to all our colleagues, given that all those we did not contact directly or those that were not in the same networks as the colleagues we knew, would have otherwise had less chance of their work being identified.

Following the second search procedure, the authors of this article first carried out an independent search and then, together, confirmed the coincidences in their results. This procedure brought to light a number of studies and it allowed us to affirm that almost all the articles published and sent by colleagues that responded to our invitation were included in our literature search. Two studies, despite having been published, were not identified in the search as they had been included in a peer-reviewed book but not included in the consulted databases. We decided to include these articles in our review.

One of the studies identified had used the ERI as a model to undertake and interpret a semi-structured interview, but it did not use the ERI questionnaire (Tejada and Gómez 2009). This work was excluded, as it was not comparable to any other study.

Once the articles to be used as the object of analysis had been identified and located, they were described using the following criteria:

(a) Studies' country of origin.
(b) Authors and publication information.

(c) Sociodemographic information of the sample, region of origin within the country, participation rate.
(d) Version of the questionnaire used.
(e) Psychometric information of the instrument.
(f) Other models or questionnaires on work stress used simultaneously.
(g) Study goal.
(h) Study design.
(i) Main results.
(j) Health outcome related to ERI model
(k) Discussion.
(l) Contextualization offered for having used the ERI model.

11.5.2 Results

The search identified 46 articles published between 2008 and 2015; however, we also found that some of the publications (of Brasil and Chile) refer to the same sample, but report different health outcomes in different papers. Origins of the studies were Brasil (17 studies/25 publications), Chile (6 studies/7 publications), México (6), Colombia (3), Venezuela (2), Cuba (1), Perú (1), multiple countries (1).

The studies, in general, had three goals: (a) to validate the questionnaire (19.57 %), (b) to describe the prevalence of effort-reward imbalance in a particular group of workers (6.52 %) or (c) to relate ERI with a health outcome (73.91 %).

The most relevant information from the nine studies whose central purpose was to assess the psychometric properties of the ERI questionnaire is presented in Table 11.3. It describes the origin and size of the samples and the average values found for the factors that make up the instrument. Despite the variability in the samples size, ranging from 100 to 3010, and despite the different occupations included, the internal consistency of the ERI scales reported in these studies are, on the whole, satisfactory and comparable with those reported by studies of ERI in other countries. The different validity indicators (construct, content and convergent) showed adequate adjustment indices in all cases.

As a convergent validity criterion we considered it interesting to describe the coincidence in the ERI scores with those of the instruments that measure closely related concepts. A good number of studies (n = 16) assessed in their samples simultaneously the ERI and the Job Content (JCQ) questionnaires. However, only the studies carried out in Colombia reported correlations between the Job Strain indicator and ERI, reporting values of between 0.2 and 0.6, significant in all cases, except for one. The remaining studies pointed out that the prediction capacity of the considered health variables increased when taking into account simultaneously effort-reward imbalance and Job Strain.

The over-commitment scale was not assessed in any of the studies as a moderating variable of the impact of effort-reward imbalance on health, as suggested in the original model. The studies that measured this factor described its prevalence in

Table 11.3 Description of validation studies

References	Language	Sample Size	Sex	Occupations studied	City of origin of the sample	Averages (SD) of ERI factors	Alphas	Other results	ERI Version
Chor et al. (2008)	Portuguese	89	Women 55 %, men 45 %	White collar workers, nurses and nurses assistants	Rio de Janeiro (Brazil)	Effort 13 (3.9)	0.68	The exploratory factorial structure -AFE-,was fairly consistent with the model's theoretical components with some minor exceptions such as the overlap between "effort" and "overcommitment" scales and an independent contributionof job insecurity	23 items
						Reward 45.7 (7.4)	0.78		
						Overcom. 13.8 (3.6)	0.78		
Griep et al. (2009)	Portuguese	1509	Women 86,5 %; men 13.5 %	Nurses and nurses assistants	Rio de Janeiro (Brazil)	Effort 12.8	0.73	With reference to corrected item-total correlations, adequate performance was observed for most items. Overall, fit indices (of Confirmatory factorial validity -CFA-) for the ERI questionnaire were adequate. For the overcommitment scale, the best adjustment of the model was obtained when correlated errors between items were considered. (worst loading item: "work overtime")	23 items
						Reward 45.2	0.76		
						Overcom. 13.6	0.75		
Silva et al. (2010)	Portuguese	100	Women 38 %; men 62 %	Workers of a bank	Minas Gerais (Brazil)	Effort 12.43 (4.28)	0.70	Exploratory factor analyses were consistent with the factors of the theoretical model. Few ítems load in more than one factor. (Worst loading item: "physically demanding")	23 items
						Reward 39.22 (14.86)	0.95		
						Overcom. 13.64 (4.01)	0.86		

Ansoleaga et al. (2013a, b)	Spanish	3010	Women 49 %; men 51 %	Various	National (Chile)	Effort (no inf)	0.63	Confirmatory factor analyses (CFA) showed good structural adjustment (RMSEA = 0.054 and CFI = 0.98), and dose-response association between incremental exposure to the psychosocial dimensions of work and distress	Short version 10 items
						Reward (no inf)	0.74		
						Overcom. (no inf)			
Gómez-Ortiz (2010)	Spanish	1922	Women 53.5 %; men 46.5 %	Various	Bogotá (Colombia)	Effort 15.41	0.73–0.81	Exploratory factor analysis with varimax rotation showed three factors as the best solution. Correlation with JCQ (to test convergent validity) varied between 0.2 and 0.6 for different groups. The correlations with the health indicators (GHQ) of the Colombian samples, that test predictive validity, show that the scales of the ERI are positive correlated with the majority of the health indicators. (worse item loading: "easily relax and 'switch off' work")	23 items
						Reward 40.08	0.80–0.87		
						Overcom. 15.37	0.71–0.80		
Arias-Galicia (2014)	Spanish	346	Women 100 %	House wifes and women with an extra occupation	Cuernavaca (México)	Effort 13.32 (5.4)	0.84	Confirmatory factor analyses (CFA) confirmed the structure of the ERI questionnaire and correlations with mental health indicators, (self-esteem, self-efficacy, mental and physical health) were in the expected direction	23 items
						Reward 46.22 (8.4)	0.79		
						Overcom. 15.02 (3.3)	0.67		

(continued)

Table 11.3 (continued)

References	Language	Sample Size	Sex	Occupations studied	City of origin of the sample	Averages (SD) of ERI factors	Alphas	Other results	ERI Version
Camacho-Ávila et al. (2014)	Spanish	324	Women 48.8 %; men 36.4 %	Blue-collar	Cuernavaca (México)	Effort	0.90	The confirmatory factor analyses (CFA) confirmed the structure of the ERI questionnaire; Reliability levels were satisfactory. Design of response options were complicated for the participants. (Worse item loading: "easily relax and 'switch off' work")	Versión de 23 items
						Reward	0.82		
						Overcom	0.69		
Díaz and Feldman (2010)	Spanish	233	Women 75.3 %; men 23.3 %	Health workers (physiotherapist, psychologist, nurses, therapist, occupational therapist, dentists)	Caracas (Venezuela)	Effort (no inf.)	0.83	Exploratory factorial analyses confirmed three factors (effort, Reward and overcommitment) of the original model (worse item loading: "easily relax and 'switch off' work")	23 items
						Reward (no inf.)	0.87		
						Overcom. (no inf.)	0.57		
Juárez-García et al. (2015)	Spanish	1292	Women 57.4 %; men 42,6 %	Health workers	Various countries (Argentina, Chile, Colombia, México, Peru, Venezuela)	Effort	0.80	Overall confirmatory factor analyses (CFA) confirmed the theoretical structure of the ERIQ. The effort and overcommitment scales were invariant (equivalent) across the six countries, but the reward scale was not totally invariant. Several associations between ERIQ and mental health remain significant after controlling for sociodemographic variables	23 items
						Reward	0.86		
						Overcom.	0.73		

			Means	Effort	Reward	Overcom			
			Global N = 1292	14.00	42.81	13.37			
			Argentina N = 104	11.09	45.67	13.95			
			Chile N = 67	13.19	44.13	14.00			
			Colombia N = 294	15.34	44.47	14.44			
			México N = 322	13.7	44.03	12.96			
			Perú N = 175	12.71	41.09	13.37			
			Venezuela N = 330	14.9	40.45	12.35			

each sample and related it directly to the health outcome studied. However, this lack of testing the moderating effects of over-commitment is not a specific fact of Latin-American studies since it is commonly observed so far in international research on the model.

Out of the publications mentioned, 26 studies analyze the relationship between ERI and health or describe the prevalence of ERI. These investigations demonstrate a great deal of variability in the size of the samples studied, as can be seen in Table 11.4. One study assessed only 15 workers that were compared to a control group of similar demographic characteristics; 5 studies included samples of less than 100 workers (57–99 range); 15 studies involved between 100 and 1000 participants, and only 5 studies had samples between 1000 and 3010 participants.

Several samples had similar occupations, mostly nurses and health workers, (which was the case in 13 of the 26 studies), military personnel, teachers, and professional drivers. Other samples included people with different occupations, usually from the same company (bank, mining company, electrical company) but also from multiple companies. Only one Chilean study reported having used a national sample of salaried workers (3010 participants).

Another important characteristic of the samples is that they include a majority of women. Eighteen of 26 studies included only women, or women represented at least 75 % of the samples. Three studies included only men and in one study men were the majority (95 %). Five studies included more or less equal numbers of both sexes, and in one there is no clear information of the distribution.

Importantly, all the studies involved a cross-sectional design with the exception of two that were carried out in Brazil. The first of the two exceptions was a case-control study that included 385 participants, 160 cases (that required sick leave benefits for over 15 days after having been diagnosed with a "mental and behavioral disorder") and 225 controls (who took sick leave for other diseases). Women constituted 43.3 % of this group (Martinez et al. 2015). The second was a cohort study which related work stress with work ability carried out 3 years later that included 1022 participants in the first wave and in which 41.4 % of these participants responded to the second wave of questionnaires. The participants were all workers in a private hospital, of which 72.1 % were female (Silva-Junior and Fischer 2014).

The samples of the studies whose purpose was to determine the prevalence of ERI and/or it relationship to health outcomes (analytic studies) were selected fundamentally from Rio de Janeiro, Sao Paulo and Minas Gerais (Brazil); Santiago and a national sample (Chile), Cuernavaca, Xochimilco, León, Torreon and Mérida (Mexico), Bogota (Colombia), Caracas (Venezuela) and Habana (Cuba). Brazil has carried out the most studies (and has the most publications) using ERI. Twenty-nine of the publications (63 %) have been carried out in English, 14 (30.5 %) in Spanish and 3 (6.5 %) in Portuguese.

Most of the study designs are cross-sectional (44 of 46), and although this does not characterize only Latin American studies, the fact of this design does limit their contribution to clarifying the causal relationships between work conditions and health.

Table 11.4 Description of studies with interest on prevalence or relationships ERI-health indicators

References	Sample size	Occupation	Sex	Participation rate	Country	City	Health outcome	Alphas	Scales averages (standard deviation) and prevalences ERI: effort-reward imbalance
Fogaça et al. (2009)	57	Physician and nurses in two pediatric intensiv care units	Women 82.5 % men 17.5 %	50 %	Brasil	Sao Paulo	Quality of life	No information	Mean effort: 8.07 (2,70); mean rewards:13.4 (2.89)
Fogaça et al. (2010)							Prevalence among different health profesionals	No information	Mean effort: 8.16 (1.91) physicians at pediatric ICU; 8.25 (2.45) physicians at the newborn ICU. Mean reward: 13.08 (3.15) physicians at pediatric ICU; 13(2.45) physicians at the newborne ICU
Fischer and Martinez (2013a)	514	Nurses	Women 100 %	83.8 %	Brasil	Sao Paulo	Work ability	Effort: 0.74; reward: 0.83; overcom.: 0.73	Mean effort: 11.6 (3.7); mean rewards: 50.7 (4.9); mean overcom.: 12.3 (3.1); ERI: 0.8 %
Fischer and Martinez (2013b))	79	Food service professionals	Women 82.9 %; men 17.1 %	96.2	Brasil	Sao Paulo	Work ability	Effort: 0.73; reward: 0.81; overcom.: 0.78	Mean effort:11.8 (3.7); mean rewards: 50.3 (5.1); mean overcomm: 12.9 (3.6)

(continued)

Table 11.4 (continued)

References	Sample size	Occupation	Sex	Participation rate	Country	City	Health outcome	Alphas	Scales averages (standard deviation) and prevalences ERI: effort-reward imbalance
Griep et al. (2010, 2011)	1307	Nurses	Women 100 %	93.9	Brasil		Self-rated health	Effort: 0.73; reward: 0.76; overcom.: 0.75	Using tertiles: high effort: 25.9 %, low reward: 25.6 %, high overcommitment: 28 %
							Sickness absenteeism	Effort: 0.73; reward: 0.76; overcom.: 0.75	Using tertiles: hight effort: 32.3 %; low reward 34.5 %; ERI and overcom. Present: 17.3 %
Haikal et al. (2013)	752	Health workers (technitians, assistants, physician, nurses)	Women 80 % men 20 %	95	Brasil	Montes Claros	Prevalence among different health proffesionals	No information	ERI: 66.9 %; overcom.: 2.5 %
Martinez et al. (2015)	1022 (first wave); 423 (second wave)	Workers of an hospital	Women 72.1 % of the second wave;		Brasil		Work ability	No information	No specific information about prevalences or means
Martins and Lopes (2012; 2013)	506	Militars	Men 100 %	92	Brasil		Physical activity	No information	ERI: 12.6 %
							Common mental disorders	No information	Using tertiles: cases with CMD have low effort-high reward: 22 %; loow effort-low rewards: 35 %; high effort-high reward: 48 %; high effort-low rewards: 55 %

Rotenberg et al. (2014)	1122	Nurses, technicians and nurses assistants	Women 100 %	89.4	Brasil	Rio de Janeiro	Minor psychiatric disorders and recovery from work	No information	No specific information about prevalences or means
Silva-Junior et al. (2011, 2014)	1436	Nurses	Women 87.3 %; men 12.7 %	No information	Brasil	Rio de Janeiro	Work ability	No information	No information
	385 (160 cases and 225 controls)	No information	Women 43.3 %; men 56.7 %	No information	Brasil	Sao Paulo	Sickness absenteeism	Effort: 0.79; reward: 0.86; overcom.: 0.85	Cases ERI: 65.8 %; controls ERI: 34.2 %; ERI + overcommitment cases 58.1 %; controls 41.9 %
Silva et al. (2008, 2010, 2011)	696	Nurses	Women 87.8 % men 12.2 %	69.9	Brasil	Sao Paulo	Perceived health	No information	Mean overcom.: 14.03 (3.1); ERI: 7.8 %
							Work hours	No information	ERI: 7.8 %;
							Health related quality of life (perceived health)	No information	ERI: 7.8 %;

(continued)

Table 11.4 (continued)

References	Sample size	Occupation	Sex	Participation rate	Country	City	Health outcome	Alphas	Scales averages (standard deviation) and prevalences ERI: effort-reward imbalance
Silva and Barreto (2010a, 2010b, 2012)	2054	Employees of a bank. White collar or managerial positions	Mujeres 50 % Hombres 50 %	82.16	Brasil	National	Health related quality of life (perceived health)	Effort: 0.82; reward: 0.80; overcom.: 0.85	No specific information about prevalences or means
							Self-rated health	Effort: 0.82; reward: 0.80; Overcom.: 0.85	Using tertiles high ERI: 16.12 %; high overcommitment: 6.20 %
							Minor psychiatric disorders	Effort: 0.82; reward: 0.80; Overcom.: 0.85	No specific information about prevalences or means
Souza et al. (2012, 2011)	158	Various of the same electric company	Men 100 %	98.2 %	Brasil	Northeast of Brasil	Depression	No information	Using tertiles: high effort: 48.7 %; low reward: 60.1 %; high overcom.: 53.2 %; ERI:32.1 %: effort mean: 13.73 (5.07); reward mean: 46.54 (7.48); overcom. mean: 14.93 (2.15); ERI in depress workers 39.2 %; in non depress 8.4 %; 50 % of workers with ERI had mental disorders
							Common mental disorders	No information	

Teles et al. (2014)	762	Primary health workers	Mujeres 79.9 % Hombres 10.1 %	95.6	Brasil	Minas Gerais	Quality of life	Effort:0.76; reward: 0.73; Overcom.: 0.78	ERI: 24.6 %; overcommitment: 40.50 %
Ansoleaga and Castillo-Carniglia (2011))	77	Non clinical workers in a public hospital	Mujeres 46 % Hombres 54 %	Latitud decisional 0,90	Chile	Santiago de Chile	Depression, anxiety and psychotropic drugs	Brief scale; no information	ERI: 75 %
Ansoleaga (2015)	782	Health workers in a pediatric hospital	Mujeres 76.9 % Hombres 13.1 %	No information	Chile	Santiago de Chile	Depression, psychological distress and psychotropic drugs	Brief scale; no information	Effort: 51 %; low reward: 51 %; overcommitment: 41 %; ERI: 67 %
Ansoleaga and Toro (2010)	303	Random sample in a mine enterprise	Mujeres 5 % Hombres 95 %	No information	Chile	No information	Depression	No information	ERI: 33 %
Ansoleaga et al. (2013a, b, 2014)	3010	National sample	Women 49 % men 51 %	57	Chile		Depression	Brief scale effort: 0.63; reward: 0.74;	High effort: 28 %; low rewards: 45 %;(not explain how define low and high effort and rewards); ERI: 50 %
							Alcohol consumption	Brief scale effort: 0.63; reward: 0.74;	Effort: 28 %; low rewards: 45 %, ERI: 50 %

(continued)

Table 11.4 (continued)

References	Sample size	Occupation	Sex	Participation rate	Country	City	Health outcome	Alphas	Scales averages (standard deviation) and prevalences ERI: effort-reward imbalance
Canepa et al. (2008)	68	Health workers	Women 91.2 % men 18.8 %	No information	Chile	Santiago de Chile	Mental health	No information	Mean effort: 11.19 (3.76); mean rewards: 44.11 (7.38); ERI: 0.60 (0.31)
Cendales et al. (2014)	142	Professional drivers	Men 100 %	35.5	Colombia	Bogotá	Blood pressure and mental health	Effort: 0.74; rewards: 0.85; Overcom.: 0.71	Mean ERI: 0.484 (0.26); mean overcom.: 12 (3.2)
Gómez-Ortiz and Moreno (2009)	251	School teachers	Women 76.9 % men 23.1 %	95	Colombia	Bogotá	Blood pressure and mental health	Effort: 0.80; rewards: 0.80; Overcom.: 0.80	Mean effort: 17.6 (5.5); mean reward: 43.7 (8.7); mean overcom.: 18 (4.1); ERI: 22.3 %
Aguilar-Zavala et al. (2012)	290	No información	Mujeres 100 %	No information	México	León, Torreón, Mérida	Postmenopause symptoms	No information	No specific information about prevalences or means
Sánchez-Barajas et al. (2015)	100	Women at peri- and early postmenopause	Mujeres 100 %	No information	México	León	Indicators of artherosclerosis	No information	ERI mean: 0.33
Martínez-Alcantara (2013)	199	Faculty of an University	Mujeres 58 % Hombres 42 %	68	México	Xochimilco	Various psychosomatic disorders and fatigue	No information	Using median: high effort: 37 %, low reward: 33 %, overcommitment: 42 %

Tamez-González et al. (2012)	15	Computer workers	Women 86.6 %, men 13.4 %	No information	México	Xochimilco	Prevalence or levels of ERI in the sample	No information	On line department: mean effort : 12; mean reward: 18.2; mean overcom.: 9.57. Control department: mean effort:7.42; mean rewards: 30.66; mean overcom.: 7.16
Blanco-Gómez (2010)	339	Physiotherapist and occupational therapist	Women 77.58 % , men 22.41 %	No information	Venezuela	Caracas	Emotional work	Effort: 0.7; reward: 0.84; Overcom.: 0.62	Effort mean: 14.84 (4.35); reward mean: 40.41 (8.81); overcom. mean: 12.94 (3.24)
Lourdes-Marrero et al. (2008)	78	Health workers	Women 100 %	No information	Cuba	La Habana	Pregnancy complications	No information	Using tertiles: high effort: 29 %; low reward: 31 %; high overcom.: 42 %; High ERI: 36 %
Loli et al. (2014)	292	House wifes and women combinign home and other job	Women 100 %	No information	Perú	Lima	Various: perceived health, self-esteem, self-efficacy, disstres and family integration	Effort: 0.84; reward: 0.88; Overcom.; 0.61	Mean effort: 13.37 (5.49); mean rewards: 47.54 (8.46); mean overcom. 11.9(3.0); ERI: 0.17(0.142)

With only a few exceptions, the studies used the 23-item version of the ERI questionnaire and the two-step answer format. The exceptions are two Brazilian studies that reported having used the 46-item version (Fogaça et al. 2009, 2010), and the studies led by Ansoleaga (Ansoleaga and Toro 2010; Ansoleaga and Castillo-Carniglia 2011; Ansoleaga et al. 2013a, b; 2014, Ansoleaga and Castillo-Carniglia 2011) in Chile, using the short 10-item version.

The averages of some or all of the ERI scales are reported in only 11 of the 37 studies (see Table 11.5). We consider that not reporting the means of the scales is an important deficiency, given that it is the means that can most easily be compared between samples from different countries and groups (assuming that there is no differential item functioning-DIF.). To make possible any kind of comparison between studies, we summarize the ERI-data reported by them in Table 11.5.

As can be appreciated, the averages of the effort scale, that can range between 6 and 24, were between 8.07 (physicians and nurses in Brazil) and 17.6 (school teachers in Colombia). In general, the values for effort and reward are within the range of data reported by Siegrist et al. (2004) in various European countries, and the same holds true for over-commitment.

Eleven of the 37 studies reported prevalence rates indicating the percentage of people in the sample whose value of the effort and reward ratio is greater than 1. The values reported range from a low of 0.8 % to a high of 75 %. Prevalences of less than 20 % were mentioned in three studies (0.8; 7.8; 12.6); values between 25 % and 50 % were reported for three studies (22.3 24.6 and 33); and values between 50 % and 75 % were reported in five studies (50; 65.8; 66.9; 67; 75). It is worth pointing out that the lowest value reported corresponds to the study that used the 46-item version, and the highest corresponds to one of the studies that used the short version.

The prevalences obtained using tertiles were reported in only six studies. A couple of studies report data for high effort, low rewards or high over-commitment but they do not indicate the criteria used to decide what constitutes high and low levels, so their data are therefore not included here. The authors of these studies used the calculation of the tertiles to explore a dose-response relationships between the model components, the ratio between effort and reward and health indicators. The huge variability in the reported data leads us to think that not all the studies follow the same procedure to calculate their cut-off points, making the values difficult to compare.

The data above makes it appropriate to point out the need to encourage researchers in Latin America to always report the averages of each scale, prevalences and as much information as possible about all the procedures followed as well as about the reasons for not following the suggestions made by the original authors of the ERI scale, for example to use the ER-ratio either as continuous variable or as categorical variable based on the quartiles of the distribution. This would make it more feasible to carry out more informative comparative analyses.

ERI-related health outcomes in the analytical studies are described in Fig. 11.3.

Table 11.5 Analytic studies compared by the type of data reported (means, ERI prevalence or extreme tertiles)

Description of ERI variables	References	Effort	Rewards	Over-commitment	ERI	Country	Occupation
Mean and standard deviation	Fogaça et al. (2009)	8.0 (2.70)	13.4 (2.89)	–	–	Brazil/mostly women	Physicians
	Fischer and Martinez (2013a)	11.6 (3.70)	50.7 (4.90)	12.3 (3.1)	–	Brazil/women	Nurses
	Fischer and Martinez (2013b)	11.8 (3.70)	50.3 (5.10)	12.9 (3.6)	–	Brazil/mostly women	Food service
	Silva et al. (2008)	–	–	14.0 (3.1)	–	Brazil/mostly women	Nurses
	Souza et al. (2011)	13.7 (5.07)	46.54 (7.48)	14.9 (2.15)	–	Brazil/men	Various
	Canepa et al. (2008)	11.9 (3.76)	44.1 (7.38)	–	0.60 (0.31)	Chile/mostly women	Health workers
	Cendales et al. (2014)	–	–	12.0 (3.2)	0.48 (0.26)	Colomb./men	Drivers
	Gómez-Ortiz and Moreno (2009)	17.6 (5.50)	43.7 (8.70)	18.0 (4.1)	–	Colomb./mostly wom.	Teachers
	Sánchez-Barajas et al. (2015)	–	–	–	0.33	Mexico/women	No informat.
	Blanco-Gómez (2010)	14.8 (4.35)	40.4 (8.81)	12.9 (3.2)	–	Venez./mostly wom.	Therapists
	Loli et al. (2014)	13.3 (5.49)	47.5 (8.46)	11.9 (3.0)	0.17 (0.14)	Peru/women	Mixed

(continued)

Table 11.5 (continued)

Description of ERI variables	References	Effort	Rewards	Over-commitment	ERI	Country	Occupation
ERI prevalence using ratio >1	Fischer and Martinez (2013a)				0.8 %	Brazil	Nurses
	Haikal et al. (2013)				66.9 %	Brazil	Health workers
	Martins and Lopes (2013)				12.6 %	Brazil	Military
	Silva-Junior and Fischer (2014)				65.8 %	Brazil	No information
	Silva et al. (2011)				7.8 %	Brazil	Nurses
	Teles et al. (2014)				24.6 %	Brazil	Health workers
	Ansoleaga and Castillo-Carniglia (2011)				75.0 %	Chile	Non clinical workers
	Ansoleaga (2015)				67.0 %	Chile	Health workers
	Ansoleaga and Toro (2010)				33.0 %	Chile	Mine workers
	Ansoleaga et al. (2013a, b)				50.0 %	Chile	National sample
	Gómez-Ortiz (2010)				22.3 %	Colombia	School teachers
Extreme tertiles		High effort	Low reward	High overcomm	High ERI		
	Griep et al. (2011)	32.3	25.6	28.0	–	Brazil	Nurses
	Griep et al. (2010)	–	34.5	17.3 (+ERI)	–	Brazil	Nurses
	Martins and Lopes (2012)	–	–	–	55.0	Brazil	Military personnel
	Silva and Barreto (2012)	48.7	–	6.2	16.1	Brazil	White collar
	Souza et al. (2012)	29.0	60.1	53.2	32.1	Brazil	Various
	Lourdes-Marrero et al. (2008)		31.0	42.0	36.0	Cuba	Health workers

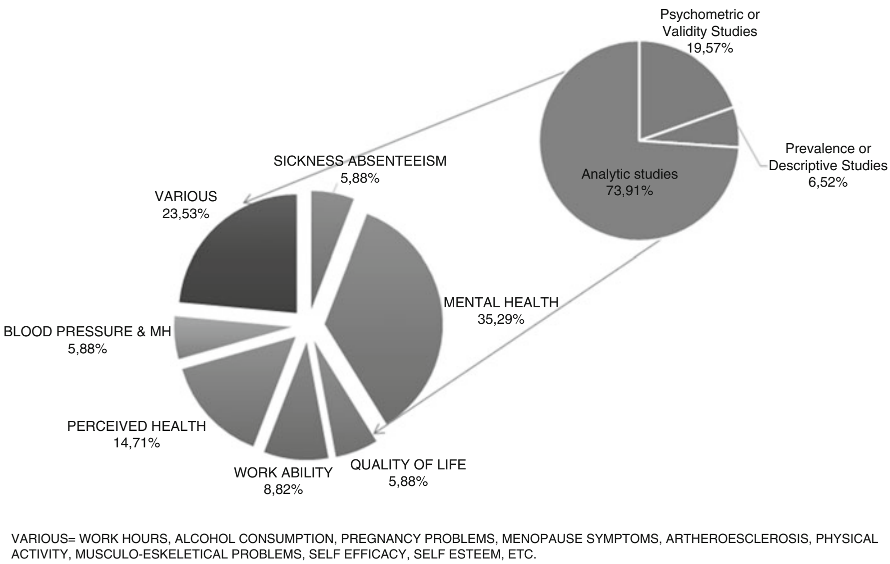

Fig. 11.3 Percentage of type of studies and health outcomes associated to ERI indicators in analytical studies

As we can see, mental health was the most evaluated outcome, followed by perceived health. In general, there is a lot of variability among the health indicators selected, and in the use of different strategies of coefficients for statistical analysis (Odds Ratios, Betas, Pearson coefficients, etc.). This makes it complicated to compare the relationships between ERI factors and each health outcome. All the outcomes showed a positive and significant relationship with the global indicator (ERI) and with each of its components, with the exception of blood pressure. Greater values on the ERI scales and a greater E/R imbalance are related to greater proportions of mental health problems, more depression, less work ability, lower quality of life, worse self-rated health, more mental disorders, alcohol and drug use, sick leave, menopause symptoms and fatigue, among others. It seems that the perception and reporting of these problems increases as levels of effort, over-commitment and E/R imbalance increase, and as perceived rewards decrease. Blood pressure could only be predicted when both ERI and Job Strain were used in conjunction. Considering the data on morbidity and mortality in Latin American countries, it is surprising that there aren't more studies that use cardiovascular problems, hypertension, diabetes, obesity and burnout (given their association to depression) as health indicators. The data described supports the idea that the ERI scale allows us to identify health risks clearly, but it could also indicate a possible publication bias.

11.6 Conclusions and Recommendations

The first important conclusion of this chapter is that the results of the research on work stress and its impact on health in Latin America reflect an early stage of scientific inquiry with clear methodological limitations. The subcontinent is lagging behind in terms of studying this topic, and this is reflected in a significant scarcity of research and in the fact that the existing publications have multiple limitations. The above is particularly true for studies that use ERI, but is not exclusive to research done with this model.

We believe that the main reasons for this scarcity of studies may include, on the one hand, the difficulty of obtaining funding and of having access to samples (especially large or national ones), which are closely related issues. On the other hand, we also consider the hindrances surrounding publishing in specialized high-impact journals.

Countries' economic problems together with professionals' and stakeholders' insufficient knowledge in terms of the models and the relevance of such studies are at the root of this scarcity. However, it is also fair to point out that many of the individuals that are interested in this problem do not enjoy the necessary conditions to be able to access much of the research published in international journals, many of them written in English. Researchers in different countries should consider to augment publishing and reading in different languages in order to increase the exchange and enrichment of everyone's knowledge and practice.

The difficulties highlighted may explain why most of the studies are concentrated in certain countries, cities, sectors or occupations. To overcome some of the problems, we would have to think about options such as establishing different types of alliances, perhaps with private advisors or state agencies, with researchers from different countries, or additional strategies can be imagined. It is important to increase the number and level of studies carried out in our subcontinent and to publish their results.

A number of other issues add to making publication difficult. One of them is that the editors of a number of recognized journals in this area are not aware of the gaps in regional knowledge, thus disregarding or rejecting respective reports submitted for publication, often labeling them as: "not contributing to existing knowledge". Furthermore, given the difficulties surrounding publication, there may be a substantial publication bias as researchers are likely to submit studies with positive findings.

Overcoming the limitations to the current studies will require research to improve in a number of ways, some of which we suggest here:

1. Most of the health indicators used in these studies were of a psychological nature and self-reported. It is necessary to increase the use of health and performance objective indicators (e.g. blood pressure) and to increase the size and occupational variability of the samples. These considerations refer to aspects that would increase our chances of more appropriately assessing the impact of work stress on health in the Latin American subcontinent. However, it also seems necessary

to use more complex designs including conducting longitudinal studies as well as utilizing advanced strategies for statistical analyses.

2. It is important to unify criteria in order to determine what should be considered a risk value in the work stress questionnaires (JCQ and ERI). For now, categorizations within each sample based on predefined scores (such as upper quartile of the score distribution) are used, but it is a well-known fact that these cut-off points are sample—related and are not defined on the basis of clinical evidence. Therefore, we don't yet know enough about how they are related to specific risks for concrete diseases. There is also a need to further explore the best form of analyzing the exposure variable, including the possibility that there exist nonlinear relationships between exposure and various outcomes, e.g. as has been found for job strain and blood pressure (Landsbergis et al. 1994).
3. It is important to complement the studies with the use of qualitative strategies. The theoretical models could be used as guides to carry out interviews and explore additional aspects of work or ones that are not totally described with respect to the work stress of different cultural and occupational groups. Additionally, when studying the stressful conditions of informal workers—that constitute practically half of the working population in various Latin America countries—they probably can't be studied using the questionnaire in its current form because questions typically refer to working conditions of formally employed workers. However, the theoretical model proposed by ERI and supplementing qualitative strategies could be used to explore psychosocial working situations not clearly described so far.
4. Insofar as the validity of the ERI questionnaire, the overall conclusion based on a review of all the studies is that its psychometric characteristics are satisfactory and that it is valid for use in the assessment of work stress here in Latin America as in other regions of the world. Nevertheless we highlight the need for more studies to further validate the ERI questionnaire using advanced psychometric measuring techniques such as confirmatory factor analyses (CFA), differential item functioning (DIF) or the demonstration of time-invariant stability of the ERI questionnaire, using pre- and post-test methodologies (Choi et al. 2014). A further challenge concerns the improved test of criterion validity in studies analyzing associations of ERI with health outcomes (especially those which are among the most important public health problems). In addition to controlling for socio-demographic variables further potential confounding variables need to be taken into account, specifically personality traits such as negative affectivity that affect the way people answer self-reported questionnaires.
5. The validity of the short ten-item ERI scale with the new one-step answer format and four response options (from totally disagree to totally agree) so far has only been analyzed in Chile. This new version has been improved psychometrically and it strengthens the response rate (Tsusumi et al. 2009; Siegrist et al. 2014). The previous two-step procedure of item response resulted in a reduced response rate in some studies, as also mentioned in some studies reviewed here.
6. Of the nine Latin American validity studies, three revealed an overlap of some items as evident from factor analyses. In fact, we also identified some items that presented low factorial loads and were problematic. In this context, at least four

of the nine validity studies identified the same problematic item of the scale 'over-commitment': "I can easily relax and 'switch off' from work." Future studies should clarify whether this problem reflects a methodological effect (as this is the only item that needs to be reversely coded), or whether the item fails to indicate the underlying theoretical construct. Moreover, it is worth highlighting that the only study that explored the factorial invariance of the ERI scales between six Latin American countries, found that the reward scale does not seem to be totally equivalent in all samples under study. This could imply that the cultural meaning of the different reward dimensions included in the model may not be identical in the region's different countries, even given that people speak the same language and have some further cultural communalities. Again, future studies should address this question (See Juárez-García et al. 2015).

Although the ERI model and its components are constructs based on the principles of social equity and are therefore assumed to have rather universal validity, the role of culture in the notions of the ERI model should be studied more thoroughly in the future. In particular, the meaning of obtaining rewards may vary among cultures (Kim and et al. 1990). Other studies have looked into the moderating role of cultural features such as collectivism/individualism on the effect of the rewards (Hui et al. 1991), an effect that was also verified in a Colombian study on the relationship between job strain and health (Cendales and Gomez 2013). Such cultural features related to the difference in the concept of reward have been studied in North American and other cultures such as the Latin-American, whereby for the former, success, personal achievements and hard work are important motivators in themselves, whereas for Latinos, the social benefit granted by work and its equilibrium with the family dimension seem to be the main sources of reward in the job (Díaz and Szalay 1993).

In conclusion, in view of the cultural differences mentioned specifically in the context of this research review in Latin America, and in view of the methodological limitations mentioned, more evidence on the relationship of effort-reward imbalance at work with major public health problems will be required.

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Part IV
Extensions Beyond Paid Work

Chapter 12
Failed Social Reciprocity Beyond the Work Role

Johannes Siegrist and Morten Wahrendorf

12.1 Introduction

12.1.1 Quality Criteria of a Theoretical Model

As mentioned above (see Chap. 1), a theoretical model is best understood as a heuristic device that selectively reduces complex reality to a set of components. Statements linking these components in terms of hypotheses are expected to explain or predict associations of real phenomena if tested empirically with appropriate methods. In almost every field of scientific inquiry several competing models have been developed, often reflecting concurrent theoretical paradigms of analysis. Competition between alternative or complementary theoretical models has been, and continues to be, part of the dynamics of scientific progress. It is nevertheless of interest to ask whether some criteria do exist that describe the quality of a theoretical model, thus providing ways of evaluating the relative strengths and weaknesses among competing models. In the context of social and behavioural sciences concerned with stressful experience and health at least the following four criteria can be applied.

First, the quality of a theoretical model is contingent on established quality criteria of its *measurement*, in particular its *reliability and validity*. Data derived from measurement approaches with limited validity or with an incomplete set of indicators provide a low degree of credibility. The difficulties of achieving valid

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measurements in the social and behavioural sciences in general, and in research on the effort-reward imbalance model in particular, were discussed in an earlier chapter of this book (see Chap. 2). Despite respective restrictions one can assume that applying the scales of the ERI questionnaire provides a satisfactory approach towards measuring the model, with satisfactory psychometric properties.

A *second* criterion concerns the *robustness of empirical evidence* in support of a model. Robustness depends on the level of evidence inherent in a respective study design as well as on the frequency and intensity of testing the model. Clearly, findings based on an experimental design are more convincing than those derived from observational investigations. Moreover, results of observational cohort studies are superior to those of case-control or cross-sectional studies, in particular if Bradford Hills criteria of causality in epidemiological research are met (Bradford Hill 1965). At least in biomedical and more general health-related research, there is a general agreement on this hierarchy of scientific evidence. Independent replication of findings supporting a model is a universal prerequisite of scientific credibility. More frequent replications go along with higher quality and acceptance of a model. The same holds true with respect to the quality of data. For instance, supplementing information restricted to statistical associations of work stress with health outcomes by data on psychobiological pathways explaining these associations augments the quality and utility of a theoretical model (see Chap. 7 for respective evidence). In all these cases it is important to observe the basic principle of falsification (Popper 1959). Accordingly, hypotheses have to be stated such that they can be refused by contradictory observations. Risky assumptions, if not falsified, have a higher probability of generating new knowledge than more conventional assumptions based on knowledge that is already available.

The *degree of generalization* of results attributable to a theoretical model can be considered as a *third* criterion of quality. For instance, the fact that the effort-reward imbalance model has been successfully applied to a range of stress-related disorders, rather than being limited to one health outcome (e.g. cardiovascular disease), is an argument in favour of its quality (see e.g. chapters in Part II of this book). In a similar vein, applying the model in working populations of different socio-demographic, socioeconomic, and socio-cultural background provides a strong case of its credibility (see e.g. chapters in Part III of this book). A different way of evaluating generalization refers to the type of outcomes predicted by the model. So far, indicators of health, functioning, well-being, and health behaviours were the exclusive outcomes. Yet, some findings demonstrate that distinct behavioural outcomes are predicted by the model's hypotheses as well. Short-spell episodes of absenteeism, not necessarily related to health (Peter and Siegrist 1997), scientific misbehaviour (Martinson et al. 2006), participation in voluntary work during retirement (Wahrendorf et al. 2015) or driving anger (Hoggan and Dollard 2007) are examples of such extensions.

A *fourth* criterion of quality of a theoretical model concerns the *parsimony of its statements*. Parsimony refers to the degree of abstraction inherent in the models' hypotheses. In case of the ERI model, its hypotheses so far were restricted to the context of employment contracts involving paid work. It is possible to conceptualize this model in terms of a higher degree of abstraction, by extending its predictions to types of costly social transactions beyond paid work. Years ago, in an editorial to the Journal of Psychosomatic Research, this extension was proposed by asking whether "we find evidence of adverse effects on health produced by lack of reciprocity in other core social roles" (Siegrist 1998, 103). Meanwhile, several such extensions have been developed, and their description defines the content of this chapter as well as the content of the following chapter. If successfully applied these extensions document a higher degree of parsimony of the model as its predictions are defined at a higher level of abstraction. High effort in combination with low reward is expected to increase the risk of poor health not only in case of paid work, but also in role-based unpaid activities conferring some utility, such as voluntary work, care of a family member, informal help, or home making. This extension opens a window to study costly social transactions and their effects on health in a life course perspective, specifically beyond employment age, as will be documented in later parts of this chapter.

12.1.2 Wider Explorations of the Principle of Social Reciprocity

Social reciprocity must be considered a universal element of interpersonal exchange rooted in human evolution (Cosmides and Tooby 1992; Gouldner 1960). Some theories claim that it acts as a driving force in other living species, either as a strategy among genetically close individuals to perpetuate one's genes (Hamilton 1964) or as a principle of natural selection, favouring cooperative behaviour among non kin group members with a high propensity of continued exchange (Trivers 1971). Yet, in human life, social reciprocity serves essential functions, such as building trust through altruistic action (Fehr and Fischbacher 2003), enforcing contracts (Fehr and Gächter 2000), or enhancing cooperation in the absence of direct control (Gouldner 1960). Given this far-reaching significance it is assumed that violation of this principle elicits strong negative emotions of anger and disappointment among those who invested their efforts without receiving the anticipated benefits in return. This is due to the frustration of basic expectations of equivalence of return in costly transactions. If experienced recurrently failed reciprocity in significant areas of social exchange may have a profound impact on human health and wellbeing, compromising one's self-esteem and arousing sustained autonomic and neuroendocrine stress reactions within the organism (see above Chaps. 1 and 7).

The *imbalance between effort spent* ('high cost') *and reward received in turn* ('low gain'), experienced recurrently in a core social role of adult life, the *work role*, defines the core assumption of the ERI model. It has been described in more detail in Chap. 1 of this book. In keeping with the proposition that this model can be applied to other types of costly social transactions one has to take into account the strengths and weaknesses of such an extension. As mentioned, in terms of scientific inquiry, a higher level of abstraction is achieved, thus allowing a parsimonious explanation of a broader spectrum of interpersonal exchange and its effects on health and wellbeing. This must be considered a particular strength. However, effort-reward imbalance at work contains some unique features that compromise its strict comparability with other types of costly transactions (Knesebeck and Siegrist 2003).

First, in *role-based exchange other than contractual employment*, the constraints of demands are often less pervasive and less explicitly defined, and the same holds true for sanctions provided in case of deviant behaviour. Second, the nature of reward differs as there is usually no place for salaries, wages or other types of financial incentives in non-economic productive activity and exchange. This is important as wages and salaries define an essential prerequisite of decent living conditions for major parts of a population. Third, the life time of most types of recurrent costly transactions in a non-economic context is significantly shorter than in case of paid work which usually covers several decades of a person's life course. Despite these differences, there is substantial communality of *social reward deficiency* shared by those who incurred high 'costs' with no or low 'gain' in return, whether experienced within paid work or in other types of costly social transaction. To answer the question of whether adverse effects on health are expected to result from experienced lack of reciprocity in other core social roles, several *extensions of the original ERI model* were developed more recently.

A *first development* concerns *close social relationships*, suggesting that non-reciprocity of exchange between couples, whether married or co-habiting, contributes to reduced mental health and wellbeing. A similar association is expected if efforts and rewards between parents and children are unbalanced. The following *section* summarizes the findings from five studies conducted so far to test this association. The first investigation was conducted in two elderly samples of men and women in Germany and in the United States of America (Knesebeck and Siegrist 2003), and the second one in a middle-aged occupational group in Germany (Knesebeck and Siegrist 2004). Importantly, these associations were further explored in the frame of the British Whitehall II study (Chandola et al. 2007), and in the baseline survey of a cohort study of an early old age urban population in the Ruhr area of Germany (Knesebeck et al. 2009). Finally, the French Gazel study offered an opportunity to analyse the research question in a different socio-cultural context (Wahrendorf et al. 2010).

A *second extension* relates to the notion of failed reciprocity in major types of *socially productive activities*, excluding paid work. These types include *voluntary work*, *caregiving*, *and providing informal help*. The authors of this chapter have taken the lead of this development, and several reports on associations with mental health and wellbeing were produced in the frame of longitudinal ageing studies in Europe, specifically the Survey of Health, Ageing and Retirement in Europe (SHARE) (Wahrendorf et al. 2006; Wahrendorf 2009; Siegrist and Wahrendorf 2009; Siegrist and Wahrendorf 2010), the English Longitudinal Study on Ageing (ELSA) (Wahrendorf 2009; McMunn et al. 2009), and the French Gazel Study (Wahrendorf et al. 2008). Major findings are presented and discussed below, preceded by an outline of the conceptual framework of social productivity (Siegrist et al. 2004).

Third, a major type of unpaid work, *household and family work*, has been studied in terms of the ERI model, where a psychometrically validated questionnaire was developed by a team at Hannover Medical School (Sperlich et al. 2012). This important area of recent research is described and discussed in more detail in the following chapter, addressing the specific burden of women's engagement in household and family not only as an additional social role beyond work, but also as a specific type of labour (Sperlich et al. 2013).

Finally, the ERI model has been applied to the context of *school work of adolescents*, suggesting that perceptions of social reward deficiency are frequent in psychosocial school environments where students' efforts may not be adequately appreciated by teachers and where unfair exchange among class mates may occur. Again, a specific questionnaire has been developed and applied in a variety of investigations (Li et al. 2010), and respective information is provided below. The chapter ends with a discussion of these theoretical extensions and some concluding remarks.

12.2 Socially Productive Activities

12.2.1 The Concept of Social Productivity

In modern societies, the work role is considered the leading model of social activity, given its crucial significance for maintaining employment and economic growth and for securing the working person's continuous income and social status. Yet, other types of role-based social activities do exist, such as volunteering or charity work, caring for a sick or disabled person, informal help, or civic engagement. Although these types of activity are less often embedded in formal contracts and are characterized by lack of monetary rewards they share some communality with paid work and employment that is best defined with reference to the notion of social productivity. 'Productivity' is mainly used in economics to describe the value and utility of goods or services generated on the basis of paid work, where optimal cost-benefit relations are of interest. By extending the term to include non-economic costly transactions, *social productivity* was defined as "any agreed-upon continued activity that generates goods or services that are socially or economically valued by the recipient(s), whether or not based upon a formal contract" (Siegrist et al. 2004, pp. 3f). Inherent in all types of social productivity is the fact that they provide *dual utility*. For individuals acting in these role-based activities utility manifests itself in the experience of material or non-material rewards (being 'valued' for goods or services), and for the partners of persons acting in these roles, or for the broader society, the utility consists in sharing the outcomes of respective activities. Socially productive transactions between providers and recipients are based on the norm of social reciprocity, where any action or service provided by person A to person B that has some utility to B is expected to be returned by person B to A, meeting some agreed-upon standard of equivalence (Gouldner 1960).

Obviously, in non-economic productive transactions *non-material rewards* are prevailing. To better describe these non-material rewards a reference to theories of *personal need satisfaction* may be helpful. According to Maslow (1943), Doyal and Gough (1991), and others (Bowlby 1969; Lindenberg and Frey 1993; WHO 2008), some fundamental, widely prevalent personal needs cannot be met without a continued exchange of individuals with their proximal social environment. Beyond biological reproduction and social affiliation, these needs include the development and reinforcement of personal autonomy through goal-oriented activities of an agentic self and an associated striving for recognition and appreciation from significant others. Need satisfaction in terms of autonomy is experienced as self-efficacy (Bandura 1997), whereas need-satisfaction in terms of recognition is experienced as self-esteem (Pearlin 1989). In accordance with these theoretical assumptions, we expect that non-material rewards in unpaid socially productive activities are mainly experienced in terms of enhanced self-efficacy and self-esteem, although distinct motivations, such as altruism or sense of obligation may matter as well. The recurrent co-manifestation of these two types of personal benefit resulting from providers' productive activity, i.e. feelings of mastery and personal control and feelings of appreciation and self-worth, exerts positive effects on health and wellbeing as these feelings are paralleled by neuroendocrine and immune responses that preserve and protect health and that activate reward-sensitive structures in the brain (Henry and Stephens 1977; Rolls 1999). Conversely, being confined to provide productive activities which offer little or no experience of autonomy/personal control, and which prevent the experience of reward/recognition due to failed reciprocity result in the providers' poor wellbeing.

In consequence, our *hypothesis* maintains that experienced reciprocity in socially productive activities is associated with enhanced wellbeing and mental health, whereas a reverse effect is expected in cases where providers' exchange expectancies are not met. This hypothesis has been tested in several studies addressing voluntary work, caring and informal help, as demonstrated in the next section.

12.2.2 Voluntary Work, Caregiving, and Informal Help

A large European study, the Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan et al. 2013), offered an excellent opportunity of testing this hypothesis among people in early old age. Among these *older people*, the socio-emotional consequences of *socially productive activities* may be particularly relevant, because options of agency, control and reward resulting from core social roles, such as the work role, are becoming less frequent and less pronounced. If this *loss* is *replaced* (*or compensated*) *by* some *non-economic productive activity*, the socio-emotional consequences may be preserved to some extent.

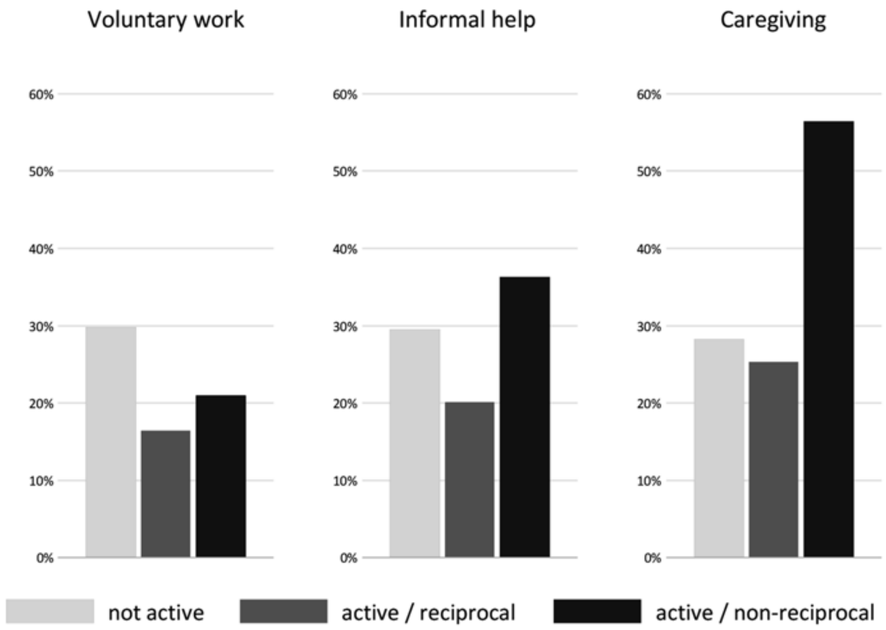

Fig. 12.1 Percentage of persons with high depressive symptoms by participation in three socially productive activities and their quality (Based on SHARE wave 2, n = 33,210, own calculations)

As part of the first wave of data collection in SHARE (conducted 2004 in ten European countries) more than 22,000 participants aged 50 and older were asked about their participation in these three activities. Importantly, in addition to information about whether or not people participated in each one of these activities, the *quality of the engagement* in terms of *experienced reciprocity* was assessed. Several findings are worth noting from this study (Wahrendorf et al. 2006). First, results show that in a majority of cases, being socially productive is characterized by experienced reciprocity of exchange, whereas failed reciprocity is still experienced by a sizeable minority of providers. Second, with the exception of caregiving, mean level of wellbeing is higher among those who are socially productive than among those who are not engaged. However, in case of volunteering and informal help, only those who felt rewarded exhibited significantly higher levels of wellbeing (in terms of quality of life or absence of depressive symptoms (as measured by the CESD scale) compared to those who were not active.

Similar findings were observed in a replication study based on cross-sectional data from the second wave of SHARE, collected in 2006. Figure 12.1 demonstrates that the prevalence of depressive symptoms (assessed by the EURO-D scale in this wave) is higher among those who are not engaged in a socially productive activity than those who are engaged while being rewarded for their activity (i.e. the majority). However, the minority of older men and women whose engagement is not reciprocated (black columns) suffer from depressive symptoms more often than the majority. This difference is particularly striking in case of caregiving.

Concordant results were found on the basis of longitudinal data from the first two waves of SHARE, where participation in the three activities was associated with changes in quality of life over time (Siegrist and Wahrendorf 2009). Here we observed that participants with reciprocated engagement in volunteering and informal help at baseline exhibited significant improvements in their quality of life at follow up, after adjusting for the effects of baseline quality of life. A replication of main findings of SHARE was conducted in the frame of another study on ageing, the English Longitudinal Study of Ageing (ELSA), using cross-sectional (McMunn et al. 2009) and longitudinal data (Zaninotto et al. 2013). In both instances analyses focussed on voluntary work and caregiving in relation to different measures of wellbeing. In the case of cross-sectional analysis, those who felt adequately rewarded for volunteering or caregiving had better wellbeing (in terms of quality of life, life satisfaction and low depressive symptoms) than those who were not participating, while those who did not feel rewarded did not differ from non-participants. Similar results were also found in the longitudinal analysis. As this latter analysis was conducted for men and women separately, the study also revealed that longitudinal associations may differ between men and women. For example, in this study experienced non-reciprocity in caring was linked to lower prospective well-being among men, but not among women, thus pointing to gender-role differences in coping with failed reciprocity in caregiving.

In sum, the studies exploring socially productive activities among older persons and their association with wellbeing enrich the current state of the art in this field in at least two important ways. First, they demonstrate that the model of effort-reward imbalance contributes to an elucidation of the pathways linking socially productive activities with health and well-being, specifically by focusing on the *socio-emotional benefits resulting from reciprocated engagement*. Second, by distinguishing between three types of productive activities and the level of reciprocity, the studies underlined that some activities (in particular caregiving) are more likely to be stressful due to an increased probability of experiencing a continued unrewarding social exchange. In this latter case, interventions may be needed to strengthen the experience of recognition and reward.

12.3 Close Social Relationships

Close social relationships in marriage, partnership, friendship, and between parents and their children are characterised by a distinct quality and intensity of emotional exchange, trust, and cooperative engagement. Weighing ‘costs’ against ‘gains’, a dominant principle of rational choice in economic life, has no major role in these types of exchange that are defined by affection, appreciation, and altruism. Yet, as far as these relationships are manifest as social roles with mutual obligations in daily life, lack of symmetry between ‘give’ and ‘take’ in dyadic relationships may matter as well. It is therefore of interest to explore *non-symmetric dyadic exchange* in the social roles of *marital couples or partners*, of *parents* and their *children*, and eventually of further *trusting relationships*.

Again, as mentioned before, there is no external party to exert control over demands or to reward accomplished tasks, and the informal, private nature of exchange prevents public visibility and social comparability of these types of exchange. Despite these limitations subjective experiences of unfair, unbalanced exchange, of recurrent disappointment, or even of severe life events, such as broken promise, deception, or unfaithful behaviour, may exert sustained negative emotions and stress responses among disadvantaged partners. In an attempt to grasp some of this perceived unbalanced exchange the measurement approach of the original ERI model was modified to be applicable to these types of dyadic exchange. In more detail, a questionnaire representing a three-factorial structure was developed, based on eight Likert-scaled items. A first scale, composed by three items, relates to marital or partnership life, a second scale measures some aspects of exchange between parents and children (three items), and a third scale addresses severe relational life events in other, non-specified close social relationships (two items). This questionnaire was included in four different studies, and a fifth investigation applied an even shorter version of this questionnaire. Main findings of these studies are summarized in the following sections.

It is important to mention that former social epidemiological research on close social relationships has largely focused on the concept of social support (Berkman and Glass 2000). Is lack of reciprocal exchange adequately represented in established measures of negative social support? If so, any additional measurement development would seem useless. To answer this question, studies linking reciprocity in close social relationships with health and wellbeing included validated instruments of social support as confounding factors. In three studies, a scale assessing the availability of a close confidant and the perceived adequacy of received emotional support was applied (Seeman and Berkman 1988), and in one study, negative social support was measured by four items from the Close Person's Questionnaire (Stansfeld and Marmot 1992).

12.3.1 Associations with Depressive Symptoms

Given their less pervasive, less intense nature of demanding efforts, compared to those related to paid work, efforts spent in close relationships are commonly expected to activate the organism's stress axes less extensively than is the case in employment contracts, perhaps with the exception of a heavy burden of homemaking and family work. As a consequence, a limited amount of 'wear and tear' of the organism's peripheral physiological systems may occur, and the 'allostatic load' resulting from continued stress in these systems is assumed to result in less severe impact on end organ damage, such as coronary artery disease or metabolic disease (McEwen 1998). Rather, social reward deficiency in close social relationships is expected to affect brain reward circuits with direct impact on mood, energy, and functioning. Therefore, as depressive symptoms and impaired cognitive, emotional and interpersonal functioning are expected to result from these negative experiences, *indicators of reduced mental health* have been selected as health outcomes in respective studies.

The first investigation studying associations of failed reciprocity in close relationships was conducted in two elderly samples of men and women in Germany and in the United States of America (Knesebeck and Siegrist 2003). One aim of this study was to test the newly developed questionnaire by confirming its three-factorial structure in the two samples of several hundred German and American participants. As a second aim, associations of effort-reward imbalance in these relationships with depressive symptoms were analysed in a cross-sectional design. It turned out that significantly elevated levels of depressive symptoms were observed in almost all analyses, after taking into account gender, age, socioeconomic position, and negative social support.

Whether this result obtained from old age samples can be generalized to adults in midlife was subsequently explored in two investigations in Germany, a cross-sectional survey of employees of a public transport company (Knesebeck and Siegrist 2004), and the baseline survey of a large cohort study on cardiovascular health in urban populations (Knesebeck et al. 2009). Both studies replicated the three-factorial structure of the questionnaire and found significant associations with *elevated risks of depressive symptoms* with regard to *partnership and severe disappointment in other close relationships*, but less consistent results with regard to children. Interestingly, in gender-stratified analyses, the associations with failed reciprocity in partnership were much stronger in women than in men. Again, all findings persisted after adjusting for the confounders mentioned, including negative social support and negative affectivity.

12.3.2 Associations with Other Health Indicators

Two further studies tested this hypothesis with additional indicators of reduced health, the first one being the British Whitehall II study (Chandola et al. 2007) and the second one the French Gazel study (Wahrendorf et al. 2010). In phase 7 of the longitudinal British study on civil servants (2002–2004), the three scales measuring reciprocal exchange in close relationships were applied together with a set of self-reported health measures. These latter were defined as physical and mental functioning, sleep disturbances, self-rated health, depressive symptoms, and angina pectoris. Data on age, sex, socioeconomic position, social network, negative social support, prior health, and health-damaging behaviours were included in multivariable analyses as confounding factors. In final analyses, associations with indicators of mental health and sleep disturbance were more consistent than with the remaining health indicators. It also turned out that non-reciprocal exchange and negative social support were moderately correlated, suggesting that part of the former association was mediated by negative social support (Chandola et al. 2007).

Mental and physical health functioning and self-rated health were also selected as indicators in analyses performed in the frame of a further cohort study, the French Gazel study. For the first time, the hypothesis of an association of perceived reciprocity in social exchange with health functioning was tested in a prospective study design as data on social relationships were collected in 2005 and data on health 2 years later, adjusting for self-rated health in 2005 (Wahrendorf et al. 2010). In this investigation, a short version of the questionnaire was applied, measuring reciprocity in participants' main activity, in partnership, and in other close social relationships with five Likert-scaled items. The Gazel cohort consists of a large sample of employees of the French National Electricity and Gas Company followed since 1989 (Goldberg et al. 2007). In 2005, a majority of the 8679 men and 2742 women participating in this study were retired. The frequencies of reported non-reciprocal exchange in respondents' main activity, in partnership and in other trusting relationships were 31,2 %, 18,5 %, and 26,8 % respectively, with a higher prevalence among women and among people with lower socioeconomic positions. After adjusting for age, sex, socioeconomic position and self-rated health at baseline significant effects of all three types of non-reciprocal exchange on mental functioning and self-rated health were observed, with no noticeable differences between men and women. Associations with physical functioning were somewhat less strong and less consistent (Wahrendorf et al. 2010). Despite some limitations the findings of this study support the notion that perceived non-reciprocity in three different types of social exchange in early old age goes along with prospectively observed reduced mental health functioning and self-reported health.

In summarizing the results of all five studies conducted so far, we can conclude that *balanced exchange between efforts and rewards in cooperative close social relationships* is *important for mental health and wellbeing*. So far, this aspect of social exchange has not been elucidated to a sufficient extent in mainstream research on social support and social networks. This conclusion results from the observation that significant associations of non-reciprocity with health were maintained in multivariate analyses after controlling for measures of social support. The consistency of findings across different age groups and populations from four different countries is remarkable in view of the modest operational measurement of quality of exchange in close social relationships, as well as in view of the inclusion of a comprehensive set of confounding factors. Therefore, this line of research offers opportunities for more in-depth exploration in future analyses.

12.4 Perceived Non-reciprocity in School Work

A most recent extension of the theoretical model of effort-reward imbalance concerns school work. Several studies documented unfavourable effects of adverse material and psychosocial school environments on the performance and wellbeing of children and adolescents in both Western and Asian countries (Torsheim and Wold 2001; Verma et al. 2002). Despite obvious differences between school and work settings it is of interest to explore to what extent work-related models of an adverse psychosocial environment can be applied to the school context. One such extension was conducted with the demand-control model in a cross-sectional study in Sweden (Gådin and Hammarström 2000). In 2010, a first test based on the ERI model was conducted in a sample of several hundred male and female adolescents (mean age 15,8 years) in the Chinese city of Kunming (Li et al. 2010).

To this end, the original questionnaire was adapted to the school setting where 5 items measured ‘effort’, 11 items assessed ‘reward’, and 3 items represented the intrinsic component ‘over-commitment’. Scales means were computed, and sex- and grade level-differences were explored. Item-total correlations and Cronbach’s alpha were calculated, and the factorial structure of the questionnaire was analysed, using exploratory and confirmatory factor analysis with calculation of goodness of fit indices. The psychometric properties of these scales were satisfactory rather than excellent, but were confirmed in an independent larger sample (Guo et al. 2014). In this first study it was of interest to demonstrate *associations of a perceived imbalance* between efforts spent and recognition or esteem received from significant others (teachers, school mates) *with a measure of self-reported health*. Although vulnerable to common method variance, the findings revealed strong associations with poor self-rated health, more so among girls than boys, and more so in high school than in middle school. Effects persisted after controlling for age, grade level, health behaviours and family wealth.

In a second publication based on the same sample associations of a stressful psychosocial school environment, as measured by this questionnaire, with the frequency of suicidal ideation were analysed (Shang et al. 2014). It was assumed that recurrent experience of failed reciprocity at school may impair the students’ self-esteem, thus rendering them more susceptible to thoughts of engaging in suicide – related behaviour. Studying this question in a Chinese school population is of special interest as China turned out to be one of the countries with highest levels of pressure and competition with regard to academic success (Sun et al. 2012). This is not surprising given the high expectations raised about their children’s academic success by parents in the context of a national one-child policy. In this survey, about 11 % of adolescents reported that they thought about suicide every month or more often during the last 6 months. *Odds ratios of suicidal ideation* were significantly *elevated among those reporting high effort or low reward at school*, and were highest among those suffering from the imbalance, as measured by the effort-reward ratio (Shang et al. 2014).

Social inequalities in health are not only a major challenge in adult life, but also among adolescents (Viner et al. 2015). In an even larger survey of Chinese adolescents conducted in the city of Zhengzhou Guo et al. analysed a moderating role of family socioeconomic position (SEP) in associations between a stressful psychosocial school environment and depressive symptoms (Guo et al. 2014). The main finding of this study is illustrated in Fig. 12.2. A significant interaction term was observed between school-related stress and family SEP. When joint effects of

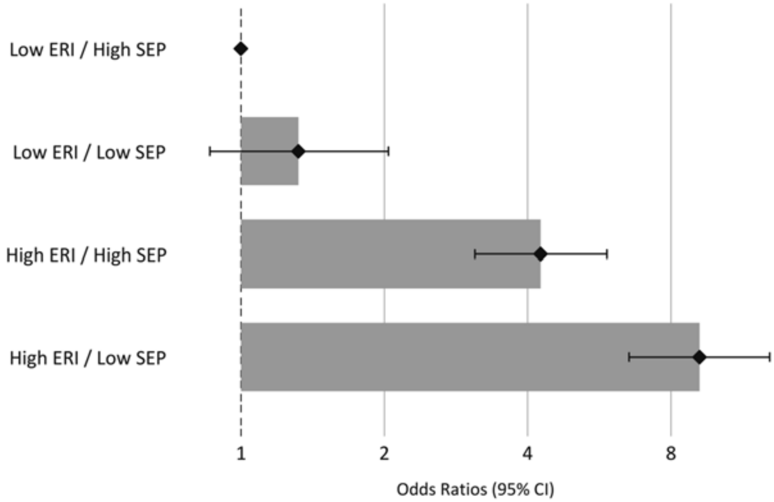

Fig. 12.2 Associations of school-related stress and family SEP with depressive symptoms. ORs and 95 % CIs, adjusted for age, sex, educational grade and health behaviour, n = 1774 (Based on (Guo et al. 2014), own visualization)

school-related stress and family SEP on depressive symptoms were estimated the odds of experiencing depressive symptoms in the most disadvantaged group (high school stress and low SEP) were about nine times as high as the odds of the most privileged group (no school stress, high SEP).

The finding that associations of school-related stress in terms of the ERI model were particularly strong among disadvantaged adolescents in this large urban sample of Chinese students deserves further consideration. It is likely that parents in socioeconomic disadvantaged circumstances are less capable of providing the material and psychosocial means for their children to develop efficacious resources of coping with challenges and threats at school, thus rendering them more vulnerable towards developing depressive symptoms. If the notion of a social gradient of reduced mental health in adolescents within a rapidly developing country of considerable global significance is further supported preventive efforts of strengthening mental health at school should be developed, directed primarily towards socioeconomic disadvantaged groups.

In summary, preliminary evidence demonstrates that the ERI model is successfully applied among adolescents in the context of school work and is associated with relevant indicators of mental health. Meanwhile, applications in other countries were conducted as well (Laftman et al. 2015; Fukuda et al. 2010). More recently, an attempt was made to measure effort-reward imbalance among university students, and psychometric properties of a respective questionnaire were analysed in a sample of first year medical students in Germany.

12.5 Concluding Remarks

In this chapter, we described possible quality criteria of a theoretical model and explored one of the criteria, parsimony. According to this criterion the strength of a theory is contingent on the breath of explanations or predictions derived from a minimal set of statements. We observed that the same small set of hypotheses that predicted work-related stress and disorders are associated with poor health in non-economic productive activities, in costly transactions occurring in close social relationships, and in effortful school work. While this evidence supports the generalization of the ERI model beyond paid work, some *limitations* become obvious as well.

First, the range of predicted health outcomes was more narrowly defined, bound to indicators of mental health and wellbeing. Moreover, few findings only are derived from prospective observational cohort studies, thus preventing the analysis of causal relationships, and additional experimental or naturalistic studies exploring potential pathways were not performed. A further limitation concerns the measurement of the model's components. For instance, reciprocity in socially productive activities was assessed by a summary indicator rather than by a psychometrically validated questionnaire Therefore comparisons across studies are limited, and the full set of hypotheses could not be tested in all cases. Yet, the fact that the proposed extension of a theoretical model was supported by significant associations with reduced mental health in almost all cases is considered a particular strength. Furthermore, results were obtained from populations representing different age groups, including the periods of adolescence, midlife, and early old age. Finally, rather than being derived from a sample of respondents recruited from one country, the findings resulted from a variety of socio-cultural contexts in different parts of the world (USA, China, and various European countries).

Social inequalities in health and wellbeing define a cross-cutting issue of concern that has only partly been analysed in these non-economic transactions. However, in case of volunteering, we observed a social gradient of participation, with higher frequency among people in more privileged socioeconomic positions. Quality of life was significantly worse among those with lower educations and income, in addition to the adverse effect resulting from perceived non-reciprocity when performing voluntary work (Siegrist and Wahrendorf 2009). Similarly, perceived effort-reward imbalance at school was more frequent among adolescents with disadvantaged socioeconomic background in China, and associations with depressive symptoms were particularly strong in this group. As a consequence, the findings reported in this chapter call for distinct policy interventions. These implications will be discussed in the three final chapters of this book.

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Chapter 13
Household and Family Work and Health

Stefanie Sperlich and Siegfried Geyer

13.1 Household and Family Work: A Neglected Issue of Public Health Research

Compared to gainful employment, unpaid household and family work – mostly done by women – still receives little attention from the public as well as from public health research. Most of what is known today about the quality of women's experiences in the homemaking role is drawn from research on fulltime homemakers conducted in the 1970s and 1980s. These studies predominantly stress the negative qualities of housework, including its fragmented, repetitive and demanding nature as well as the isolation and low social rewards associated with this role (Kibria et al. 1990). As Kibria notes "the neglect of homemaking as a topic of research reveals the implicit but widespread assumption that involvement in paid employment overwhelms the social and psychological significance of homemaking activities for women" (1990, p. 329). He concludes that while domestic work continues to hold an important place in women's live, little is known about women's experiences in the homemaking role and about the relationship of these experiences with women's health. In line with this, Staland-Nyman et al. (2008) stated that future research needs to address strain in domestic work as a contributory factor to women's ill-health. More recently, Molarius et al. (2014) pointed out that domestic work is highly important for population health and also for gender equity in health. They concluded that domestic work should not be omitted when considering factors that affect self-rated health. As a first step towards strengthening the visibility and importance of household and family work the WHO report on social determinants of health recommends to include unpaid work in national accounts (CSDH 2008).

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In contrast to household and family work research on the reconciliation of work and family life has continuously grown over the last two decades. Due to increasing participation of women in the workforce, the focus was placed on the impact of multiple role occupancy, including the roles of parent, spouse and employee. Two major theories were put forward concerning the relation of multiple roles with well-being. The ‘role-stress-theory’ indicates that managing multiple roles is difficult and creates strain and conflicts between the demands of work and family. On the other hand, the ‘role-benefit-theory’ suggests that participation in multiple roles provides a larger range of opportunities and resources that can be used to promote better functioning in other live domains. Empirical evidence was found for the role-strain-theory (Glynn et al. 2009; Krantz and Östergren 2001) as well as the role-benefit-theory (McMunn et al. 2006; Fokkema 2002; Lahelma et al. 2002). However, the multiple-role-approach was criticized for a number of reasons. For example, it was claimed that work and family were considered unrelated to each other, while a growing body of research shed light on their interdependence (Tsionou and Konstantopoulos 2015). In addition, it was argued that in their roles as workers, spouses, and parents, women experience both suffering and gratification. Hence, rather the qualitative than the quantitative aspects of women’s experiences of social roles are important to understand their psychological well-being, or lack thereof (Baruch and Barnett 1986).

13.2 Measuring Qualitative Aspects of Household and Family Work

In order to capture the qualitative dimensions of domestic and family work, some scholars started to use similar models for the study of paid and unpaid work on health. Initially, the job strain model developed by Karasek and Theorell (1990) was applied to household and family work with the two central components of high job demands and low decision latitude (see Chap. 1). The findings showed that women reporting low control of their domestic work had increased risks of burnout (Kushnir and Melamed 2006), lower self-rated health (Staland-Nyman et al. 2008), depression and anxiety (Griffin et al. 2002) as well as coronary heart disease (Chandola et al. 2004).

More recently, the Effort-Reward-Imbalance-model (ERI) was adapted to unpaid household and family work as well. This approach defines women’s engagement in household and family not only as an additional social role beyond work, but also as a specific form of labour. Literature suggests that some crucial efforts of paid labour also apply to domestic work, in particular ‘time pressure’, ‘interruptions and disturbances’ and ‘pressure to work overtime’ (Glass and Fujimoto 1994; Lennon 1994). The underlying hypothesis claims that household and family work – similarly to paid employment – contributes to one’s social identity and social status. In addition, household and family work may also offer ‘rewards’ in terms of promoting self-esteem and may therefore provide the potential for experiencing a favourable self-concept. As Baruch and Barnett (1986) argued, the prevailing images of housework as purely burdensome may be overly simplistic. They pointed out that – very similar to the basic assumption of ERI at work – the balance between rewarding and stressful aspects of the homemaking-role seemed to be the best predictor of well-being. Siegrist (1998) stated that the principle of reciprocity may not be confined to paid work. It may be experienced in a similar way in other domains, such as marital and parental relationships. However, as Knesebeck and Siegrist (2003) pointed out, rewards in unpaid work compared to paid labour are rather of an emotional than an economic nature. This means that feelings of esteem, respect, appreciation and love rather than material benefits may be the most important reward transmitters in unpaid work (see Chap. 12). According to Baruch and Barnett (1986), women found the most rewarding aspects of the mother-role in the love they received by their children and pleasure in their accomplishments. They also identified aspects related to the partner as important, in particular having an emotionally supporting partnership. Studies suggest that women attaching a high priority on motherhood and taking care for the family showed higher values of satisfaction and well-being (Martire and Stephens 2000; Wickrama et al. 1995). Thus, the sense of doing something meaningful might be another important source of intrinsic reward. On the other hand, it was reported that household and family work are receiving insufficient recognition and social prestige, and the value of being housewife has significantly decreased over the last decades (Cox and Demmitt 2014; Glass and Fujimoto 1994).

13.3 ERI in Household and Family Work

Based on a literature-review, items were generated for measuring ERI in household and family work, abbreviated as ERI-HF (Sperlich and Geyer 2015c). The component 'effort' is composed of eight items referring to demanding aspects of household and family obligations by emphasizing quantitative workload. In the instructions of the questionnaire it was stated that "household and family work" covers a wide range of activities, including family organization, child care, help with homework, providing transportation for the children, as well as cooking, washing, tidying up, shopping, cleaning and much more. While 'effort' – analogous to ERI in paid work – was expected to show an unidimensional structure, 'reward' was assumed to be composed of four dimensions: (1) 'affection from the child(ren)', (2) 'recognition from the partner', (3) 'intrinsic value of family and household work' and (4) 'societal esteem'.

Response formats were constructed in analogy to the original ERI. First, subjects may agree or disagree whether the item content describes a typical feature of their work situation. Subsequently, mothers who agree are asked to rate to what extent they usually feel distressed by this experience. Every item has five response categories ranging from (1) 'does not burden me at all' to (5) 'burdens me greatly'.

In addition, the short version of the over-commitment questionnaire was adapted to household and family work that captures the personal characteristic of inability to withdraw from work obligations (Peter et al. 2006). Minor linguistic changes only were needed, but two items had to be excluded due to poor reliability. The modified over-commitment-questionnaire consists of four items with four response categories ranging from (1) 'totally disagree' to (4) 'totally agree'. Up to now, the ERI-HF questionnaire and the modified scale 'over-commitment' were translated from German language into English and Brazilian Portuguese language (Rosembach de Vasconcellos et al. 2016).

Psychometric properties of the ERI-HF-questionnaire were tested in a population-based study of German mothers (n = 3129). Data were collected in 2009 by means of a mail survey. Finally 3183 women agreed to participate, corresponding to a response rate of 62.3 %. Overall, the sample can be considered as representative for German mothers in terms of German federal state, school education, mother's age, marital status and number of children. The age of participating women varied between 17 and 60 years (mean age 39.1, SD = 6.8), and that of the youngest child ranged from 0 to 18 years (mean age 9.4, SD = 5.3). Most women (72.8 %) were married, 17.5 % were single mothers. 44.5 % of mothers had one, 42.6 % had two and 13 % had three and more children. About one out of three participants (32.6 %) attended the school for no more than 9 years, and 30.4 % had an income considered at risk of poverty (<60 % of the median equivalent income). For more information on socio-demographic and family-related characteristics see Sperlich and Geyer (2015a).

Confirmatory Factor Analysis (CFA) reproduced the theoretical structure of ERI-HF: the 'effort'-scale is based on one latent factor with eight items, whereas the scale 'reward' is composed of the expected four latent factors. With the exception of one item, 'Reward2', the model fit is appropriate with respect to standardized regression weights and squared multiple correlations (Fig. 13.1). Fit indices ($\chi 2$/df, RMSEA, GFI, AGFI) and internal consistency (Cronbach's Alpha) are satisfactory, indicating that the proposed theoretical construct fits the data. The same holds true for 'over-commitment', as evident from high internal consistency and satisfactory fit indices (Sperlich et al. 2012).

Analogous to Siegrist et al. (2004), the effort-reward ratio was computed for each respondent according to the formula: $e/(r \times c)$ where e is the sum score of the effort scale, r is the sum score of the reward scale (with reversed coding according to the notion of imbalance) and c defines a correction factor for different numbers of items in the nominator and denominator. The effort-score based on the eight items varies between 8 and 40 (highest distress-level), the reward-score varies between 11 and 55 (highest distress-level). Values close to zero indicate a favourable condition (relatively low effort, relatively high reward), whereas values above 1.0 indicate an effort-reward imbalance, e.g. a high amount of effort spent that is not met by the rewards received in turn.

About 19.3 % of mothers perceived lack of reciprocity in household and family work (Table 13.1). With regard to 'effort', high distress due to the 'feeling as never being off duty' was reported by every third mother and was therefore experienced

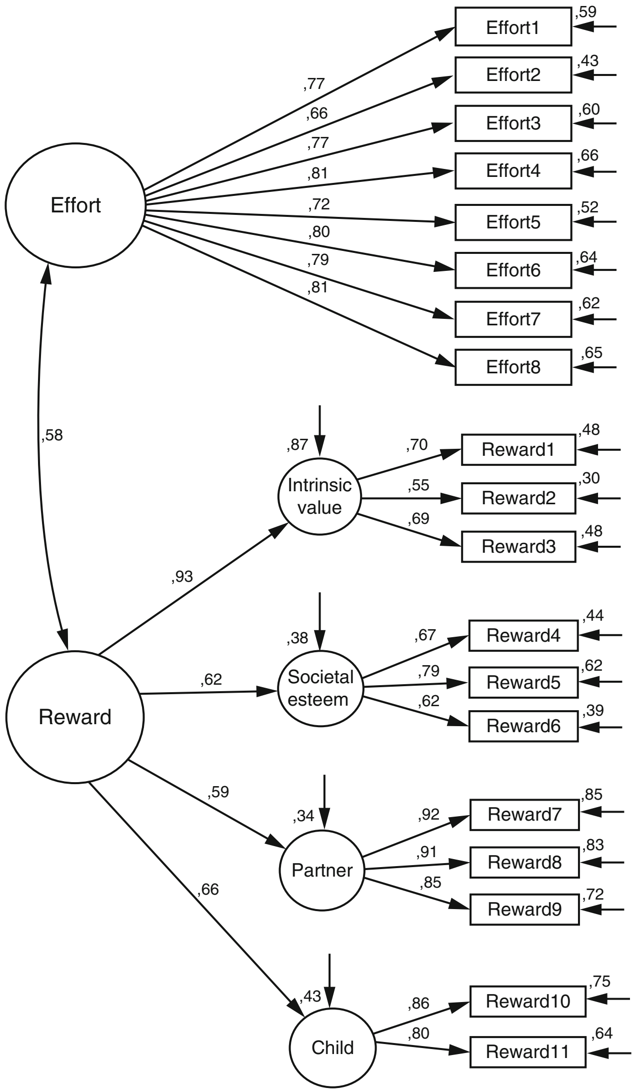

Fig. 13.1 Factorial structure of ERI in household and family work with standardized regression weights (direction of the *arrows* to the *right*) and squared multiple correlations (direction of the *arrows* to the *left* and *downward*) (Source: Sperlich et al. 2012)

as the most common stressor in household and family work. The rate of mothers reporting high distress due to effort was comparatively high, ranging from 17.2 % to 33.0 %. Lack of reward was less frequently experienced, with lack of 'societal esteem' reaching the highest degree of approval. Considering 'over-commitment', 23.8 % of mothers reached a sum score ≥12 suggesting a psychosocial risk condition. The items 'I easily run into time pressures' and 'already in the morning I begin to worry about family work' received highest approval rates (almost 60 %).

Table 13.1 Frequency distribution of ERI- and over-commitment-items (Source: Sperlich et al. 2012)

		M	SD	%
	Effort-reward imbalance	0.75	0.45	19.3
	Effort			
Effort1	Frequently there is great time pressure	2.77	1.09	22.8
Effort2	I'm frequently interrupted and disturbed	2.62	1.05	17.2
Effort3	Often I feel as never being off duty	2.77	1.34	33.0
Effort4	I would need more hours in the day to accomplish all my household and family work	2.42	1.30	22.1
Effort5	My family work has become larger and larger	2.55	1.20	22.0
Effort6	I have to do a 'thousand things' all at the same time	2.90	1.14	30.7
Effort7	I'm often overwhelmed by the large number of responsibilities	2.32	1.33	22.0
Effort8	I hardly get a moment's rest during the day because of the many demands placed on me by the household and my family	2.57	1.27	25.4
	Reward: **intrinsic value**			
Reward1	I (don't) feel that family work are worth the effort	1.64	1.04	7.4
Reward2	I often question the meaning of household/family work	2.31	1.24	16.9
Reward3	The work I do for my family (don't) provide a deeper meaning to my life	1.61	0.90	4.5
	Reward: **societal esteem**			
Reward4	I often experience that household and family work is poorly recognized and appreciated	2.71	1.19	25.5
Reward5	Nowadays, a person is regarded disapprovingly if he/she is 'only' involved in household and family work	2.32	1.21	18.2
Reward6	The fact that family work is unpaid seems unjust to me	2.72	1.30	28.5
	Reward: **recognition from the partner**			
Reward7	I (don't) obtain appropriate recognition from my partner	2.10	1.28	16.6
Reward8	Often my partner doesn't notice my work	2.31	1.32	21.2
Reward9	My partner (don't) often thanks me for my work at home	2.35	1.20	17.4
	Reward: **affection from the child or children**			
Reward10	From my child/children, I usually get (not) the appreciation and affection that I would wish for	1.95	1.13	10.5
Reward11	I (don't) receive a great deal in return from my child/children	1.85	1.20	12.1
	Over-commitment	9.40	2.80	23.8
Over1	I easily run into time pressures	2.62	0.81	58.0
Over2	Already in the morning I begin to worry about family work	2.64	0.94	58.3
Over3	I constantly think about my responsibilities at home	2.27	0.89	38.7
Over4	If I postpone something, I have trouble sleeping at night	1.88	0.84	22.3

M Mean value, *SD* Standard deviation, *%* Percentage of mothers reporting ERI (ratio >1), high over-commitment (categories 3 and 4 of response format, sum score ≥12) and high distress due to high effort and low reward (categories 4 and 5 of response format)

13.4 ERI in Household and Family Work and Women's Health

At work, lack of reciprocity elicits strong negative emotions which in the long run adversely affect employees' physical and mental health (see Chap. 1). A large body of evidence supports this assumption, indicating that an imbalance between high effort and low reward is associated with (psycho-) somatic symptoms, cardiovascular disease outcomes and psychological well-being (Siegrist 2009; Van Vegchel et al. 2005). We assumed that an imbalance in household and family work between efforts spent and subsequent rewards received may have adverse health consequences comparable to those associated with paid work.

Analyses of covariance (ANCOVA) were carried out in order to analyze the associations between ERI in domestic work and various health outcomes (anxiety and depression, somatic complaints, subjective health, hypertension) (Sperlich et al. 2012). Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale German Version (HADS-D) (Hermann-Lingen and Buss 2005). A modified version of von Zerssen's complaints scale (v. Zerssen 1976) was used for assessing physical disabilities and discomfort. Subjective health was assessed by a single item with five response categories ranging from 1 ('very poor') to 5 ('very good'). For measuring hypertension the mothers were asked if a doctor had ever diagnosed high blood pressure (response format 'yes' or 'no'). As a predictor of health outcomes the effort-reward ratio was transformed into a binary variable (values ≤ 1 vs. > 1). In order to differentiate between mothers with slight, moderate, or marked imbalance, women with a ratio > 1 were divided into three equally sized groups: (1) ratio score $\leq$ 33th percentile (slight imbalance), (2) ratio score ranging from the 34th–65th percentile (moderate imbalance), and (3) ratio score with values above the 65th percentile (marked imbalance). For 'hypertension' as outcome, logistic regression was performed due to its categorical scale level. In order to eliminate confounding effects we controlled for mothers' age, personality traits (optimism and over-commitment) and socio-demographic characteristics (income, school education, employment status, single motherhood, number of children and age of youngest child).

As Fig. 13.2 illustrates, there is a linear association between ERI and health outcomes such that health impairments are continuously increasing with ERI. The strongest association can be found for mental health: Mothers reporting no lack of reciprocity have significantly lower anxiety and depression levels as compared to those reporting high levels of imbalance. A similar, less pronounced trend is observed for somatic complaints and self-rated health. With respect to blood pressure, a marked imbalance is significantly associated with hypertension.

In order to analyze the associations of ERI with health in more detail, we tested the following three main hypotheses in analogy to ERI at work (Siegrist 2002a):

1. ERI is associated with health risks, whereby the effect of ERI is higher than the single effects of high effort and low reward,

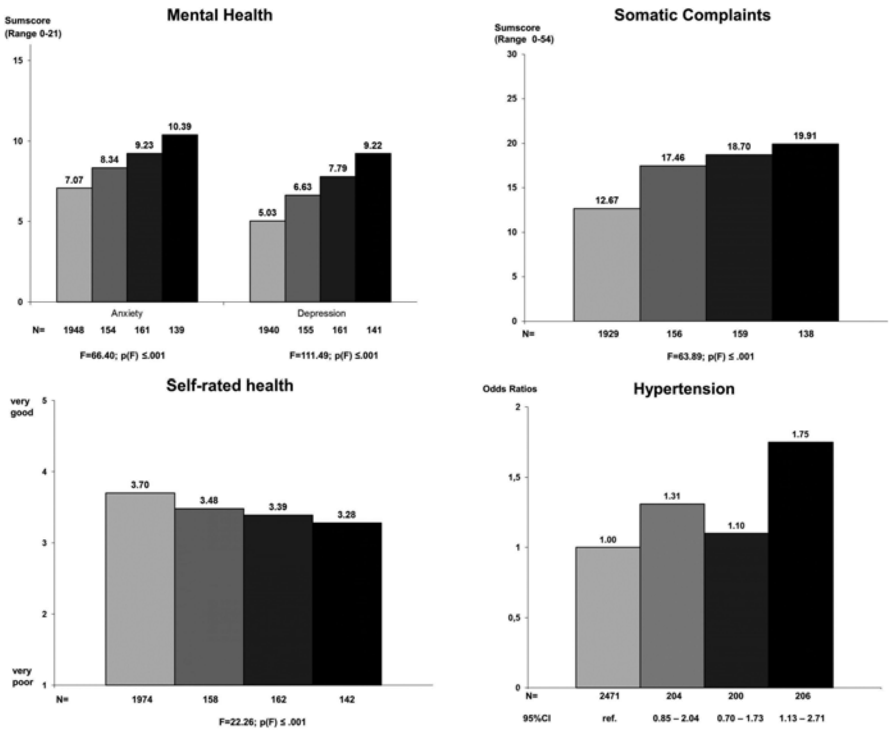

Fig. 13.2 Associations of ERI with mother's health outcomes. ANCOVA and logistic regression statistics adjusted for age, personality traits and socio-demographic characteristics. ■ none, ratio ≤1.0 ■ slight, ratio ≤33th percentile ■ moderate, ratio between the 34th and 65th percentile ■ marked, ratio ≥66th percentile (Source: Sperlich et al. 2012)

2. A high level of over-commitment may increase the risk of poor health even in the absence of ERI
3. Mothers reporting ERI and a high level of over-commitment are at highest risk of poor health.

Using the same health indicators (except for hypertension), we performed logistic regression analyses calculating odds ratios (OR) and confidence intervals (CI). To investigate the first hypothesis, we estimated odds ratios of poor health for ERI and the two subscales separately, resulting in three regression models (Sperlich et al. 2013). In addition, we analyzed the effect of ERI before and after controlling for the separate effects of 'effort' and 'reward'. Regarding the second hypothesis we evaluated over-commitment as an independent variable by controlling for ERI. Third, we analyzed whether mothers reporting an extrinsic ERI *and* a high level of over-commitment had an even higher risk of poor health. To this end both risk factors were combined into a single variable with four levels with 'ERI ratio low and over-commitment low' as reference group. All analyses were adjusted for pessimism, mother's age, social status (school education, income), employment status and single motherhood (for more details see Sperlich et al. 2013).

In line with the first hypothesis, 'high effort' as well as 'low reward' are significantly associated with all health outcomes (for detailed results see Sperlich et al. 2013). Overall, the health-related impact of 'high effort' (ORs ranging from 3.14 to 7.09) is more pronounced than the effect of 'low reward' (ORs ranging from 2.71 to 4.36). The mismatch between high effort and low reward (ER-ratio) is also significantly associated with poor health. Partly in line with the first hypothesis the odds ratios of the ER-ratio for anxiety and depression were elevated also after including the single scales together with the ER-ratio. In contrast, this does not hold for subjective health. Similar results for ERI at work were reported by Preckel et al. (2007) and by Wahrendorf et al. (2012), demonstrating that the ER-ratio produces eventually, but not always a significant effect after controlling for the separate effects of 'effort' and 'reward'. Consistent with the second hypothesis, a significant association of over-commitment with elevated health risks was found (ORs ranging from 1.71 to 3.79). Even after adjusting for ERI this association remained stable indicating that the inability to withdraw from household and family work may matter for women's health. In line with the third assumption of the ERI model, mothers reporting an ER-ratio above 1.0 in combination with a high level of over-commitment are at highest risk of poor health with ORs ranging from 4.27 to 17.59. In sum, the main assumptions of the ERI model were largely confirmed by this study. Hence, it may be concluded that failed reciprocity in household and family work defines a state of emotional distress with negative health consequences, as evidenced by the original model of ERI at work (Sperlich et al. 2013).

13.5 The Impact of Social and Family-Related Factors on ERI in Household and Family Work

The evidence on construct validity suggests that ER-ratio scores increase with the number of children and decrease when children are getting older. In addition, socioeconomic position seems to affect the mismatch between requested efforts and given rewards. In particular low income is associated with higher effort and lower reward, resulting in higher ER-ratio scores. A high mismatch was also found for single mothers (Sperlich et al. 2012). However, the strength of relationships tends to be overestimated in bivariate analyses when the independent variables considered (such as income and single motherhood) are strongly correlated (Sperlich et al. 2011). Therefore, in a further study, we investigated the effects of all possible predictors simultaneously on the ERI components by means of regression analyses (Sperlich and Geyer 2015a). As we had no theoretical assumptions about the relative importance of the social and family-related factors considered, stepwise logistic regression analysis was used in an exploratory way. We assessed the degree to which strain-based-pressures in the work role impair performance in the family role ('negative work-to-family spillover') as a possible further predictor of ERI. To this end, three items from a previous study were included (e.g. "due to job strain I am often too tired for joint activities with my partner/my child/ren)" (Siegrist 2002b).

As expected, the number of variables that are significantly associated with the ERI-components decreased after considering all predictors simultaneously. However, family-related characteristics such as 'age and number of children' remained largely significant in the multivariate model, confirming that effort in household and family work decreases with children's age and increases with number of children. In addition, low levels of 'social support', marked 'negative work-to-family spillover' and women's statement to be 'mainly responsible for household and family work' remained significantly associated with higher odds of all ERI-components. By contrast, 'socioeconomic position' (school education, job position and per capita income) was less important in the presence of other social and family-related factors. However, the effects of 'school education' on the 'ER-ratio' and on the subscale 'reward' remained statistically significant in the multivariate approach. Further analyses on the four dimensions on reward revealed that 'having older children' and 'having more than one child' was significantly associated with high distress related to lack of affection from child. Lower levels of 'perceived social support' and holding the 'main responsibility for household and family work' proved to be powerful in explaining higher levels of distress related to all dimensions of reward. Similarly, marked 'work-to-family spillover' contributed to distress related to all reward-dimensions, in particular with respect to lack of intrinsic value, and lack of recognition from spouse. Working women tended to show lower odds of distress related to lack of societal esteem compared to fulltime-housewives. In addition, women with lower levels of socioeconomic position (education and income) showed significantly higher rates of stress due to lack of societal esteem of household and family work. This may indicate that the perception of domestic work as a low-prestige activity is a source of stress, particularly among socially disadvantaged women (Sperlich and Geyer 2015a).

13.6 Stress in Household and Family Work: A Factor Contributing to Health Inequalities in Women?

Research on social inequalities in health suggests that the socio-economic gradient in health is less steep in women than in men. In particular, occupational position proved to be less relevant in explaining health inequalities among women (Sacker et al. 2000; Arber 1997; Koskinen and Martelin 1994). Chandola et al. (2004) assumed that the main mechanisms underlying social inequalities in health may differ between men and women: while employment-related factors may be more important for men, women may have other potentially demanding social roles related to family, child-care and care taking of others. Supporting this assumption, we found stress in household and family work in terms of ERI being significantly associated with mother's adverse health. In addition, we demonstrated that socially disadvantaged mothers perceive higher stress due to lack of societal esteem of the homemaking role. If both findings are considered in combination the question emerges whether stress in household and family work may contribute to health inequalities in women.

In order to address this issue, we analyzed ERI in household and family work as a mediator in the relationship between low socioeconomic position (as measured by school education) and women's somatic complaints (Sperlich and Geyer 2015b). Effort-reward imbalance (ERI) in household and family work acts as a mediator if school education exerts significant effects on somatic complaints and on ERI, and if ERI is assumed to have an impact on somatic complaints (Holland 1988). The regression coefficients and their 95 % confidence intervals of the total and direct effects as well as the indirect effects via ERI (mediator effect) were estimated by means of ordinary least squares (OLS) regression analyses. We calculated five different mediator models according to different ERI components. For all analyses, we controlled for age, employment status, occupational stress, perceived social support and the personality trait 'optimism/pessimism' as possible confounders. Inference about indirect effects was determined by 95 % bias corrected bootstrap confidence intervals based on 1.000 bootstrap samples. If zero was not in the confidence interval, the indirect effect was different from zero and considered as significant. In addition, the Sobel Test (normal theory test) was used to specify the p-value of indirect effects.

Our analyses revealed a significant total effect of education (X) on somatic complaints (Y) (Fig. 13.3). As expected, higher levels of education are associated with lower levels of somatic complaints (total effect = −0.46). Adjusting for the effort-reward ratio (Model 1) only slightly reduced the magnitude of the association between education and somatic complaints to $\beta = -0.42$ (direct effect). No significant indirect effect of X on Y through the effort-reward ratio can be found (indirect effect = −0.04). However, by considering 'effort' (Model 2) and 'reward' (Model 3) separately, significant indirect effects are observed for both subscales. The effects have very different directions, thus canceling each other out, resulting in a statistically insignificant ER-ratio. Adjustment for 'effort' leads to increased educational differences in somatic complaints ($\beta = -0.63$). On the other hand, adjustment for 'reward' resulted in a marked reduction of the association between school education and somatic complaints ($\beta = -0.31$). Regarding the reward dimensions, we found a significant indirect effect for 'societal esteem' ($\beta = -0.15$) and for 'affection from the child(ren)' ($\beta = -0.03$) (Model 4). With regard to 'intrinsic value' the effect was slightly above statistical significance ($p = 0.073$) while 'recognition from spouse' (Model 5) clearly failed to exert a significant indirect effect ($p = 0.407$).

Our findings demonstrate that the ERI-components have different effects on somatic complaints. Contrary to our expectation, the regression coefficient for 'effort' was positive, indicating that higher educated women are more affected by extensive workload from household and family duties than lower educated women. A possible explanation may be that higher educated mothers are more committed to paid work (Gutiérrez-Domènech 2005). Therefore they may be more susceptible to

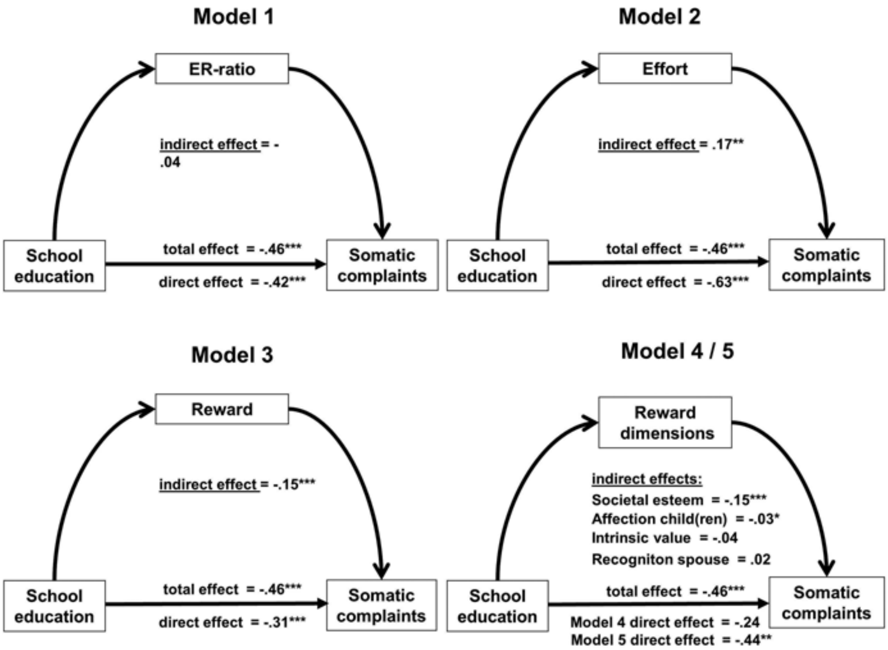

Fig. 13.3 The mediating effects of ERI and its components on the relationship between school education and somatic complaints (Source: The diagram is based on Sperlich and Geyer 2015b). Notes: *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$. Model 4 includes all reward dimensions except 'recognition from spouse', Model 5 contains 'recognition from spouse' (not applicable to single mothers) with decreased sample size and reduced total effect size ($\beta = 0.41$)

work-family conflicts (negative work-to-family spillover) – fact that may explain their higher level of effort in household and family work. However, after controlling for negative work-family spillover, the effect of education on effort slightly decreased but remained statistically significant (Sperlich und Geyer 2015b). Thus, it can be assumed that work-to-family conflicts do not sufficiently explain increased effort levels among higher educated women. Contrary to 'effort', 'reward' was positively associated with school education. Our findings suggest that less well educated mothers perceive less appreciation and affection from their children which may reflect difficulties with parenting and mother-child relationship.

As Artazcoz et al. (2004) pointed out, the effects of parenthood on health depend on socioeconomic resources. While family work may be an important source of emotional distress for women of lower educational level, children mainly mean a source of satisfaction for women with high levels of material well-being. In supporting of this assumption, Conger and Donnellan (2007) found difficulties with parenting to occur more frequently in socially disadvantaged mothers. While the impact of parent-child relationship on children's cognitive and emotional growth has been the subject of extensive research (e.g. Yunus and Dahlan 2013) its implications for women's well-being received less attention. Our results support the assumption that the quality of mother-child relationship is an important determinant of women's health as well.

In addition, we found that less educated women raised more often doubts about the meaningfulness of domestic and family work. Although failing to reach statistical significance, this finding suggests that lower educated women experience less satisfaction in the homemaking-role. In line with this interpretation they more often complained about a lack of 'societal esteem' for their household and family work. This may be related to the fact that they are more often fulltime-housewives. In our study, this was the case in almost every fourth lower educated mother (24.6 %), whereas only one out of ten (10.6 %) of the higher educated women stayed at home. According to the 'role-benefit theory', employment is beneficial because it provides women with a wider set of identities (Pavalko et al. 2007; Martikainen 1995). Thus, lower educated women might perceive higher distress related to low societal esteem as they have insufficient means for compensating negative experiences in the homemaking-role by other more satisfying role involvements.

In sum, we found some evidence that the association of women's education with somatic complaints is mediated by stress related to low reward for household and family work. In particular, lack of societal recognition, but also lack of affection from the children and lack of intrinsic value of being mother and housewife, contribute to the explanation of higher levels of somatic complaints in lower educated women. After adjustment for all reward dimensions, the associations between education and women's somatic complaints were no longer statistically significant. Therefore, we might conclude that stress due to lack of reward for household and family work is a contributing factor to health inequalities in women.

13.7 Concluding Remarks

This chapter is devoted to findings obtained from studies conducted with a questionnaire measuring effort-reward imbalance in unpaid household and family work. Our results support the assumption that the ERI-model is suitable for unpaid work and that it provides an explanatory framework for assessing stress experiences of family work. Particularly among socially disadvantaged mothers, lack of social recognition in the homemaking role proves to be a relevant source of psychosocial stress which may contribute to health inequalities in women. Given these findings, we conclude that future research on health inequalities should take into account stress related to household and family work in addition to other more established factors.

Before we turn to policy implications and future research perspectives, some important limitations of our findings need to be addressed. First, in line with literature (see Chap. 1) we assume that ERI is predicting health rather than health predicting ERI. However, the cross-sectional design of our studies precludes any causal inference. Hence, longitudinal studies are warranted in order to clarify the direction of causality. Second, as all analyses so far are based on subjective data, individual differences in personality traits may have affected the reporting of family-related stress and of subjective health. In order to minimize this possible 'common method bias', we controlled for optimism as one particular personality trait, demonstrating that this bias is unlikely to account for the observed associations. However, other potential sources of common method bias may need to be considered (Podsakoff et al. 2003). Finally, as our data are based on samples of mothers from Germany, the question arises whether our findings can be generalized beyond this context. As countries differ with respect to their cultural norms and family policies (Palència et al. 2014), future research will benefit from cross-country comparisons.

13.7.1 Policy Implications for Promoting Women's Health

Since the reunification in 1990, family policies in Germany gradually changed from traditional carer-strategy (men as 'breadwinners', women as 'caregivers') to the earner-carer-strategy where women and men are treated as being equally involved in both earning and caring (Bertram and Bujard 2012). Alongside this transformation, the societal value of being a fulltime-housewife has significantly lost its prestige (Cox and Demmitt 2014). Even though a number of women still stay at home, fulltime-homemakers are increasingly perceived as 'old-fashioned'. We found lower educated mothers to complain more often about lack 'societal esteem' for their household and family work than those with higher education – a fact that may be attributable to their high prevalence of being fulltime-housewives. As demonstrated elsewhere (Sperlich et al. 2011), lower educated women also have more children and bear their first child earlier in life compared to higher educated women. Our findings suggest that lower educated women are particularly affected by lack of social recognition as they remain more affiliated with the traditional gender role. They also raise more often doubts about the meaning of household and family work as compared to higher educated women, indicating that they are also less satisfied with their job at home. Hence, we might suppose that their fulltime-homemaking role is not always chosen voluntarily, but in part reflects a lack of occupational opportunities. In this respect, future interventions should aim at improving the labor market integration of low-educated and low-skilled women. However, as Glass and Fujimoto (1994) pointed out, employment can be considered as health promoting as long as overload does not outweigh its positive effects. Thus, not all mothers will necessarily benefit from employment. Family policies that are fostering free choice between paid work and household and family work (particularly in case of caring for very young children) (Misra et al. 2007) appear to be the most appropriate strategy for promoting women's well-being.

In the former Federal Republic of Germany (Western Germany, GFR) the government was in favor of a policy where women were treated primarily as carers (Misra et al. 2007; Gustafsson et al. 1996). This policy explicitly rewarded women for providing childcare through measures such as long periods of parental leave and tax benefits, leading to gender segregation of work with men as the 'breadwinner' and women as being responsible for family obligations. By contrast, the former German Democratic Republic (Eastern Germany, GDR) fostered fulltime employment of mothers and provided a comprehensive childcare infrastructure. As a consequence, in the former GDR women and men showed nearly the same employment patterns. In the past 25 years following the reunification, family policies were the same in the Eastern and Western parts of Germany. However, employment patterns of women with preschool children still differ systematically in both regions, showing considerable higher rates in East as compared to West Germany. According to Pfau-Effinger and Smidt (2011), gender differences in the division of labor can largely be explained by differences in the cultural values that have developed differently in Western and Eastern Germany after the Second World War.

Remarkably, we also found different patterns of effort-reward imbalance in household and family work among women in East and West Germany. Whereas in the Western part 20.3 % of mothers reported an imbalance between high effort and low reward, this applied only to 13.5 % of East German mothers (Sperlich 2014). Levels of demand turned out to be approximately the same among East and West German mothers. Hence, 'effort' could not account for the observed difference. By contrast, West German mothers showed significant higher levels of distress related to lack of reward, specifically 'societal esteem', 'intrinsic value' and 'affection from child'. We found that lower school education and lower labor participation rates are important mediators of these associations, thus contributing to distress attributable to low reward among West German mothers. In addition, we found that only 17.1 % of West German women stated that household and family work was shared equally between partners as compared with 32.3 % of East German women. Hence, gender inequity of household labor might be a further factor in explaining the observed differences between women in Eastern and Western Germany (Sperlich 2014). These findings suggest that family policies should not only aim at improving participation of women in the labor market, but also aim at promoting changes of gender roles towards a more equal sharing of paid and unpaid work between both parents (Mellner et al. 2006).

13.7.2 Stress in Household and Family Work: An Important Issue Also for Men?

Along with the increasing labor force participation of mothers, attitudes on gender roles gradually changed to the benefit of more equal role expectations. In Germany, some 20 % of fathers are currently identified as having a 'modern' gender role orientation (Volz and Zulehner 2009). These 'new fathers' are expected to be more fully engaged in the physical and emotional care of children and in developing more egalitarian relationships with their partners (Cabrera et al. 2000). As a consequence, men are increasingly expected to face household and family stress and a double burden of paid and domestic labor. So far, the adopted questionnaire ERI-HF was exclusively used among women in childcare responsibility. However, recently the ERI-model of household and family was tested with a clinical sample of fathers attending a family-focused rehabilitation (Sperlich et al. 2016). It provides specific treatments for mothers, and since 2002 for fathers as well, in childcare responsibilities. The data collection took place in 2014 in 14 institutions (n = 415). Confirmatory factor analyses revealed good to satisfactory properties for ERI as well as for overcommitment. Overall, 13.4 % of men in childcare responsibility reported an imbalance between high effort and low reward of household and family work, whereby levels of effort were more frequently present than stress due to low reward. In addition, a significant proportion of fathers had difficulties to withdraw from housework obligations. ERI in household and family work revealed to be significantly associated with father's health. Our preliminary findings suggest that the instrument is applicable to men in childcare responsibility. Further studies have to show whether ERI in household and family work also contribute to our understanding of the social determinants of men's health.

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Part V
Interventions and Policy Implications

Chapter 14
Reward, Flow and Control at Work

Tores Theorell

14.1 Reward, Control and Flow

Since its introduction (Siegrist 1996) the effort-reward imbalance (ERI) model has been used extensively in stress research. In my country this theoretical model has been used not only in research but also in occupational health practice along with other theoretical models, in particular the demand control (or job strain) model (Karasek 1979; Karasek and Theorell 1990). A recent survey (Theorell et al. 2015) of the international scientific literature has shown that the predictive value of effort reward imbalance in relation to augmented depressive symptoms is equal to the predictive value of job strain. In addition, in an early collaboration with Siegrist and Peter, the Stockholm group studied the combined effects of job strain and effort reward imbalance on cardiovascular disease risk (Peter et al. 2002). It was shown that the two models supplement one another in cardiovascular predictions. Similar findings have been made in the Whitehall II study of British state employees with regard to cardiovascular disease risk (Bosma et al. 1998) and later with regard to self rated health in the Netherlands (de Jonge et al. 2000). Direct comparisons between the two models have also been made with regard to the circadian rhythm of saliva cortisol which is a frequently used indicator of the activity in the HPA axis (which mirrors the regulation of energy mobilisation in the body). Maina et al. (2009), for instance, followed saliva cortisol levels in 104 telephone operators during two workdays and one leisure day. While a high level of job strain was associated with increased cortisol excretion in the morning, a high level of effort reward imbalance was associated with lowered cortisol awakening response and lowered

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overall cortisol excretion (both of which may mirror physiological exhaustion). The theoretical difference between the two models is discussed more extensively in other chapters in this book. The core concept in the effort reward model – and the concept that differentiates the model from other theoretical models in the field – is reward. When a subject's level of effort is not matched by reward in the form of material reward, social recognition and positive feedback, frustration arisesses. If this is longlasting, illness risk increases.

What are the neurobiological mechanisms underlying the increased illness risk associated with effort reward imbalance? Siegrist et al. (2005) contributed to the understanding of brain mechanisms in a study of a sample of working subjects who had a history of chronic work-related reward frustration (frustrated) who were compared with subjects without such a history (non-frustrated). Solving arithmetic tasks was followed randomly by either monetary reward or omission of reward. Functional magnetic resonance imaging was performed in both groups of subjects during the experiments. Hyperactivation of dopaminergic regions of the brain was found in the frustrated compared to the non-frustrated subjects when reward was omitted – as an indication of a more long-lasting disturbance in the regulation of dopamin stimulation.

Psychophysiological researchers (see Csikszentmihalyi 1990) have recently introduced a concept that is theoretically related to reward, namely psychological flow. Another label for the same concept is "effortless attention" (Bruya 2010; Ullén et al. 2010) that typically occurs during active performance of challenging tasks and is accompanied by a sense of automaticity, high control, low self-awareness, and enjoyment. A flow experience mostly requires that the performance has been rehearsed extensively and also that the person's skill has been developed during a long period of intensive training. The state of flow has been studied neurobiologically by means of functional magnetic resonance imaging (Ulrich et al. 2014). Although the general activation pattern in the brain during flow differs from the activation pattern observed during acute frustration of reward in chronically reward frustrated subjects there is one common feature which is that the medial prefrontal cortex is activated in both conditions.

In a recent study of the Swedish working population, Fagerlind Ståhl (2015) examined the interrelationships between work-related flow and other work-related psychosocial concepts. Work-related flow was measured with the "work-related flow inventory" introduced by Bakker (2008). This questionnaire consists of 13 questions. Participants are asked to retrospectively assess their experience of work during the past 2 weeks (e.g. I do my work with a lot of enjoyment. I get my motivation from work itself, and not from the reward for it. When I am working, I think about nothing else.). It is closely related to questionnaires measuring work engagement with the components vigour, dedication and absorption (Schaufeli et al. 2006). Although it is difficult to translate the transient intensive state of flow that a performer experiences suddenly and unexpectedly during a performance in front of an audience into the everyday experience of work, it is obvious that the questions do have a lot in common with "effortless attention". Automaticity, low self-awareness, high control and enjoyment are obvious common features. According to Fagerlind

Ståhl (2015), one of the factors determining work-related flow is the experience of control at work, which links the concept also to decision latitude which is one of the two core concepts in the demand control model.

Propensity to flow (FP) corresponds to an individual's likelihood of experiencing flow in any arena of life. Flow experiences can take place on several arenas. The Swedish Flow Proneness Questionnaire (SFPQ) was used as an indicator for flow proneness in daily life. The SFPQ is a 22-item self-report measure developed to estimate an individual's proneness to experience flow and consists of three subscales (seven items each) assessing FP during work, leisure, and maintenance activities. The questions are briefly: "When you do something at work/during leisure/during maintenance, how often does it happen that you feel (a) bored (reversed), (b) have enough ability, (c) clear image of what to do, (d) aware of how you perform, (e) totally concentrated, (f) being in control and (g) extreme satisfaction ?" Each item has five response options. Again total focus seems to be an important aspect of the flow experience. Propensity to flow reflects how frequently in life a subject is allowed to have such experiences. In a large study based upon the Swedish Twin Registry, Mosing et al. (2012) showed that the general propensity to flow is determined both by genetic and environmental influences. Internal locus of control (the feeling that the individual can exert control over his/her environment) and low propensity to experience anxiety are also correlated with propensity to flow.

In the twin study a more intensive examination was performed of "monozygotic twin pairs discordant with regard to piano playing" (Eriksson et al. 2016). In each pair one of the partners had spent a lot of time playing the piano throughout life whereas the other one had not done so. The estimated difference in piano playing hours in adult years between the twin partners ranged from 1456 to 7800 h. Ten such pairs were studied from many points of view. As expected the propensity to flow experiences related to music was significantly higher in the playing twin, speaking in favour of a strong environmental component in music related flow. This did not generalize to the score for propensity to flow in general, however, which was not higher in the playing twin partner than in the twin sibling. In addition a high correlation was observed between reward at work and general propensity to flow ($r=0.74$, $p=0.0002$, $n=20$).

14.2 Physiology of Peak Flow During Performance

In a study which our group performed on highly professional pianists the participants were asked to play a self-selected very difficult piece that they liked and had played in several concerts (de Manzano et al. 2010). They were asked to do so on five occasions in the laboratory. After each playing session they were asked to fill in a short questionnaire (Csikszentmihalyi 1990) designed to assess flow. Psychometric analyses showed that the core concept of flow in this situation could be characterized by means of three dimensions, namely high degree of arousal, self-evidence in execution (autotelic) and elated mood. Out of the five occasions, the occasion with the highest total score for flow was selected and the physiological state was compared between this "flow" occasion and the other occasions. The results showed that there was significantly (1) increased activity in the major zygomaticus muscle (the "smiling muscle"), (2) higher level of arousal (higher heart rate and blood pressure) and (3) deeper and slower breathing during the occasion with the maximal flow than during the other conditions.

The results in the pianist study indicate that during flow there is a joint activation of the sympathetic and parasympathetic systems. The state of high arousal could thus be counterbalanced by a concomitant activation of the parasympathetic system, effected by a breathing pattern with deep slow breaths. Further support for this theory regarding the psychophysiology of flow was derived from a non-musical experience, namely video game playing (Harmat et al. 2015). In this experimental study, the video playing conditions were manipulated in such a way that participants were exposed to "easy", "optimal" (corresponding to flow when the level of difficulty was high but had been adapted to the individual capacity), and "difficult" (when the level of difficulty was slightly above the individual capacity) playing conditions in random order. The results showed that the state of arousal (heart rate) was comparable in the "difficult" and "optimal" conditions but that the participants had larger respiratory depth during the "optimal" condition. This confirms in a more general setting the importance of the parasympathetic system activation in successful counterbalancing of the high arousal state which arises when a subject is performing at a near maximally difficult situation. Accordingly, peak flow experiences must exist in other non-stage situations at work as well.

In a study of professional singers and flute players (Harmat and Theorell 2010) recordings of heart rate variability were made when each one of the musicians performed a strenuous and an easy piece at rehearsal and at concert. Not unexpectedly the heart rate was at its highest level when they performed the strenuous piece in front of an audience than during the other three conditions. Another observation was that those who reported nervousness before concert had a more pronounced decrease in heart rate variability than the others, indicating a poorer activation of the parasympathetic system in these subjects.

Both reward and flow represent two positive aspects of work. As indicated above (Ståhl Fagerlind 2015), the possibility to exert control seems to be an important condition for work-related flow. The experience of flow, regardless of whether we consider it from the point of view of transient peak experiences of flow or from a more every-day perspective, is a fundamental aspect of a positive life. An individual who has not been given the privilege to learn something difficult which requires hard efforts and to feel that his/her efforts have paid off in an elated feeling that he or she is in control of the situation is a reward in itself. Interestingly the work-related flow feeling is also related strongly to the feeling of being in control. That there are links also to parasympathetic activation during high arousal is interesting in the light of everyday variations in "being in control". Collins, Karasek and Costas (2005) have described how variations in self-reported decision latitude (control) at work correlates with heart rate variability (HRV) – in general when the participants felt that they were exerting control over their situation, the HRV pattern changed in a way that was indicating elevated parasympathetic activity.

14.3 Combining the Three Concepts Control, Flow and Reward

Karasek (2008) has applied the second thermo-dynamic law to a discussion about energy storage and release in workers. According to this model, periods of regeneration of energy (restitution/anabolism) with dominance of parasympathetic activity are interfoliated with periods of energy release dominated by sympathetic arousal. A theoretical model which incorporates control, flow and reward in one and the same model would postulate that a high level of decision latitude (control), with good possibility for workers to participate in decisions (decision authority) and good possibility for them to develop skills (skill discretion) needed for the exertion of control particularly in unexpected situations, is a necessary (but not the only) requirement for flow experiences at work. This would allow workers to train skills so that they feel they can focus and to manage difficult tasks and mobilize parasympathetic activity in situations with high arousal. Such flow experiences seem to be an important ingredient in reward at work.

Conceived in this way, “reward” is defined as an intrinsic state of the working person. According to ERI theory, however, social reward (wage, promotion prospect, job security, esteem) matching previous effort is considered a transactional process involving a giving and a receiving relationship. Thus, it is part of the extrinsic opportunity structure at work, in addition to the opportunity structure of task control and skill discretion. It is necessary to make this distinction theoretically since the real-life applications of the ERI theory have to do with improved structures at work for such opportunities. Of course, such transactions are expected to result in strong positive (protective, regenerative) emotions triggered by the brain reward system, and to some extent such emotions may be experienced as flow or elation (see also Chap. 1).

14.4 Environment and Individual, Positive and Negative Factors: A Theoretical Model

Figure 14.1 (Theorell 2012) presents an image of the interplay between environmental and individual factors in the workplace. There are three levels in the diagram – to the left stressors and regenerative factors (anti-stressors corresponding to the environment), in the middle coping (corresponding to the individual’s positive and negative ways of handling the environment) and to the right stress/regeneration reactions (corresponding to the responses themselves). Each level theoretically

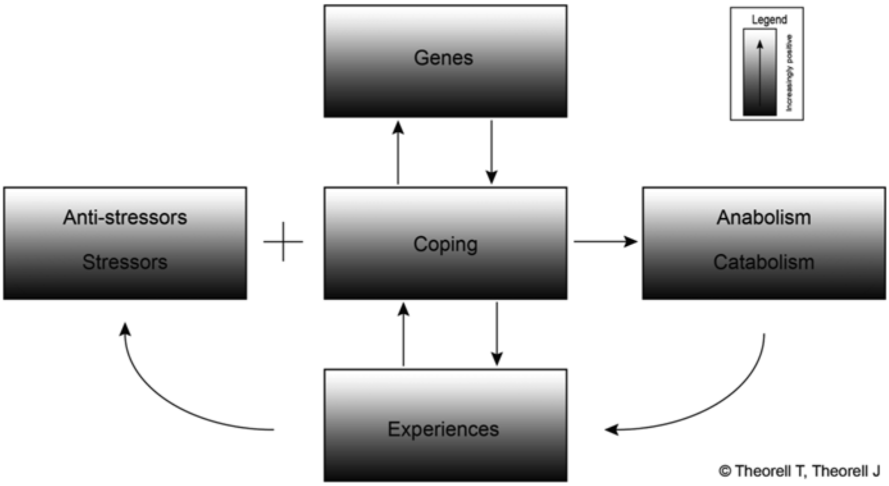

Fig. 14.1 Schematic presentation of the interplay between environment (*left*) and individual (*middle*) in responses (*right*)

represents a level for intervention efforts. The environmental level corresponds to work organization interventions. The individual level represents efforts to strengthen the individual's ability to handle the environment. The response level represents efforts to improve the response itself (for instance psychotherapy and pharmacological therapy reducing stress reactions). The diagram illustrates that the processes include "positive" (anabolism or regeneration) and "negative" (energy mobilization (stress) aspects. The lower black parts of the squares represent "stress"/"energy mobilization" whereas the upper white parts represent "anabolism" or "regeneration". The floating border between black and white illustrates that stressors can become anti-stressors and vice versa. For instance, an organizational change that is expected to benefit the health of the employees may turn out to be bad if it is poorly planned and executed. A passive coping pattern may be beneficial in an acute situation but if it is practiced in all situations for a long time in an adverse job situation it could have adverse effects on health in a longer time perspective. Anxiolytic medication may work in an acute situation but could be dangerous to health if practiced excessively.

The individual's coping programme is shaped by an 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. Accordingly, the individual is not a static machine which has been built in the beginning of life by genes and childhood. Old individuals may change coping patterns when the environment changes. We have seen this in several evaluations of psychosocial interventions performed on elderly subjects (Arnetz et al. 1983; Lökk et al. 1991; Wikström et al. 1993). These studies show that coping patterns may change also in old subjects when psychosocial intervention programmes are introduced. This also means that educational approaches could influence coping patterns which is the basis for individual stress management. The coping level corresponds to stress reduction aimed at changes in the attitudes and strategies for dealing with stressors in the workplace, rather than changing the stressors themselves. This type of stress management is mostly based on behavioural therapy principles – for instance, “mindfulness”, “heart math” or other similar systems for stimulating the individual to systematically analyze his/her own situation in relation to the environment.

The “interpretation” of the stressors and the subsequent handling of them (coping) is a result of genes 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 stressors and coping will develop, and how the physiological and psychosocial reaction will be. An important goal in worksite-based stress management programmes is, accordingly, to increase the likelihood that an employee will have positive outcome expectancies – a way of reducing individual stress reactions. The CATS theory is related to the ERI model in the sense that those who have experienced positive feedback and reward in many situations, sometimes in the form of positive feedback from superiors or colleagues and sometimes in the form of flow – which could mean positive feedback from the work process itself – are more likely than others to have a positive expectancy in stressful situations.

Epigenetic research has shown that strong social stimuli can activate and deactivate genes that are relevant for stress reactions. This means that the environment also influences the sensitivity of the genes themselves. Even the chemistry of such changes is beginning to be explored. One of the known mechanisms is methylation of genes (Szyf 2012; see also Hunter et al. 2014).

14.5 Balance Between Energy Mobilisation and Regeneration

My version of the psychophysiological background of stress reactions has been described more in detail elsewhere (e.g., Theorell 2009). It has been stimulated to a great extent by Henry (1982). One of the central parts of the stress reaction is the Hypothalamic Pituitary Adrenocortical (HPA) axis, extending from the hypothalamus to the adrenal cortex (see Fig. 14.2). 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

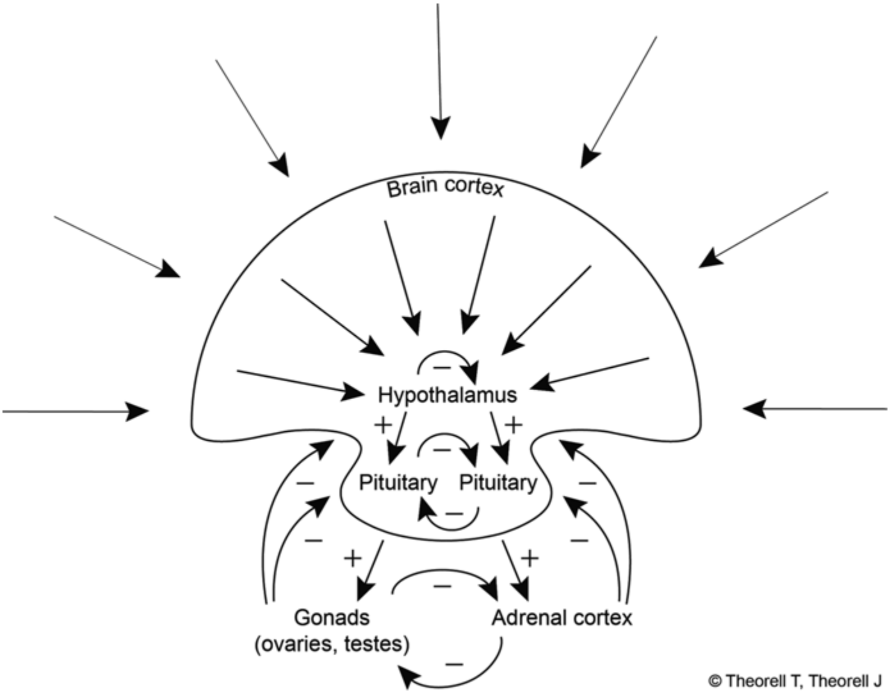

Fig. 14.2 The stress reaction and its positive counterpart, regeneration. Schematic presentation of the interplay between energy mobilization (*right hand side*) and regeneration (*left hand side*) from the hypothalamus through the pituitary to the endocrine end organs

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 inhibition of acute inflammatory reactions. However, if the stressor is long-lasting, those 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), such as those taking place in the sympatho-adrenergic system (noradrenalin) and in the sympathomedullary system (adrenalin).

There is also a "good" counterbalancing system (an anti-stress system) which protects from adverse effects of long-lasting stress. This HPG (Hypothalamo Pituitary Gonadal) axis has the same levels as the HPA axis, ranging from the hypothalamus to the gonadal glands. The balance between the HPA and HPG axes is illustrated by Fig. 14.2. The HPG axis represents the "regenerative" or "anabolic" part of metabolism. The male testes and the female ovaries are the end organs of this axis, and they represent the extremes of this activity, 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, however, is closely related to this. 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 separation in the left and right side of Fig. 14.2 is theoretical and not anatomical. Cells producing hormones that are mainly active in regeneration are located in the adrenal cortex, which is mainly producing and releasing hormones that are active in energy mobilization. The diagram illustrates that 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 (years, 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. Similarly, white blood cells have to be replaced when they are worn out. If not, increased resistance against 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 contributing for instance to deteriorating short memory function. Testosterone and oestrogen, as well as their precursor DHEA-s (dehydroepiandrosterone sulphate), 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. Thus, the balance between HPA and HPG activity is an important principle in health promotion. We are constructed for a life in "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 interspaced with periods of regeneration and recuperation. In a symbolic (but not anatomical) way energy mobilization is represented by the sympathoadrenomedullary system and the HPA axis while regeneration is represented by the parasympathetic system and the HPG axis. Our hypothesis is that in the peak flow experiences the two systems may be highly active at the same time.

Long term exposure to stressors gives rise to toxic effects of stress hormones, immune system hyperactivity and elevated blood pressure and it also causes disturbed regulation of energy mobilization suppresses and weakens the good positive regenerative forces in the HPG axis activity (see Mc Ewen and Wingfield 2003).

14.6 Work Organization Improvement Versus Individual Stress Management

As has been pointed out by several reviews recently (see for instance Ahlbäck Öberg and Wockelberg 2012) there is an increasing societal orientation towards blaming the individual for his/her wellness. This tends to lead us away from work organization interventions and collective efforts. Most of the contemporary anti-stress literature is therefore on individual stress management programmes. However, if work organization is functioning poorly, individual stress management programmes are not likely to have lasting effects. There are several examples of work organisational efforts that have been evaluated with regard to employee health effects. Most of these intervention programmes have tried to improve both decision latitude and reward for employees (Semmer 2006). A recent Cochrane review included 39 job site interventions including a wide range of organisational as well as physical interventions with evaluation of employee health effects. Success rates were higher among more comprehensive interventions tackling material, organisational and work-time related conditions simultaneously (Montano et al. 2014).

An idea that has been tested by our group is that teaching leaders about psychosocial factors in relation to employees would benefit the health of subordinates. Such interventions are usually not included in reviews of work organisation interventions although in my opinion they should be. I will report more in detail on two studies from our group because they illustrate how control and reward as well as employee health can be beneficially affected by improvement of managers' psychosocial competence.

The *first evaluation study* (Theorell et al. 2001) was planned during the Spring 1998. During that period, Sweden was in 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 business 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. During the study period, no pronounced change in this particular company's market conditions took place, but there was a constant discussion about such a change 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 good psychosocial knowledge would be more able to handle employee anxiety and, accordingly be able to prevent dysfunction in the organization during the turmoil better than managers with poor psychosocial knowledge. 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 for 2 h each time. The meetings consisted of a lecture lasting for half an hour, 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 meant that they could support one another during the intervention year. 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. Accordingly a similar department of the same insurance company was assigned to be control group. This department 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) were collected before start, as well as after 1 year. The results from the questionnaires showed that there was a significantly more favourable development of 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 who provided blood sample collections (130 in each group), morning serum cortisol remained unchanged during the study year in the control group, but decreased in the experimental group – with a significant Group × Time interaction effect. Important characteristics in the design and interpretation were the following ones:

The initiative came from management, not from the employees or union. Although the target of the intervention was the manager group, one of the specific aims of the programme 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 favourable development in the experimental group, both in the managers themselves and in employees. Indeed, improved decision authority has been shown to be an important mediator of improved employee health in successful psychosocial job site interventions (Bond and Bunce 2001; Jackson 1983). 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. Although speculative, this could also have created an improved basis for work-related flow as well as reward for the employees.

Biological indication of reduced stress level 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 then subsequently on the whole employee group.

It could be argued, since there was only one intervention group and one control group, that non-recorded irrelevant factors could explain the difference in development. While this may theoretically be true, we found no competing processes in the two halves of the organization that were likely to explain the difference. There was no effect on work demand or work tempo. The significant psychosocial effect that was observed was a more favourable development of decision authority in the intervention group (both among managers and subordinates) than in the other group during the study year. This was associated with reduced morning cortisol, which is in this relatively healthy working population an indication of reduced energy mobilization, ie decrease HPA activity. The most likely interpretation is that the intervention programme had reduced the stressors by improved influence over decision for the employees and, thereby, decreased their level of energy mobilization. Unfortunately there was no assessment of biological regeneration so there was no possibility for us to explore the effects on balance between HPA and HPG activity.

There was no qualitative evaluation of the intervention programme. The researchers even deliberately avoided extensive qualitative interviewing because it was felt that this could have had an adverse effect on the course of the psychosocial process. However, interviews with the personnel management after the end of the intervention year showed that the managers in the psychosocial intervention group were more sensitive to the psychosocial needs of their employees, so an effect of the programme was clearly visible. Although not specifically assessed, this is likely to have influenced the reward dimension favourably. That reward can be favourably influenced by psychosocial work site interventions has been shown in other studies (Bourbonnais et al. 2011; Limm et al. 2011)

The *second evaluation study* (Romanowska et al. 2013, 2014; Romanowska 2014) included assessment of a hormone related to the activity in the regenerative system (HPG axis), namely De-Hydro-Epi-Androsterone sulphate (DHEA-s). This intervention was based upon a different educational principle than the first one. In addition, the framework was different because the participants in the study did not represent whole organizations. They came from many companies/agencies, and represented themselves only. Therefore, they did not enjoy the support from other managers who had taken part in the same education concomitantly.

The participating managers were recruited among managers who had applied for manager education. They were informed that they would be randomly allocated into two different groups, and that extensive examinations would take place with them during the process (before start, after 1 year and after 18 months). If they did not accept these conditions before randomization had taken place, they were not recruited for the study. The basic new educational idea was that managers need training in empathy. Aesthetic experiences may give important educational triggers in such a learning process and, therefore, the managers in the "artistic training"

Table 14.1 Plasma DHEA-s concentration (micro-mol/l) in two groups (Schibbolet and conventional) with leaders and subordinates together (similar findings for subordinates only) before start (baseline), after 12 months and after 18 months (Romanowska et al. 2011)

	Baseline	12 months	18 months
Schibbolet	4.93 ± 0.39	4.88 ± 0.37	4.55 ± 0.35
Conventional	4.90 ± 0.32	4.62 ± 0.30	4.21 ± 0.28

group were subjected to a collage of poems with adjacent emotionally adapted music – Schibbolet performances. The topics in the Schibbolet performances were related to human suffering, and also related to the responsibility that human beings may have in situations that are dangerous for their colleagues. The topics were not necessarily related to work situations but, rather, to more general situations. They were, however, certainly translatable into situations that managers encounter in their employee contacts (e.g., when bullying arises against an employee). There were ten Schibbolet performances during the intervention year, and the performances were always systematically followed up with group discussion (in the large group and in smaller groups) led by experts. In addition, the participating managers were asked to write diaries after each performance. Notes from the diaries were used in follow-up talks.

The intervention programme for the managers in the comparison group was very similar to the programme in the first study with short lectures, group discussions, participants telling one another how they solve problems and home lessons. The amount of time, frequency of lectures etc were comparable between the two groups. For both groups the intervention periods were started after a high quality widely accepted short course in leadership lasting for 2 days. This course was the same for both groups of managers. In the evaluation of the Schibbolet study there were assessments of plasma cortisol and DHEA-s, representing energy mobilisation (HPA) and regeneration (HPG) before start, after 12 months and after 18 months (Romanowska et al. 2011) both in the managers themselves and in subordinates.

The 1-year follow-up showed that – as in the previous evaluation study – plasma cortisol tended to decrease in the conventional group, possibly indicating a tendency to decreased energy mobilisation. In the Schibbolet group the plasma cortisol concentration tended to increase. After 18 months there was no difference between the groups from this point of view. However, the plasma concentration of the regenerative indicator, DHEA-s, developed differently in the two groups with a more favourable development in the Schibbolet group. The group difference was not yet significant in subordinates associated with the respective managers after 12 months but became significant after 18 months. Table 14.1 shows the results for the combined groups (leaders and subordinates together) in the Schibbolet and control group respectively.

The results show that the DHEA-s concentration decreases in both groups. This general tendency could be explained by a small aging effect (there is a strong decrease in DHEA-s concentration with increasing age, despite the short period a small effect is expected) and a seasonal effect. The latter effect is due to the fact that the first two measurements were made during the spring while the 18 month follow-up was made in November when several endocrine measures show deterioration. However, there is a striking difference in development between the two groups – the observed decrease is much smaller in the Schibbolet group. It is as if the subordinates of the Shibbolet managers, relatively speaking, were protected from normal anabolic deterioration during the winter season. Two-way analysis of variance showed a statistically significant difference in development in the two groups ($n=49$ in Schibbolet and 74 in conventional group, $p=0.003$), and the group difference in DHEA-s development was statistically significantly different between the groups also when the analysis was confined to subordinates only ($n=31$ in Schibbolet and 58 in conventional group, $p=0.027$).

The DHEA-s finding was accompanied by parallel significant findings after 18 months in the subordinates in favour of the Schibbolet group for mental health (sum of sleep disturbance, depressive symptom and emotional exhaustion), covert coping and performance-based self esteem. DHEA-s is an interesting hormone because of its relationship to regeneration. Lennartsson et al. (2013a, b). The plasma concentration of DHEA-s is lowered in subjects who live in a longlasting stress situation and in addition it has been shown that the ability to respond with increased DHEA-s level in acute stress situations is lowered in these subjects.

The managers themselves had changed differently (in favour of the Schibbolet group) in the two groups already after 12 months with regard to variables which could be assumed to have particularly strong importance for the health of the subordinates. These were (Romanowska et al. 2013) *agreeableness* (one of the standard personality traits in the "Big Five") which is close to empathy and engagement in others, *sense of coherence* which relates to the manager's ability to handle stressful situations and finally *laissez faire* (the opposite of engagement). An interesting observation (Romanowska et al. 2014) was based upon the fact that the score for laissez faire was calculated both from the managers' own responses to the standardised questionnaire and from the responses of their subordinates who were asked to answer the same questions about their managers' laissez faire before and after the intervention year. The results showed a statistically significant discrepancy with regard to development of laissez faire/engagement – the Schibbolet subordinates rated improved engagement from their managers while the managers themselves in this group self-reported a deterioration from this point of view. In the other group the discrepancies went the opposite way – the managers considered themselves to have improved while their subordinates reported decreased engagement in their manager. This discrepancy could be explained if we assume that as a consequence of the programme several of the Schibbolet managers became aware of a problem (awareness of psychosocial needs in the subordinates) that they had not thought of previously. In the other group the managers may have reinforced one another (in their groups settings which were part of the programme) in behaviours perceived by the subordinates as disengaged laissez faire behaviours.

Due to the fact that the manager participants in this latter study came from many different organisations and could not support one another, the effects of the intervention on organisational aspects may have been weaker than in the first study. The art based programme was aiming more specifically at improved empathy and engagement in the individual managers and this may have been less sensitive to the lack of support from manager colleagues. In parallel with the first study the effects on subordinates were not immediately observed, at first after 18 months.

How can we link the two intervention studies to the general model introduced in this chapter, the one including control, flow and reward? In a general sense empathy (agreeableness) and ability to handle organisation stress (sense of coherence) were more beneficially affected in the Schibbolet participants. Perhaps this has allowed the subordinates of the Schibbolet managers to feel more flow, to "relax" with increased parasympathetic activity in demanding situations? Neither work-related flow nor reward at work were assessed but indirect evidence for this kind of effect was found. The favourable development of DHEA-s as well as lowered performance-based self esteem and lowered scores for covert coping could be regarded in this way. However, the most important conclusion to be drawn from this is that the three concepts control, flow and reward at work should be linked to one another in future job intervention research.

14.7 Conclusions

In this contribution the complicated interplay between control at work, work-related flow and reward at work is reviewed. Our knowledge regarding how they are interrelated is limited but a general hypothesis is formulated which links them to one another. There is evidence indicating that experience of control and frequent flow may be important anti-stressors (see Fig. 14.1) adding to the total feeling of reward. All of these concepts are important in psychosocial interventions. However, in order to understand this in future research efforts we have to regard the processes themselves as part of the research task. As has been formulated by a Danish group of researchers: "*The results indicate that employee participation in intervention processes is crucial in what appears to be an important association with perceived changes in procedures and*, *therefore*, *in intervention outcomes*" (Nielsen and Randall 2012).

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Chapter 15
Workplace Interventions Aiming to Improve Psychosocial Work Factors and Related Health

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15.1 Introduction

Cardiovascular diseases are the main cause of death in men and women worldwide. According to the World Health Organization (WHO), 17.5 million people died from CVD in 2012 which represents 31 % of all deaths (WHO 2011). Hypertension is the leading CVD risk factor (Kearney et al. 2005; Ezzati et al. 2002). Globally, approximately 54 % of strokes and 47 % of coronary heart diseases are attributable to high blood pressure (Lawes et al. 2008). For their part, mental health problems account for close to a third of the disease burden associated with non-communicable diseases in high income countries (WHO 2008). Depression and anxiety altogether represent the second leading reason for visiting a general practitioner in Canada (IMS Health Canada 2010). Mental health problems also are the first or second cause of sickness absence from work (Henderson et al. 2005) and represent the leading cause of disability for ages 15–44 (WHO 2002). Certified sickness absences from work for mental health problems usually have a long duration and a high risk of recurrence, thus leading to a considerable social burden and loss of productivity (Koopmans et al. 2011; Henderson et al. 2005).

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As presented in Chaps. 5, 6, and 7, prospective evidence has been accumulating on the deleterious effects of adverse psychosocial work factors, on the development of CVD (Gilbert-Ouimet et al. 2013; Babu et al. 2014; Kivimaki et al. 2012; Nyberg et al. 2013; Landsbergis and Schnall 2013) and mental health problems (Ndjaboue et al. 2012; Bonde 2008; Stansfeld and Candy 2006; Netterstrom et al. 2008). Two well-defined and internationally recognized theoretical models are generally used to measure psychosocial work factors: the effort-reward imbalance (ERI) (Siegrist 1996) and demand-control (Karasek 1979) models. 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 (job security, promotion prospects, unforced job changes) (Siegrist 1996). Workers are in a state of detrimental imbalance when high efforts are accompanied by low reward, and thus more susceptible to health problems (Siegrist 1996; Siegrist et al. 2004). For its part, the demand-control model suggests that workers simultaneously experiencing high psychological demands and low job control (job strain) are more likely to develop stress related health problems (Karasek 1979). In prospective studies conducted in industrialized countries, about 20 % of workers are exposed to these adverse psychosocial work factors (Brisson et al. 2011). In the current globalized economy, organizations are facing ever-stiffer competition and workers are consequently being increasingly exposed to adverse psychosocial work factors, mainly increased workload and precariousness (Algava et al. 2014; Quinlan et al. 2001; Eurofound 2015).

Workplace interventions aiming to improve work environment characteristics, including psychosocial work factors, have been recommended two decades ago by the World Health Organization (1995) and reaffirmed in 2001 by the International Labour Office (2001) and in 2004 by the London department of health (Department of health 2004). If preventive interventions are successful in reducing adverse psychosocial work factors (intermediate effects) they could also lead to the reduction of work-related health problems, such as high blood pressure, CVD, and mental health problems (final effects).

This chapter will first present a brief overview of evidences regarding the effects of preventive intervention aiming to reduce adverse psychosocial work factors and related health problems. This overview will be followed by a discussion of important quality criteria required to conduct solid research in this area. In the third part, three psychosocial workplace intervention studies meeting most of these quality criteria will be presented in depth. Finally, public health policies aiming to help reducing adverse psychosocial work factors will be discussed.

15.2 Overview of Psychosocial Workplace Interventions Studies and Health

A number of systematic reviews have been conducted to evaluate the effects of workplace interventions aiming to improve work characteristics and related health outcomes (Ruotsalainen et al. 2015; Richardson and Rothstein 2008; Corbiere et al.

2009; Egan et al. 2007; Montano et al. 2014). The systematic review conducted by Egan et al. (2007) is the only one systematic review which included specifically studies in which the intervention aimed at improving adverse psychosocial work factors which can be related to the ERI or the demand-control models. This review included 18 intervention studies published between 1981 and 2006. The study was restricted to interventions aiming *to increase employee's opportunities to make decisions or participate in decision making process at work* (Egan et al. 2007). The studies included had to evaluate health effects, but no restrictions were made regarding the type of health outcomes (ex. mental health, physical health, absenteeism and physical measures). Twelve studies out of 18 were prospective with a control group. Altogether the results were mixed. Indeed, in 8 studies out of 18 there were improvements of psychosocial work factors and in 11 studies out of 18 there were 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 sub-group improvements in workers' health were observed in the large majority of studies i.e. seven out of the eight studies. One of these studies targeted the ERI model directly (Bourbonnais et al. 2006a). This study will be presented in depth in Sect. 15.4 of this chapter.

Three other systematic reviews were restricted to (Montano et al. 2014) or made separate analysis for (Ruotsalainen et al. 2015; Richardson and Rothstein 2008) organizational-level intervention studies. Organizational-level interventions refer here to interventions aiming to improve workplace characteristics as opposed to interventions aiming to act at the individual level by enhancing the capacity of individuals to cope with adverse psychosocial work factors. However, unlike in the review by Egan et al. presented previously, the interventions evaluated in these reviews combined organisational-level interventions on adverse psychosocial work factors with other organizational-level interventions such as physical conditions, exposure to noise or chemical agent, working time, schedule, etc. In the systematic review by Montano et al. (2014), the interventions were classified according to three categories of targets: (1) material conditions, (2) work time-related conditions and (3) work organization conditions including psychosocial work factors of the effort-reward and the demand-control models. Thirty-two studies published between 1993 and 2011 included at least one intervention in the work organization category. Compared to interventions on only one of these three categories of targets, interventions addressing targets in more than one category were more likely to report a significant health improvement. Indeed, significant health improvements were reported for 6 of the 16 studies when only work organization conditions were targeted, one of three studies when work organization were combined with time conditions, six out of ten studies when work organization conditions were combined with material conditions and three out of three studies when all three conditions were targeted. In the systematic review and meta-analysis by Ruotsalainen et al. (2015), 21 organizational-level intervention studies conducted in health care workers between 1993 and 2013 were reviewed. In these studies, the intervention aimed at improving work schedule, work conditions, support, care, and communication skills. The outcomes evaluated included a number of scales such as the Maslach Burnout Inventory (MBI) scale, the Nurse Stress Scale, the Perceived Stress Scale and the General Health Questionnaire. Note that psychosocial work factors were considered as stress outcomes. This meta-analysis showed that improving the work schedule was significantly associated with a reduction in workers' stress level (Standardized mean difference (SMD) = −0.55 (95 % CI −0.84 to −0.25), two trials, 180 participants). No clear benefit of any other organizational-level interventions was observed. In the systematic review and meta-analysis by Richardson et al. (Richardson and Rothstein 2008) five organizational-level studies conducted between 1983 and 2000 were included. The intervention aimed at improving social support, participatory action, promotion program and problem-focused coping. The health outcomes included general mental health, general physical health, anxiety, depression, emotional exhaustion (MBI) and absenteeism. The effect size, defined by the mean differences between intervention and control group, was non-significant (SMD = 0.144 (95 % CI −0.123 to 0.411), five studies, n = 221 participants).

Finally, in the systematic review by Corbières et al., organizational-level intervention studies were not evaluated separately but in combination with interventions at the individual level, such as cognitive-behavioral interventions, relaxation technics and physical exercises (Corbiere et al. 2009). The authors mentioned that interventions aiming to improve adverse psychosocial work factors, including ERI, combined with a participatory approach, observed significant improvements of workers' mental health (Corbiere et al. 2009). This last observation was based on three studies, one of which will be presented in depth in Sect. 15.4 (Bourbonnais et al. 2006a).

The systematic reviews presented above show that workplace intervention studies have led to inconsistent findings (Ruotsalainen et al. 2015; Richardson and Rothstein 2008; Corbiere et al. 2009; Egan et al. 2007; Montano et al. 2014). Indeed, approximately half of the studies observed improvements of psychosocial work factors or improvement in workers' health (Ruotsalainen et al. 2015; Richardson and Rothstein 2008; Corbiere et al. 2009; Egan et al. 2007; Montano et al. 2014). These inconsistencies could be explained by a number of methodological limitations. In addition, workplace intervention take place in complex social structures and often include multiple components (Goldenhar et al. 2001). A better understanding of the content and context of the intervention may also contribute to explain their varying effectiveness. In order to advance our knowledge in this area a number of important issues have to be taken into account (Nielsen and Randall 2013). The next section of this chapter will discuss these issues through the presentation of criteria required to conduct high quality workplace intervention studies.

15.3 Criteria for High Quality Psychosocial Workplace Intervention Studies

The framework elaborated by Goldenhar and colleagues (2001) suggests three phases for a rigorous intervention research process (Goldenhar et al. 2001), namely: (1) the development phase, (2) the implementation phase and (3) the effectiveness phase. The development phase aims at identifying changes needed to improve health and the best ways to bring about these changes. The implementation phase aims at systematically documenting how an intervention is carried out. The effectiveness phase evaluates whether the intervention was successful in reducing adverse work factors (intermediate effects) and related health problems (final effects). Figure 15.1 presents an adaptation of Goldenhar's framework. The figure describes the questions that need to be answered at each phase as well as suggestions for the corresponding quantitative and qualitative methods that can be used to answer them. The quality criteria presented below cover all three phases of the intervention research process.

One of the first steps of a workplace intervention is to obtain a *strong commitment from head and line managers* of the participating organization(s) (Nielsen 2013). The implication and support from the managers favor the development and implementation of organizational changes required to reduce adverse work factors. Managers commitment could include communicating (or allowing researchers to communicate) relevant information to employees and promoting their involvement in the intervention process. The use of a participative approach where employees are involved in the planning and implementation of interventions may help determining how and why interventions work (Nielsen and Randall 2013). Such participative approach stimulates the synergy between the actors responsible for interventions implementation (managers, employees and-or researchers) (Corbiere et al. 2009; Montano et al. 2014). The lack of commitment from managers and/or employees is one of the main reasons pointed out in recent literature reviews to explain the mixed results of organizational-level interventions (Montano et al. 2014; Corbiere et al. 2009; Egan et al. 2007). Since this commitment might influence the success of each intervention phase, it needs to be reaffirmed throughout the whole process of the intervention.

The development phase of the intervention should include *an* a priori *risk evaluation* to identify which groups are most at risk within the study population (Goldenhar et al. 2001). An a priori quantitative assessment of adverse psychosocial work factors and health outcomes will help identifying these groups. However, the risk assessment of adverse psychosocial work factors faces unique challenges. Research on chemical or physical hazards typically allows the specification of exposure standards, which can be used in the regulation of exposure to potential sources of illness. However, such thresholds are not readily available for adverse psychosocial work factors. A useful approach is to compare the prevalence of psychosocial work factors and health indicators in a study organization with reference populations, thus providing a "barometer" of the importance of psychosocial exposures and health outcomes within the study organization. Adverse psychosocial work factors whose prevalence is found to be greater than that of the reference populations can then be deemed "in excess" and identified as targets for intervention. Since the reference populations and the intervention population may differ regarding potential confounders, such as age, socioeconomic characteristics, and gender, a statistical adjustment for these factors or other methods to take these factors into account are recommended to provide a valid risk assessment.

	1. Development	2. Implementation	3. Effectiveness
PHASES	• What theories apply? • What changes are needed? • What are the best ways to bring about changes?	• Type of changes? • How many workers are affected by changes? • Actual degree of transformation achieved?	To what extent does the intervention reduce: 1. Adverse work organization factors? (intermediate effects) 2. Health problems? (final effects)
EXAMPLES OF CORRESPONDING METHODS			
• Quantitative	• *A priori* risk assessment		Quasi-experimental studies with pre-and post-intervention measurements and a control group
• Qualitative	• Focus groups with employees • Meetings and follow-ups with managers and union representatives or intervention teams	• Intervention log books • Focus groups with employees • Meetings and follow-ups with managers and union representatives or intervention teams	

Fig. 15.1 Three-phase intervention study design with corresponding questions to answer and examples of quantitative and qualitative methods (Adapted from Goldenhar et al. (2001) and Brisson et al. (2006))

The a priori risk assessment of psychosocial work factors and health outcomes and the evaluation of effects require the use of *validated instruments*. Validated instruments to measure exposures to adverse psychosocial factors have to be theoretically and empirically supported (Bambra et al. 2007; Nielsen et al. 2006; Corbiere et al. 2009). Such instruments do exist for psychosocial factors defined by the ERI model (Siegrist 1996) and the demand-control model (Karasek 1979). A number of self-reported validated scales are likewise available to measure mental health outcomes (Muntaner et al. 1998; Kessler et al. 2002; Ilfeld 1976). Objective measures of health should also be used when possible. Objective health indicators are not subjected to self-report bias (Rothman et al. 2008) and therefore provide important support for the validity and impact of the results. Ambulatory blood pressure measurement is a well suited objective cardiovascular health indicator which has several important advantages over the more classical clinic blood pressure measurement. Ambulatory BP also offers better precision and validity, by capturing the BP fluctuations related to daily life (O'Brien 2003). Ambulatory BP measurement is also known to avoid three sources of bias: the observer error, the "white-coat effect" and masked hypertension (Bobrie et al. 2008; Cloutier et al. 2015; O'Brien 2003). Prospective studies showed that ambulatory blood pressure measurement is a much stronger predictor of cardiovascular morbidity and mortality than clinic blood pressure measurement (Grossman 2013; O'Brien 2003).

The development phase also aims at identifying organizational changes needed to eliminate or reduce adverse psychosocial work factors identified as intervention targets and determining how these changes can be optimally implemented. Qualitative tools such as *focus groups and follow-up meetings with employees and managers* could be used to develop well-adapted interventions. These complementary tools also stimulate the continuous implication of both employees and managers in the development and implementation processes.

The implementation phase also requires ***a systematic documentation of how an intervention is carried out***. This comprises a thorough description of the changes implemented in order to: (1) understand how intervention priorities established at the start of the process may be translated by workplace actors into organizational changes and (2) enlighten an intervention success or failure at improving intermediate and final outcomes (Robson et al. 2001; Goldenhar et al. 2001). Documenting the changes implemented will help determining whether the intervention was ineffective or whether it may have been effective but was not properly implemented (Kristensen 2005). As pointed out in a recent literature review of workplace interventions studies (Egan et al. 2009), many studies referred to implementation, but reporting was generally poor and anecdotal in form.

There is often no "one size fits all" solution to improve the psychosocial work environment. Interventions often have to be tailored to an organization and to its local priorities and context. Since adverse psychosocial work factors can take a variety of forms, improving them often requires the use of *multiple components* solutions. Indeed, even though single target interventions may be successful in addressing one specific problem, more comprehensive interventions addressing several organizational-level targets tend to have a higher chance of improving workers' health (Montano et al. 2014; Corbiere et al. 2009).

There is no standardized way to record the changes implemented in psychosocial workplace interventions. A qualitative report of the changes is particularly important in contexts of: multiple components interventions, when changes implemented are specific to work departments, and when intervention priorities are translated into organizational changes by managers, instead of researchers (Bourbonnais et al. 2006a). Detailed logbooks (Gilbert-Ouimet et al. 2015) or updated action plans can be used as qualitative tools to record the changes implemented (Nielsen et al. 2006).

The effectiveness phase aims to evaluate whether an intervention was successful in reducing the prevalence of adverse psychosocial work factors (intermediate effects) and health problems (final effects). A number of quality criteria should also be considered at this stage to provide a valid evaluation of the intervention effectiveness.

First, a prospective design with pre and post intervention measurements and *a control group* are essential to provide a valid measure of intervention effects. A control group in which no intervention takes place is needed to compare workers exposed to the intervention to workers not exposed to the intervention over the same time period. The control group allows to distinguish the changes resulting from the intervention from the changes that would have naturally occurred over the same time period. It is crucial to discriminate the effect of these naturally occurring changes from the effect of the intervention per se (Kristensen 2005). The control group should be comparable to the intervention group in terms of socioeconomic, demographics and general occupational characteristics.

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). While a meaningful reduction of the prevalence of adverse work factors could occurs over some months, related improvements in health outcomes may take longer (Gilbert-Ouimet et al. 2011). Longer follow-up durations including more than one post-intervention measure will also make it possible to evaluate whether short-term improvements are sustained over time. It is noteworthy that the use of an inappropriate follow-up time will generally lead to an underestimation of the true effects (Rothman et al. 2008).

Third, a *good participation proportion* reduces the risk of introducing a selection bias due to difference between workers who participate in a study and those who do not (Rothman et al. 2008). Such a selection bias could lead to an under- or overestimation of the true effects. Participation rates should always be reported, at each measurement time. Differences between those who participated and those who did not should be carefully examined and reported. Statistical techniques, such as inverse probability weighting were also identified as appropriate analytical tools to mitigate the potential selection bias induced by loss to follow-up and could be used in workplace intervention studies facing high dropout rates (Howe et al. 2015).

Fourth, the *sample size* has to be sufficiently large to provide the statistical power needed to detect the expected effects of the intervention. One should bear in mind that changes in health outcomes following a workplace intervention can be of small magnitude and nonetheless have important public health implications. An appropriate sample size is necessary to detect such changes. Larger sample size also allows comparing the intervention effects in groups having different risks of illnesses, for example according to socioeconomic status and gender (Egan et al.).

Fifth, an appropriate *control for confounding factors* should also be performed. Confounding factors, such as lifestyle related and behavioral factors are likely to change over time. These factors should ideally be measured before and after the intervention. The use of single baseline measurements could result in residual confounding, leading to potential under or over-estimation of effects.

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 (RTM). This statistical phenomenon occurs when more extreme measurements tend to be followed by measurements that are closer to the mean (Barnett et al. 2005). In non-randomized workplace interventions, baseline levels of a given illness-related outcome might be higher in one of the compared groups. This discrepancy is sometimes even expected given the fact that the intervention is a priori designed to target groups with worse psychosocial and health profiles (Kristensen 2005). One solution often proposed to eliminate the RTM effect is to adjust for the baseline value of the health outcome. However, baseline adjusted analyses may be biased in the presence of RTM (Glymour et al. 2005). Although not feasible in all settings, a design with several (>1) pre-intervention time points have been recommended to mitigate the RTM effect in non-randomized interventions (Linden 2013).

Finally, cluster analysis should always be considered when the intervention is administered at the departmental level, i.e., when departments act as the unit in which the intervention is implemented (cluster). One consequence of clustering is that measurements on units within a cluster tend to be more similar (Fitzmaurice et al. 2004). Ignoring this correlation among individuals in the same cluster might lead to artificially low standard errors, increasing the risk of Type 1 error (i.e. conclude that a supposed effect exists when it doesn't). One should thus carefully examine the impact of within-department correlation on their study findings.

15.4 Description of Three Psychosocial Workplace Intervention Studies

This section will provide an overview of three psychosocial workplace intervention studies (Bourbonnais et al. 2005b, 2006a, 2011; Gilbert-Ouimet et al. 2011; Brisson et al. 2006) meeting most quality criteria discussed in Sect. 15.3. These three studies aimed to reduce adverse psychosocial work factors and improve mental health. In addition, in one study, the intervention effects on ambulatory blood pressure and hypertension prevalence were also assessed. Studies designs, examples of implemented organizational changes, main results, and contextual elements of these studies will be presented.

15.4.1 Common Grounds of the Three Studies

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. The three intervention studies included a control group composed of workers having comparable socioeconomic and work characteristics to those of workers of the intervention group. Participation proportions were very good in intervention groups and control groups, with most proportions ranging between 73 % and 86 % (Table 15.1).

The three intervention studies were supported by strong commitments from head managers of the participating organizations. These studies followed the three-phase framework of Goldenhar (Goldenhar et al. 2001) (Fig. 15.1): (1) During the development phase, the a priori risk evaluation consisted in a quantitative assessment of adverse psychosocial work factors and psychological distress. The adverse factors evaluated were high psychological demands, low job control, lack of social support from supervisors and colleagues, and low reward and their combination in the effort-reward imbalance model and the demand-control model. Validated questionnaires were used to measure these psychosocial factors (Karasek et al. 1998; Brisson et al. 1998; Larocque et al. 1998; Niedhammer et al. 2000) and psychological distress (Ilfeld 1976; Perreault 1987; Bellerose et al. 1995; Préville et al. 1992). This initial portrait allowed the identification of intervention priorities. (2) During the implementation phase, the interventions were implemented and systematically documented with a number of tools using mainly qualitative methods but also, to some extent, quantitative ones (Brisson et al. 2006; Bourbonnais et al. 2006b). 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 factors of the effort-reward imbalance model or the demand-control model. 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 managers representatives (Bourbonnais et al. 2005b). (3) During the effectiveness phase, the intervention effects were evaluated using quantitative assessment(s) of psychosocial work factors and health outcomes.

15.4.2 Populations and Specificities of the Three Studies

Table 15.1 presents the populations and designs of the three intervention studies. Here is a brief description of each study.

The long-term care centers study (Bourbonnais et al. 2005b) was conducted among health care 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. A multidisciplinary work team of

Table 15.1 Population at baseline and design of intervention studies on effort-reward imbalance and demand-control models and mental and cardiovascular health outcomes

Author Year	Population type, N (% women)	Intervention group (% participation)	Control group	Post-intervention follow-up(s)	Intervention	Outcome
Bourbonnais et al. (2005b)	Health care providers in 12 long-term care centers, N = 872 (78 % women)	195 health care providers of 4 centers (pre- and post-intervention: 81 % and 79 % participation)	298 health care providers of 8 centers (pre- and post-intervention: 82 % and 86 % participation)	12-month	A Priori assessment of psychosocial work factors and psychological distress. Identification of work constraints and development of action plans by intervention teams. Implementation of the plans by teams with support of direction. Documentation of the interventions	Psychological distress
Bourbonnais et al. (2006a, 2011)	Health care providers in 2 general hospitals N = 1110 (80 % women)	492 health care providers of 1 hospital (pre- and 12- and 36-month post-intervention: 73 %, 77 %, 60 % participation)	618 health care providers of the other hospital (pre- and 12- and 36-month post-intervention: 69 %, 62 %, 60 % participation)	12- and 36-month	A Priori assessment of psychosocial work factors and psychological distress	Psychological distress
					Observation of care units (direct and interviews with key informants)	Burnout
					Identification of priorities by the intervention team (2 researchers and 12 employees). Implementation of interventions by managers. Documentation of the interventions	

(continued)

Table 15.1 (continued)

Author Year	Population type, N (% women)	Intervention group (% participation)	Control group	Post-intervention follow-up(s)	Intervention	Outcome
Brisson et al. (2006, 2016), (Gilbert-Ouimet et al. (2011), and Trudel et al. (2011)	White-collar workers of 3 insurance organizations, N=2167 (60 % women)	1093 workers of 1 organization (pre- and 6- and 36-month post-intervention: 81 %, 86.3 %, 85.2 % participation)	1074 workers of 2 other organizations (pre- and 6- and 36-month post-intervention: 80.7 %, 86.3 %, 85.4 % participation)	6- and 36-month	A Priori assessment of psychosocial work factors and psychological distress. Identification of priorities through a focus group with workers. Implementation of interventions by managers. Documentation of the interventions	Psychological distress Blood pressure level Hypertension

10–15 workers was put in place in each of the four intervention centers. The team was composed of employees and managers representatives. Action plans were developed separately in the four centers to address their specific priorities, which were identified through the quantitative a priori risk assessment. Examples of action plans were: (i) stabilization of work teams and improving the quality of care (psychological demands); (ii) clarification of roles, tasks, and functions of the members of the caregiver team (reward and job control); (iii) staff training, development of leadership skills, team consolidation and sense of belonging (social support); and (iv) 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 health care providers working in two acute care hospitals in Quebec City. Both hospitals offer general and specialised 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. This team was created according to the following criteria (Beermann et al. 1999): operate in small groups, group members of various hierarchical levels, regularly scheduled work meetings, preferably eight to ten meetings, meetings led by an external moderator, and expertise of team members used as input to identify solutions to reduce adverse psychosocial work factors. The team 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 their solutions. The intervention team identified a number of problems which were listed, described in detail, and finally synthesised under 56 intervention targets (Bourbonnais et al. 2006b). These targets were then classified according to six problem categories (team work and team spirit, staffing, work organization, training, communication, and ergonomics) and according to the four adverse psychosocial work factors (each problem could be linked to more than one psychosocial factor). Of the 56 intervention targets, 43 % aimed at improving psychological demands, 24 % reward, 20 % decision latitude, and 13 % social support at work. A total of 63 solutions were suggested to address the targets. A number of solutions suggested by the intervention team were implemented (Bourbonnais et al. 2006b). They mainly included conditions that could be resolved and managed by the units. Examples of implemented solutions were as follows: transmission of information on the evening and night shifts (social support), management of 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 semi-public organizations. The intervention group was composed of 1093 workers of a first organization. Their jobs covered the full range of white-collar positions, including senior and middle managers (5 %), professionals (38 %), and technicians and office workers (57 %). The organization was composed of 12 departments of which nine were targeted by the intervention based on a priori risk assessment (described below). All workers currently employed in these nine departments were invited to participate in pre- and post-intervention measures. The control group was composed of 1074 workers, who were either employed in two other semi-public insurance organizations or evolving in the three departments of the first organization for which no intervention was implemented.

An a priori risk assessment was performed separately for each department. Figure 15.2 provides, as an example, the risk assessment conducted in a major department. This department (department A) was composed of 146 office employees (28 men and 118 women) whose work consisted of following up clients and answering clients' requests in accordance with pre-established rules. As shown in Fig. 15.2, in this department, the prevalence of the four adverse psychosocial work factors were significantly higher than in the reference populations (Brisson et al. 2006). All four adverse psychosocial work factors were thus identified as intervention targets. The methods and results of these a priori risk assessments and the related intervention targets 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. The aim of these focus groups was to identify, from the worker's point of view, organizational changes that would contribute to reduce the adverse psychosocial work factors that were previously identified as targets for intervention (Brisson et al. 2006; Trudel et al. 2009). These changes were then presented to the managers in written reports and during an oral presentation, as suggestions for implementation.

The organizational changes implemented were systematically documented (Gilbert-Ouimet et al. 2015). Key informants kept a logbook providing a detailed record of every change implemented in the workplace to improve the four adverse psychosocial work factors. A separate logbook was kept for each department. A member of the research team met with each key informant to provide detailed explanations on how to keep the logbook and to emphasize the importance of the task. The following information was recorded in the logbooks for each change implemented: (1) a description of the activity, (2) the goal (or the current problem or situ-

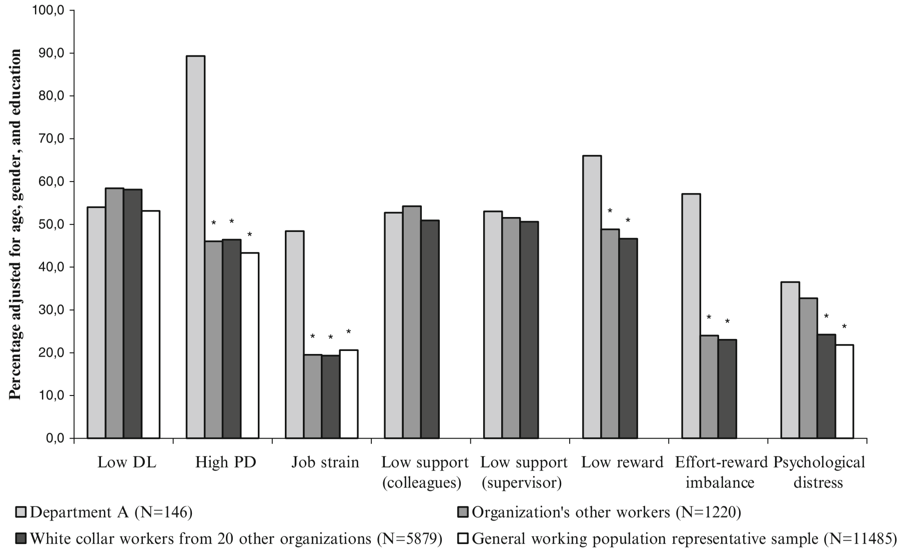

Fig. 15.2 Prevalence of adverse psychosocial work factors and psychological distress in department A compared to reference populations (a priori risk assessment) (From Brisson et al. (2006). *p<.05, *DL* decision latitude, *PD* Psychological demands (Note: The number of men in Department A was insufficient to perform separate analyses by gender)

Changes were consistent with interventation targets and covered all four adverse psychosocial work factors.

The interventation group implemented four times more major changes as compared to the control group

Changes targetting the workload * were introduced only in the interventation group.

Social support and reward were the most often targeted psychosocial work factors.

Fig. 15.3 Summary of the implemented organizational changes. *Workload is a component of the psychological demands scale (Adapted from Gilbert-Ouimet et al. (2015))

ation to be solved or improved), (3) the administrative unit involved, (4) the date or period of the activity, (5) the number of employees involved, (6) the adverse psychosocial work factor(s) targeted, and (7) the degree of improvement expected from the activity (weak, medium or strong). A qualitative analysis of the reported changes was performed. Changes were classified into 29 categories providing a description of the intervention content. The "one main" psychosocial work factor potentially improved was assigned to each of these 29 categories (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) (Fig. 15.3). Reward and social support were the most acted upon psychosocial work factors. In addition, the intervention group implemented changes to reduce the workload; this psychosocial factor was not acted upon in the control group. The intervention group also implemented four times more major changes than the control group. These major changes were defined as those which: (1) reached a large percentage of employees in the department, and (2) brought about a genuine transformation in the work environment from the viewpoint of the key informants of the organization. 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), and grouping teams together to facilitate the use of expertise and to promote synergy (psychological demands and social support) (Table 15.2). The psychosocial work factors potentially improved were identified by the key informants.

15.4.3 Intervention Effectiveness

Table 15.3 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. 2005b, 2006a) or three (Brisson et al. 2006; Gilbert-Ouimet et al. 2011) adverse psychosocial work factors (Table 15.3).

Table 15.2 Examples of major changes and targeted adverse psychosocial work factors

Major changes	Targeted adverse psychosocial work factors
Slower implementation of a large project to prevent increased workload	Psychological demands
Increased workforce and replacement of long-term leaves	Psychological demands
Grouping teams to facilitate the use of expertise and to promote synergy	Psychological demands and social support
Career and skills development with conferences and training activities	Decision latitude
Improvement of management practices: consult, orient, and coach	Psychological demands, decision latitude, and social support

Adapted from Gilbert Ouimet et al. (2015)

In the long-term care centers study, the prevalence of job strain decreased from 46.5 % to 38.5 % and the prevalence of low job control decreased from 82.9 % to 76.7 % ($p<0.05$). Although non-significant, there were also improvements of effort-reward imbalance (48.9–46.3 %), high psychological demands (59.4–57.8 %), low social support from colleagues (33.2–27.4 %) and from supervisors (30.5–26.8 %). In the acute care hospitals study, two psychosocial work factors significantly improved at 12- and 36-month after the intervention: effort-reward imbalance (means of scores decreasing from 1.1 to 1.08 to 1.00) and high psychological demands (from 12.5 to 11.8 to 11.6). Finally, in the white-collar insurance services study, low reward, as shown by the sub-scale “lack of respect and esteem”, decreased from 36.1 % to 29.8 %, high psychological demands decreased from 50.1 % to 47.8 %, and low co-worker social support decreased from 53.9 % to 50 % (p-values <0.05) (Table 15.3). No improvements (Bourbonnais et al. 2005b) or a single improvement (Gilbert-Ouimet et al. 2011; Bourbonnais et al. 2011) were observed in the control groups of the three studies.

Table 15.4 presents the comparison of health outcomes before and after the intervention in the intervention and control groups, respectively. All three studies showed a reduction in the prevalence of high psychological distress in the intervention group (Table 15.4). This reduction was however only significant in the white-collar insurance services study (32.9–29.2 %). In the acute care hospitals study, work-related burnouts and client-related burnouts also reduced between pre-intervention and 12- and 36-month post-intervention evaluations. Mean scores reduced from 48.2 to 46.3 to 43.2 ($p<0.05$) and from 34.9 to 36.2 to 33.0 ($p<0.10$), respectively. In the control groups, there was no improvement in any mental health indicators. In the long-term care centers, the control group rather experienced a rise in the prevalence of psychological distress from 43.6 % to 46.0 % (non-significant) (Table 15.4). In the white-collar insurance services study, a significant reduction in systolic (−2.3 mmHg, $p<0.05$) and diastolic (−1.3 mmHg, $p<0.05$) BP means was observed (Brisson et al. 2016; Trudel et al. 2011). The prevalence of hypertension was also reduced from 28.2 % to 23.6 % ($p<0.05$).

Table 15.3 Comparison of psychosocial work factors before and after the intervention period in intervention and control groups

Author Year	Psychosocial work factors	Intervention group			Control group		
	Prevalence (%)	Before	12-month		Before	12-month	
Bourbonnais et al. (2005a, b)	Low reward:	41.3	44.4		57.5	53.0	
	ERI:	48.9	46.3		51.2	48.8	
	High psy. demands:	59.4	57.8		56.5	53.4	
	Job strain:	46.5	38.5*		47.6	44.8	
	Low job control:	82.9	76.7*		87.1	85.4	
	Low SS from coll.:	33.2	27.4		31.6	32.6	
	Low SS from sup.:	30.5	26.8		37.7	33.9	
	Mean scores	Before	12-month	36-month	Before	12-month	36-month
Bourbonnais et al. (2006a, 2011)	Reward:	30.8	31.11	31.3	30.2	30.0	30.2
	ERI:	1.10	1.08*	1.00*	1.2	1.16	1.2
	Psy. demands:	12.5	11.8*	11.6*	13.3	12.9	12.8
	Job control:	69.9	68.7*	70.2	69.4	68.0*	68.6
	SS from coll.:	12.5	12.5	12.5	12.5	12.2*	12.04
	SS from sup.:	11.5	10.8*	11.3	11.1	10.4	10.5*
	Prevalence (%)	Before	6-month		Before	6-month	
Brisson et al. (2006, 2016), Gilbert-Ouimet et al. (2011), and Trudel et al. (2011)	Low reward:	50.5	51.0		58.2	54.8*	
	Low respect and esteem	36.1	29.8*		NM	NM	
	ERI:	29.8	29.2		21.4	20.6	
	High psy. demands:	50.1	47.8*		35.9	37.2	
	Low job control:	56.2	56.7		59.9	59.5	
	Low SS from coll.:	53.9	50*		52.4	49.5	
	Low SS from sup.:	52.1	52.2		54.6	53.8	

* $p < 0.05$ for intra-group comparison between pre-intervention post-intervention measures

Changes in health outcome occurring in the intervention group must be statistically compared to those occurring in the control group to accurately assess the intervention effect per se. These complementary analyses of the intervention effects were performed in the acute care hospitals study and in the white-collar insurance services study. In the acute care hospitals study, the mean scores for client-related and work-

Table 15.4 Comparison of mental and cardiovascular outcomes before and after the intervention in intervention and control groups

Author Year	Psychosocial work factors	Intervention group			Control group		
	Prevalence (%)	Before	12-month		Before	12-month	
Bourbonnais et al. (2005a, b)	Psychological distress	44.9	42.3		43.6	46.0	
	Mean scores	Before	12-month	36-month	Before	12-month	36-month
Bourbonnais et al. (2006a, 2011)	Psychological distress	21.9	21.1	20.6	22.6	22.5	22.4
	Client-related burnout	34.9	36.2	33.0†	36.3	38.5*	37.8
	Work-related burnout	48.2	46.3*	43.2*	48.1	49.4	48.3
		Before	6-month		Before	6-month	
Brisson et al. (2016), Gilbert-Ouimet et al. (2011), Trudel et al. (2011)	Prevalence (%)						
	Psychological distress	32.9	29.2*		30.1	30.9	
	Means						
	Systolic BP	126.6	124.3*				
	Diastolic BP	80.0	79.8*				
	Prevalence (%)						
	Hypertension:	28.2	23.6*				

*$p<0.05$ for intra-group comparison between pre-intervention post-intervention measures
† Borderline significant: $p<0.10$

related burnout were significantly lower ($p<0.05$) as a measure of the intervention effect, 36 months after the 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 (reduction) 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 demonstrated using the control group (not shown).

15.4.4 Discussion

Interpretation The three intervention studies showed improvements in adverse psychosocial work factors. There were also improvements in psychological distress, burnout prevalence and blood pressure level. This section will highlight contextual elements of particular importance for understanding these findings.

In the long-term care centers study, the main contextual elements mentioned as having favoured 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-intervention to the 12-month post-intervention evaluation (41.3–44.4 %, Table 15.3). A longer intervention period might have led to a more thorough implementation of the actions plans. A longer follow-up might also have revealed that the non-significant 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 interventions aimed to improve mental health indicators.

There was a significant reduction in the prevalence of psychological demands in two out of the three studies (Gilbert-Ouimet et al. 2011; Bourbonnais 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. More precisely, work overload and worker shortages were initially reported in the acute care hospitals study (Bourbonnais et al. 2011), while the workload was identified as an intervention priority in six out of nine departments in the white-collar insurance services study (Gilbert-Ouimet et al. 2011). Acting upon this factor implies improving components of the workload (e.g., increasing staff or replacing workers on sick leave), which can be hard considering the context of strong competition of the current globalized economy. However, findings of these two studies support the fact that it is possible to improve the workload.

In the study conducted in acute care hospitals, a large majority of the solutions proposed by the intervention team were implemented (80 %) (Bourbonnais et al. 2011). One of the main targets of the intervention 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 and communication problems between workers from different work shifts and care units. Nevertheless, in the intervention group, the level of social support (i.e., mean score) remained stable, while in the control group, social support from supervisors deteriorated.

Compared to the two intervention studies conducted among long-term care centers or acute care hospitals, the beneficial effects observed in the white-collar insurance services study were facilitated by the facts that: (1) the study took place among white-collar workers benefiting from regular daytime schedules (8 h00 to 16 h00). Considerable evidence has demonstrated that shift work and night work have deleterious health effects (Ulhoa et al. 2015). These schedules could potentially contribute to dilute the beneficial effects of the interventions among health care providers.

(2) The interventions were mainly implemented at the department-level, which meant that they were specific to each department's priorities. This was not the case in the hospital interventions. 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). (3) The intervention group of the white-collar insurance services study was involved in a reward promoting program at the time of the study. This program could help to explain the management's interest in acting to improve reward.

The results of the 36-month follow-up of the white-collar insurance services study were not presented here. Preliminary results showed that the beneficial effects observed in the intervention group were maintained, after 36 months, which supports the long-term effectiveness of such psychosocial workplace interventions in reducing blood pressure and improving mental health.

Strengths and Limitations The three intervention studies had some substantial strengths. Among them was the fact that they respected most quality criteria presented in this chapter. First, the participative process of these studies relied, from the start, on both manager 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 evaluation that allowed intervention targets to be identified. This evaluation also included interviews that gathered crucial background information allowing characterising the initial problems and their setting. Third, the multiple component interventions made it possible to target several components of the psychosocial work exposures identified as priorities (Karsh et al. 2001; Denis et al. 2001). Fourth, the studies relied on a sound theoretical background favouring a choice of targets and solutions based on four well-defined psychosocial work factors, whose deleterious effects on CVD (Kivimaki et al. 2012; Aboa-Eboule et al. 2007), high BP (Babu et al. 2014; Landsbergis et al. 2013; Nyberg et al. 2013; Gilbert-Ouimet et al. 2013), and mental health problems (Ndjaboue et al. 2012; Bonde 2008; Stansfeld and Candy 2006; Netterstrom et al. 2008) 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.

The three intervention studies presented in this chapter provide evidence that it is possible to conduct high quality intervention studies without using a RCT design. It is noteworthy that a RCT design is not feasible or even desirable in a number of real life situations (Kristensen 2005; Nielsen and Randall 2013). Findings observed in these studies support the effectiveness of rigorous quasi-experimental workplace intervention studies, given that significant improvements were observed in the intervention groups while almost none were observed in the control groups. To be rigorous however, workplace intervention studies have to rely on the previously suggested quality criteria (Sect. 15.3). Respecting these quality criteria may foster intervention success or, at least, provide a better understanding of intervention failures.

Gender differences have been observed in the effects of adverse psychosocial work factors on cardiovascular and mental health outcomes (Stansfeld and Candy 2006; Netterstrom et al. 2008; Bonde 2008; Backe et al. 2012; Hemingway and Marmot 1999; Eller et al. 2009; Landsbergis et al. 2013; Kivimäki et al. 2006; Belkic et al. 2004). In the white-collar insurance services study, beneficial effects on psychological distress and blood pressure were observed in both men and women, which support the consistency of the intervention effects across both genders. This finding adds important new knowledge to the field of psychosocial workplace intervention. Indeed, Bambra et al.'s systematic review (Bambra et al. 2007; Egan et al. 2007) pointed out that the available studies provide very little insight into the differing effects of such workplace interventions by gender (Bambra et al. 2007; Egan et al. 2007). Most studies performed statistical adjustment for gender, preventing to observe potential differences between women and men.

Strong evidence shows that the incidence of cardiovascular diseases and mental problems tends to be higher among people with lower socioeconomic positions. However, workplace intervention studies have predominantly been conducted in middle class samples (Kristensen 2005). As suggested by Kristensen, these interventions should also be implemented among workers of lower occupational classes, immigrants, young workers, obese workers, workers in small- and medium-size enterprises and temporary workers.

Impact on Managerial Practice The probing results of the white-collar insurance services study led to a guide of organizational practices beneficial to health (Gilbert-Ouimet et al. 2009). This guide was intended to promote the implementation of practices having the potential to improve psychosocial work factors of the effort-reward imbalance and demand-control models (low reward, high psychological demands, low decision latitude, and low social support). The guide comprises 18 practices. These practices were chosen because: (1) they were implemented in administrative units where at least one psychosocial work factor significantly improved and (2) they were coherent with available empirical evidence and researchers' expertise. The organizational practices were classified according to five organizational dimensions, namely: (i) participative management, (ii) interpersonal aspects and support, (iii) work organization, (iv) career and skills development, and (v) mission, culture, and leadership. These dimensions were selected from theoretical models of organization performance and change (Burke 2002; Peters and Waterman 1982). Table 15.5 presents the 18 practices according to the psychosocial work factor that they are likely to improve.

A recent research project identified factors facilitating or preventing the implementation of the practices suggested in this guide and in other tools designed to improve psychosocial work factors. Over 100 managers of four organizations participated in the project. To identify factors influencing implementation of the organizational prac-

Table 15.5 Organizational practices aiming to reduce psychosocial work factors and improve health, according to five organizational dimensions

Organizational practice	Psychosocial work factor(s)
Participative management	
1. Creating committees, workshops, team meetings (participation to decision making)	Social support and decision latitude
2. Having individual meetings with managers (adjustment of the tasks and workload and talk about difficulties)	Psychological demands, decision latitude, and social support
Interpersonal aspects and social support	
3. Holding reward activities (for the work done)	Reward
4. Highlighting the employees successes	
5. Holding interpersonal activities	Social support
Work organization	
6. Revising processes	Psychological demands, decision latitude, social support, and reward
7. Introducing work tools facilitating work task(s)	Psychological demands
8. Implementing organizational changes progressively	
9. Increasing staff (temporarily or permanently)	
10. Replacing employees on sick leave	
11. Introducing flexible scheduling	Psychological demands and decision latitude
12. Enriching tasks	Decision latitude
Career and skills development	
13. Revising tasks complexity	Reward
14. Coaching/mentoring	Psychological demands
15. Encouraging participation to formation activities	Decision latitude
Mission, culture, leadership	
16. Communicating objectives, mandates, issues	Social support
17. Defining and diffusing politics and action plans to employees	Psychological demands, decision latitude, social support, and reward
18. Managing the planning of the workforce	Psychological demands and decision latitude

tices, self-reported questionnaires were administered at baseline and 3 months later (N = 144 at baseline; N = 157 at 3-month follow-up). The results showed that managers were more likely to implement practices beneficial to health when: (1) their organization gives high priority to mental health; (2) they have more decision latitude; (3) they have better relationships with their subordinates, and (4) they have less psychological distress. 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 manager's workload was not identified as a factor influencing the implementation of these practices suggesting that adopting good management practices doesn't increase the workload of managers (Biron et al. 2015).

15.5 Public Health Policies

Enterprises can be supported by public health policies in order to achieve primary prevention of organizational or psychosocial work factors. We have in this matter, few interesting initiatives from many countries. UK for example, put in place, a few years ago, the Health and Safety Executive project aiming to support enterprises by proposing managerial standards to reduce or control psychosocial risks factors (Health and Safety Executive 2007). Six factors were targeted; workload, control, support, interpersonal relationships, roles and transformation (organizational changes). The proposed process relies on a three steps approach, namely: risk evaluation, discussion of the results by stake holders and joint discussion for improving working conditions.

In Canada, there are also two voluntary standards aiming to promote healthy organizational practices and prevent related health problems: *Psychological Health and Safety in the Workplace* (CAN/CSA-Z1003-13/BNQ 9700-803/2013) and *Prevention*, *promotion and organizational practices contributing to health in the workplace* (BNQ9700-800/2008).

The first standard states in its introduction that the strategic pillars of psychological health and safety rely on human needs which, when unmet or thwarted, can become risk factors for psychological distress, whereas, when satisfied, can lead to psychological and organizational health (Standards Council of Canada 2013). These human needs include security and physiological safety, belonging, social justice, self-worth, self-esteem, self-efficacy, accomplishment, and autonomy. These human needs are well covered by or part of the ERI and demand-control models. The standard was launched in January 2013 (Standards Council of Canada 2013). A group of Canadian researchers from Simon-Fraser University in British Columbia, with whom our group collaborates, are currently conducting case studies in organizations to *document success and failures in implementing this standard.* Regarding acceptability of this standard for stake holders, a recent study showed that *the standard was positively described as a resource that could provide direction*, *tools*, *and guidance to address psychosocial elements in the workplace and that a broad range of potential benefits for employees*, *employers*, *and workplaces were identified for implementing the standard* (Kunyk et al. 2016).

The second standard applies only to the province of Quebec (Canada) and is composed of four areas of activities. One of these areas specifically targets management practices in order to reduce adverse psychosocial works factors. The three other areas of this standard relate to lifestyle habits, physical work environment, and work-life balance. This standard was put in place in 2008 (Bureau de Normalisation du Québec (BNQ) 2008). The standard is currently being evaluated by our research group in ten workplaces in terms of its implementation, effects on physical and mental health of employees, and economic impact for employers (Sultan-Taïb et al. 2014–2016).

Some countries like Denmark have gone further by training their labour inspectors in the use of tools and sectorial guides to evaluate psychosocial risk factors.

They have also established an intervention monitoring system based on discussion with social partners (Rasmussen et al. 2011). These preventive strategies can also take the form, at a national level, of social and labour policies to protect the least privileged segments of the labour market. These national policies are promising. In fact, recent research has shown that the average level of stress at work (as measured by the ERI and the demand-control models) was significantly lower in countries with well-developed social and working policies. Furthermore, the effect of effort-reward imbalance on depression was also less pronounced in these countries (Lunau et al. 2013).

15.6 Conclusions

Available evidence shows that primary prevention through workplace interventions has the potential to reduce exposure to adverse psychosocial work factors such as those of the effort-reward imbalance model. Moreover, these interventions could lead to significant improvements of mental and cardiovascular health outcomes. Findings from the three psychosocial workplace intervention studies presented in this chapter showed improvements of psychosocial work factors, psychological distress (Bourbonnais et al. 2005b; Gilbert-Ouimet et al. 2011), and burnout prevalence (Bourbonnais et al. 2006a, 2011). Also, one of these intervention study showed that reducing exposure to ERI, high psychological demands, and low social support led to significant reductions in workers' blood pressure level and hypertension prevalence, in both men and women (Brisson et al. 2016; Trudel et al. 2011). At the population level, reduction of blood pressure in the range of those observed in that study may prevent large numbers of premature deaths and disabling strokes. Indeed, a 2 mmHg lower systolic blood pressure mean would involve about 10 % lower stroke mortality and 7 % lower mortality from ischemic heart diseases (IHD) or other vascular causes in middle age (Lewington et al. 2002).

Cardiovascular diseases and mental health problems result in important economic and social costs. Population-wide strategies, targeting whole populations are crucial preventive measures, found to be effective in reducing the burden of these health problems (Whelton et al. 2002; Whelton 2015; WHO 2004). In the particular case of high BP, there is a clear need for additional population-level initiatives and multifactorial interventions (Perkovic and Rodgers 2015). In this context, determining whether or not workplace interventions are effective in improving cardiovascular and mental health is of major public health significance. As supported by the presented evidence, workplace interventions targeting adverse psychosocial work characteristics appear to be promising approaches and could lead to significant benefits on disease prevention. The underlying causal pathway would involve the implementation of theory-based multi-components workplace interventions leading to reductions of adverse psychosocial work factors and subsequent improvements of mental health and blood pressure. Lowering the burden associated with work-related health problems could lead to reductions of the use of health services, compensation for permanent disabilities, and sickness absenteeism. These consequences require going beyond the traditional approach limited only to compensable occupational morbidity. In order to advance our knowledge, innovative research and preventive interventions have to open on the wider field of all morbidity due to work, using validated models to identify specific dimensions of work organization that are pathogenic. The effort-reward imbalance model provides a strong contribution to local, national and international efforts developed toward this goal.

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Chapter 16
Challenges of National and International Policies

Michael Marmot and Johannes Siegrist

16.1 Employment, Work and Health in a Globalized Economy: An Introductory Statement

In the United Nation's recently endorsed Sustainable Development Goals Agenda one of the important goals was defined as follows: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (UN 2015). Other major international organizations and bodies support this ambitious aim in their declarations, such as the World Health Organization (WHO 2008, 2014) and the International Labour Organization (ILO 2013). A brief look at the current worldwide situation of employment and working conditions reveals how far we are still away from approaching this declared goal.

Today, roughly 195 million people of the world's population of employment age are unemployed. Any respective figure is of limited reliability, given between-country differences in defining *unemployment*, and given a large proportion of men and women who bypass registration for a number of reasons (Benach et al. 2007). Although unemployment, and in particular long-term unemployment, reduces the health and life expectancy of those exposed (Roelfs et al. 2011), additional threats are given by different forms of *precarious work*, such as involuntary part-time jobs, fixed-term contracts, temporary agency work, freelance, and some forms of self-employment. A major trait of these forms of precarious work is *job insecurity*, a condition that is clearly associated with reduced mental health and elevated cardiovascular risk (Siegrist et al. 2015; Virtanen et al. 2013). Considering less developed

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countries, the *working poor* define a huge challenge to economic and societal progress. For instance, according to ILO, “in 2005, 84 % of workers in South Asia, 58 % in South-East Asia, 47 % in East Asia…did not earn enough to lift themselves and their families above the US$2 a day per person poverty line” (ILO 2006, p. 1), with more women than men affected. A majority of those working in low-income countries are employed in the *informal economy*, often lacking any statutory regulation, protection against occupational hazards, and social security benefits (Labonté 2015). Even worse, despite international proscription, several millions of children are still exposed to *child labor*, and more than ten millions of adults are suffering from *forced or bonded labor*, specifically in Africa, South America, and the Pacific region (Benach et al. 2007).

More than half of the world’s population is working in the formal or informal economy. Fatal and non-fatal *occupational accidents* and injuries make a large contribution to the overall burden of work-related morbidity and mortality. It was estimated that almost 1000 workers lose their life every day due to occupational accidents, most of them in low- or middle-income countries (Hämäläinen et al. 2006). *Exposure to* physical, chemical, and biological *hazards and physically strenuous work* has been substantially reduced in high-income countries as a result of technological progress, safety regulation and occupational health investments, but remains high in developing countries. As an example, in rapidly developing countries it was recently estimated that 125 million workers are still exposed to asbestos (WHO 2008), and the incidence of cancers caused by occupational exposures is likely to increase in most regions of the world (Hogstedt et al. 2007).

Even in highly industrialized and post-industrial societies, such as the member states of the European Union, adverse working conditions continue to be rather frequent (Eurofound 2015). For instance, every sixth worker is exposed to handle chemicals and every seventh to handle infectious materials, every fourth worker is exposed to vibrations, and more than 40 % are working in painful, tiring positions, at least a quarter of time or more. Moreover, shift work and permanent noise at work affect more than 20 % of the workforce (Eurofound 2015). Research on *shiftwork* documents elevated risks of cardiovascular disease and metabolic syndrome among shift workers (Härmä 2006; de Bacquer et al. 2009), and the rate of occupational injuries is particularly high among night shift workers (Bambra et al. 2008). A further health risk at work relates to *long working hours*. In Europe, every tenth male worker reports to work regularly more than 60 h per week. For special service occupations and professions, persons performing on-call jobs, freelancers, and several groups having ‘modern,’ less formalized, atypical jobs, it has become increasingly difficult to clearly distinguish work from non-work periods in their daily life. Long working hours were shown to increase the risk of stress-related disorders to a substantial extent, in particular depression (Virtanen et al. 2012), coronary heart disease and stroke (Kivimäki et al. 2015). The recent report of Eurofound extends the list of adverse working conditions by pointing to distinct *psychosocial stressors*, such as fear of losing one’s job (16 %), exposure to restructuring (24 %), or poor prospects of career advancement (in midlife 63 %) (Eurofound 2015). Nor, even in high income countries, is work a way out of poverty. With the shift in income from labour to owners, low paid work has become more prevalent (Marmot 2015).

What is the *impact of economic globalization* on the development of relationships between employment, work and health? As mentioned earlier (see Chap. 1), this impact may be ambivalent. On one hand, economic growth goes along with the creation of new jobs, thus reducing unemployment and poverty in less developed countries. Moreover, with technological progress, industrialization and growth of the service sector, heavy physical work, as prevalent in agriculture, and hazardous jobs in 'old' industries are continuously replaced by modern equipment, automation, information and communication technology. On the other hand, we observe a high level of competition and work pressure in large parts of the workforce in developed and rapidly developing countries, often in combination with increased job insecurity and instability. A rise in non-standard work contracts, and a rapid expansion of flexible job arrangements result from globalized economic development. As a consequence, the threats of health-adverse psychosocial work environments are becoming more widespread and more visible, and they contribute to a growing burden of work-related diseases (Schnall et al. 2009; Siegrist et al. 2015).

This book is devoted to this latter aspect, with a special focus on the model of effort-reward imbalance at work. Distinct from several complementary concepts of a health-adverse psychosocial work environment that mainly address job task features, this model is concerned with the employment contract as a core element of employment relations (see Chap. 1). *Employment relations* represent the main linkages between individual workers and their employers, as they define rights and obligations, negotiate remuneration as well as conditions of employment, including job termination (Kalleberg 2009). In times of economic globalization, far-reaching and partly stressful changes in employment relationships occurred, as mentioned. 'Effort-reward imbalance' was designed as a theoretical approach towards identifying and assessing stressful aspects of employment contracts in this context, by focusing on conditions of 'high cost' and 'low gain' (see Chap. 1). More specifically, working people's low gains are defined at three levels, earnings, job promotion prospects including job security, and esteem or recognition related to achievement. As two of these levels of reward point to labour market conditions, this model links the micro-environment of organizations or enterprises with the macro-environment of labour-market regimes. To date, with an expanding economic globalization, these latter links are receiving special prominence, in particular as neo-liberal policies weaken the workers' needs for protection and security that are traditionally addressed by national legislation and welfare state regulations. In summary, the model of effort-reward imbalance at work seems well suited to capture stressful features of work and employment in the context of economic globalization.

It is of interest to note that this model of stressful work has been extensively applied in recent years by researchers interested in work and health in the context of economic globalization. This is the case for research conducted not only in Europe and North America (Chaps. 3, 4, 5, 6, and 7), but also in Japan (Chap. 8), Australia (Chap. 9), China (Chap. 10), and Latin America (Chap. 11). Importantly, by assessing stressful work and employment in different parts of the world with comparable data a new source of information with relevance to national and international policies has become available. '*Effort-reward imbalance*' and '*job strain*' are the two models that were most often used so far in comparative international research on work stress-related health outcomes, but other concepts may complement this development in the future.

Monitoring between-country and within-country differences and trends of psychosocial stress at work has been recognized as one of several crucial prerequisites of designing targeted policies of prevention, as reflected, for instance, in the initiative of the European Commission to conduct regular European Working Conditions Surveys through Eurofound (2015). A related initiative was recently launched by OECD, aiming at providing guidelines on the measurement of quality of the work environment for all its member states. Descriptive evidence on inequalities in the quality of work and employment between and within countries is definitely important, but current scientific knowledge has more to offer to policy development, as the following short summary reveals.

16.2 Entry Points for Policies

16.2.1 The Challenge of Causality

In the twentieth century, occupational health and safety (OHS) has witnessed several successes where findings of epidemiological research contributed to the implementation of far-reaching preventive measures. The ban of asbestos and the recognition of asbestos-related occupational diseases provide an instructive example. Can we expect similar success with respect to current scientific knowledge on the impact of health-adverse psychosocial work environments on stress-related disorders? The first part of the answer to this question rests on judgements of causality. To help it may be useful to refer to Bradford Hill's *criteria* of demonstrating a *causal association* between exposure and health in the frame of epidemiological research. Importantly, these criteria include the strength and consistency of prospectively documented associations between exposure and health, the dose-response relationship of this association, the demonstration of biological pathways explaining the link, and the reduction of risk following removal of the exposure (Bradford Hill 1965).

Several chapters of this book have discussed these criteria with respect to the effort-reward imbalance model. For instance, in Chaps. 5 and 6, the strength and consistency of prospectively assessed relationships were documented for coronary heart disease and depression respectively. While the consistency of findings was considered satisfactory, in particular in case of depression, the strength of associations, as indicated in the elevation of odds ratios, in general was rather moderate, rarely exceeding a doubling of relative risk. However, this latter finding deserves two important comments. First, even moderately elevated relative risks are relevant for policy if the prevalence of exposure is high and if the health problem under study occurs with sufficient frequency. Both aspects are clearly met, given the fact that, overall, every fifth working person is experiencing a critically high level of stressful work in terms of effort-reward imbalance (e.g., Wahrendorf et al. 2013), and as depression and coronary heart disease have been recognized as leading public health problems (Mathers and Loncar 2006). Second, as was also demonstrated in several chapters above, adverse psychosocial work exerts negative effects on a variety of stress-related health outcomes. Therefore, judging available evidence with regard to a single health outcome does not do justice to a rich body of available knowledge. Rather, a synthesis of evidence derived from a spectrum of health outcomes should inform policy. Two more causality criteria identified by Bradford Hill were addressed in this book. For instance, in Chap. 3 current knowledge of a dose-relationship was discussed in the frame of life course studies, and Chap. 7 reviewed research findings on psychobiological mechanisms linking exposure to stressful work with adverse health outcomes.

On balance, it seems that there is now sufficient scientific evidence available to recognize a *stressful psychosocial work environment*, defined and assessed according to leading theoretical models, as an *occupational risk factor*. This occupational risk factor deserves systematic monitoring and implementation of evidence based interventions as it can now be assessed in internationally comparable ways, and as its effects on health can be quantified, thus providing new explanations and predictions that are relevant for policy.

There is one last criterion in Bradford Hill's list that continues to challenge today's scientific community. It concerns the proof of reduced disease incidence following an elimination or substantial reduction of the exposure. As discussed in Chaps. 5 and 6, it seems almost impossible to conduct randomized controlled trials with adequate statistical power to demonstrate that a substantial reduction of psychosocial stress at work results in a clinically meaningful decrease in the incidence of disease. However, for the following reasons we maintain that this limitation does not invalidate our conclusion.

First, although trials meeting the highest level of scientific evidence may not be feasible, solid scientific results can be derived from carefully designed *intervention studies*. This has been demonstrated to an impressive extent in the previous chapter. In Chap. 15, criteria for high quality psychosocial workplace intervention studies were discussed, and several successful intervention studies were described, documenting significant effects on intermediate health indicators, such as reductions in blood pressure values or in burnout symptom scores.

Second, we can learn from '*natural experiments*' where distinct adverse or beneficial changes in work environments or employment conditions result in documented negative or positive health outcomes. Despite its methodological shortcomings, a rich body of relevant evidence is available, either evaluating negative aspects such as restructuring of enterprises, privatization of public organizations, or plant closures, or exploring positive aspects such as improving job security, work time control, or introducing new leadership principles. For instance, one such positive 'natural experiment' was observed in Northern Ireland where the Open University together with a trade union established courses for skill training and knowledge development of low skilled, low paid workers in large health care organizations (e.g., catering, cleaning), negotiating some free time for attending tutorials and preparing examinations. As a consequence, over 500 low paid employees earned certificates which improved their future job promotion prospects and their quality of work more (The Marmot Review 2010) (for more examples Cooper et al. 2012; see also Chaps. 14 and 15).

Third, adverse psychosocial work environments are embedded in broader socioeconomic structures. As mentioned, two reward dimensions within this work stress model, earnings and job security, connect the micro-environment of organizations or enterprises with the macro-environment of labour-market regimes. It is therefore important to consider the promises of conducting interventions at a more distal level of adverse work environments. Distinct *labour market policies* define one such distal level of interventions. As these policies vary substantially between countries with respect to their quality and comprehensiveness, cross-country comparisons may be used to explore whether well-developed labour policies are associated with a respective higher overall quality of work and employment and vice versa. The next section gives some preliminary research evidence along these lines, pointing to potential 'intervention' benefits of distinct worker-friendly labour policies.

16.2.2 Distal Entry Points

In two recent papers, an empirical approach towards studying distal interventions in terms of evaluating the quality of distinct national labour policies was developed. Both publications rely on a cross-country comparative longitudinal study, the Survey of Health, Aging and Retirement in Europe (SHARE), containing data from 13 to 16 countries respectively (Wahrendorf and Siegrist 2014; Lunau et al. 2015). The *first paper* uses SHARE data from the third wave (2008–2009), while data from the fourth wave (2010–2011) were analysed in the second paper that additionally included data from the English Longitudinal Study on Aging (ELSA) obtained during the same time period. Both studies collected interview data on a health-adverse psychosocial work environment, and they combined this data with information on two sets of labour market policy indicators, designed as proxy measures of national integration or compensation (protection) policies. Measures of the first type of policies reflect investments in continued education and in return-to work of disabled or unemployed people, whereas measures of the second type indicate the amount of generosity and accessibility of benefit programmes for workers in case of disability or unemployment. Although indicators of the two studies are not strictly identical, their results provide some comparative insights. Both publications tested their research hypothesis by means of a series of multilevel linear models, and they visualized relevant findings as scatter plots or as graphs derived from linear regression analysis.

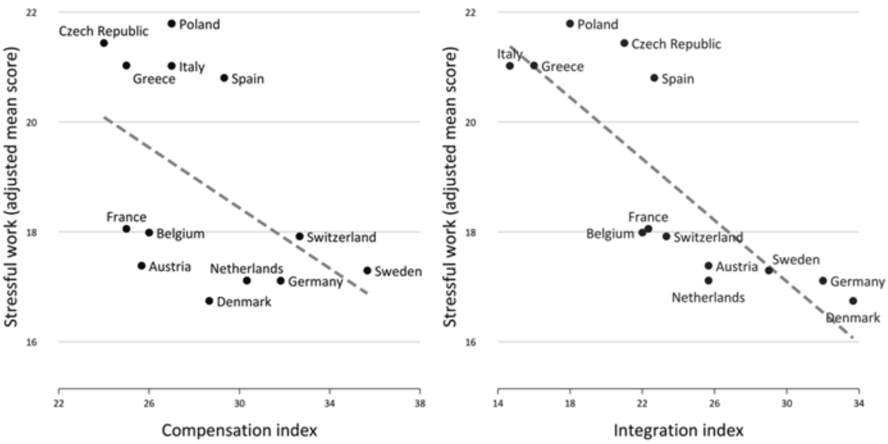

Fig. 16.1 Adjusted mean scores of stressful work among older male and female employees (N = 11181) and policy indices. Mean scores of stressful work are adjusted for sex, age, retirement age, periods of disability, job absence due to disability, childhood circumstances (occupational position of main breadwinner, number of books, housing conditions and overcrowding) and labour market disadvantage (occupational position in main job, involuntary job loss (laid off and plant closure) and period of unemployment) (Source: Wahrendorf and Siegrist (2014))

Figure 16.1 displays the scatter plots of associations between a summary measure of stressful psychosocial work at national level, based on the aggregate mean score of the respective population, and an index of each country's amount of offering compensation and integration policies respectively. Stressful psychosocial work was measured by a sum score of 16 items representing abbreviated scales of the demand-control and effort-reward imbalance models and a self-evaluation of one's overall job career. The two 'integration' and 'compensation' indices were developed by OECD, reflecting the availability and quality of ten respective policy programs, evaluated by experts on a score ranging from 0 to 5 for several years. To interpret the results of the figure one should notice that scores of stressful work range from 0 (no stress) to 48 (high stress) and that policy indices range from 0 (poorest policy) to 50 (best policy) (Wahrendorf and Siegrist 2014). In case of the compensation index, associations are slightly less pronounced as we observe a group of countries with low compensation scores (low levels of system generosity) and low mean level of stressful work (Austria, France, Belgium) ($R^2 = 24.2$). In contrast, an almost linear association is observed in case of the integration index where more pronounced integration policies are related to lower mean scores of stressful work ($R^2 = 66.5$).

The findings of this study support the notion that the average level of stressful work experienced by employees of a country varies to some extent according to the degree to which distinct national labour and social policies are implemented. In our case, this holds particularly true for integration policies which support the efforts of disabled, chronically ill and unemployed people to return to paid work. As the risks of disability, chronic illness and unemployment are unequally distributed among employed populations, leaving those in lower socioeconomic positions at higher risk, these policies have the potential of contributing to a reduction of the social gradient of adverse working conditions and their negative effects on the health of working people.

To address this latter problem in more detail the *second paper* analysed social gradients of stressful work and the potential impact of national labour policies on the steepness of these gradients. In this extended data set on older working persons from 16 European countries psychosocial stress at work was assessed by two summary measures reflecting the two work stress models of effort-reward imbalance and demand-control (control only), and the two sets of policy indicators were further distinguished by using two macro indicators of integrative and compensation (or protective) programmes. In the latter case, 'replacement rate' describes the expected financial support in the period directly after job loss as a percentage of the net income before job loss, whereas the OECD indicator of 'passive labour market policy' (PLMP) is calculated as percentage of GDP investments in unemployment benefits and in expenditures that compensate premature retirement of older workers with disadvantages on the labour market. In case of integrative policies, the first indicator represents the percentage of older workers who confirmed that they received training or education in the last 12 months ('lifelong learning'), and 'active labour market policies' (ALMP) refers to the amount of public expenditures to promote reintegration into work (percentage of GDP). Social inequality was measured by the respondents' highest educational degree, as defined by the International Standard Classification of Education (ISCED). This measure explicitly considers national variations in educational systems, and thus renders it accessible for cross-country comparisons (Lunau et al. 2015).

Three results of this study deserve attention. First, as expected, consistent educational gradients of stressful work were observed in a majority of countries, with higher levels of stress among those with lower education. Second, when the predicted educational differences in work stress per country (low vs. high education) were plotted against the two indicators of integrative policies, 'lifelong learning' and 'ALMP', linear trends similar to those depicted in Fig. 16.1 were observed. Sweden, Denmark, Switzerland, the Netherlands and Belgium were countries where differences in work stress between low and high educated workers were relatively small. At the same time these countries exhibited a high percentage of older workers with training experiences, and their ALMP expenditures were high. Conversely, large educational differences in stressful work were found in Eastern and Southern European countries, where participation in lifelong learning and ALMP expenditures were modest (Lunau et al. 2015; results not shown). Third, when testing in multilevel models whether the strength of associations between educational level and work stress varies according to the extent of implementation of policies, the main results visualized in Fig. 16.2 show that with regard to effort-reward imbalance this is the case for three out of four policy indicators, whereas in case of low control this variation is obvious with regard to lifelong learning only (Lunau et al. 2015).

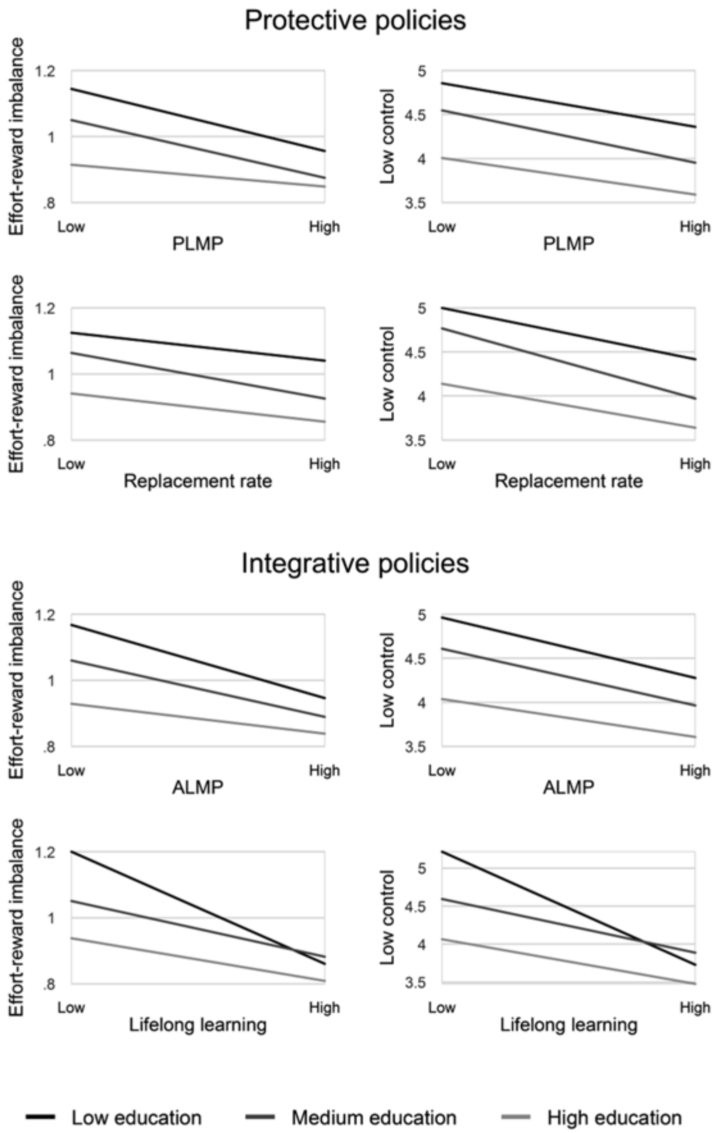

Fig. 16.2 Predicted levels of work stress by education at different levels of macro indicators. Expenditures into active (ALMP) and passive labour market policies (PLMP) are weighted by unemployment rate (Source: Lunau et al. (2015))

Although these findings should be interpreted with caution they indicate that the *burden of disadvantageous work*, as measured by the effort-reward ratio, is *lower among less educated people* in countries with *well developed integration policies* than in countries with poor policies. Moreover, disparities between educational groups are smaller. This suggests that specific active labor market policies target the needs of less privileged older workers particularly well. The benefits of measures that support return to work following disease or disability, and of measures that enable workers to change or modify their job following retraining and education may become visible in lower mean levels of stressful work. Given the negative consequences of stressful work on health, the results of this study can direct policy attempts towards reducing social inequalities in health of older workers (Lunau et al. 2015).

In conclusion, current *scientific evidence* derived from more than two decades of international research on *stressful working and employment conditions* and their effects on health, and more specifically on social inequalities in health, has reached a level of consistency and robustness that justifies its use as a *knowledge base informing and directing policy efforts* through different entry points. These entry points concern the implementation and improvement of routine monitoring systems, the investments in human capital to strengthen occupational health and safety services, the pressures and incentives to employers and other stakeholders to promote healthy work within companies and organizations, and the development of active labour market policies at national and international levels that reduce the burden of stressful work and its adverse effects on health. The final section describes these entry points as calls for action.

16.3 What Should Be Done

To ensure that workplaces are safe and to protect workers from occupational hazards and diseases is a key responsibility of *employers*. These duties and responsibilities need to be controlled by authorities, based on *national laws and regulations*, and *OHS services* have been established to support employers and employees in their efforts to prevent work-related risk and to promote healthy work. Legislation and regulations vary considerably between countries, despite some binding international conventions, most importantly those on fundamental rights of workers declared by the *International Labour Organization* (ILO) (2013). To date, many countries in less developed parts of the world still lack basic safety, health and social protection measures of working people, they are deprived of occupational health and safety services, and their social security system fails to meet even basic needs of working people and their families (WHO 2008; Benach et al. 2007). Moreover, substantial variations in the availability and quality of worksite risk prevention and health promotion are observed in economically advanced societies, for instance between eastern and western European countries, and between northern and southern European nations (WHO 2014). Importantly, there are also drawbacks in countries with well-developed welfare regimes. With the diffusion of neo-liberal policies stimulated by *economic globalization* the impact of national legislation, of social protection and active labor market programs has been weakened, in conjunction with a cutback in government spending and an increasing privatization of public services, thus *reducing the governments' policy capacity* (Labonté 2015). The great recession starting in 2008 has exacerbated these developments in some high income countries, urging them to adopt austerity programs with their negative consequences for the health and welfare of vulnerable groups (Stuckler et al. 2009).

Against this background, it has become increasingly difficult to achieve progress in negotiations on fair employment and working conditions between employers, trade unions and governments, given their restriction to the national context. In low income countries, with large proportions of the work force in informal employment, trade unions may not be potent forces for improving working conditions. The Self Employed Womens Association (SEWA) in India is a notable exception (Marmot 2015). In countries such as the US and UK, decline in trade union membership, particularly in the private sector, has led to a shift in the balance of power to employers.

With the liberalization of capital, trade and labor markets and with increasing economic power of transnational corporations the regulatory impact exerted by national governments has been substantially diminished. Therefore, efforts are needed towards *establishing effective supranational regulation* to ensure basic human rights at work internationally. Several such initiatives have been proposed. As a first, particularly important activity, the ILO's 'Social Protection Floor Initiative' must be mentioned (ILO 2013). Although several UN agencies, development banks, and governments support this initiative, there is still a long way to go until all member states will adopt it, given the absence of formal sanctions. Amongst others, this initiative recommends the introduction of minimal wages, of health- and unemployment- insurance, and of reliable pension systems, thus *extending formal employment contracts* at the expense of the informal sector. Moreover, national labor market programs are proposed to reduce youth unemployment and adult long-term unemployment. *Transnational corporations* are asked to apply the same employment standards for their employees in high-income and low-income countries, and to refrain from relocating their production sites to countries with minimally regulated workforce. There is now some evidence that the *World Trade Organization* (WTO) recognizes the importance of occupational health and safety standards and related social protection measures in transnational trade and investment treaties (Labonté 2015).

In addition to the initiatives of ILO and WTO the *World Health Organization* (WHO) has fostered a global movement to promote health equity, including work-related health, based on the Commission on Social Determinants of Health Final Report (WHO 2008). *Core recommendations* of this influential report are that:

- "Full and fair employment and decent work be made a shared objective of international institutions and a central part of national policy agendas and development strategies;
- National governments develop and implement economic and social policies that provide secure work and a living wage that takes into account the real and current cost of living for health;
- Public capacity be strengthened to implement regulator mechanisms to promote and enforce fair employment and decent work standards for all workers;
- Governments reduce insecurity among people in precarious work arrangements;

– Occupational Health and Safety (OHS) policy and programmes be applied to all workers …and include work-related stressors and behaviours as well as exposure to material hazards" (WHO 2008, p. 76ff.).

More recently, these recommendations were reinforced and extended by a Task Group Report on Employment and Working Conditions that was developed, not least with our own input, in the frame of the 'Review of social determinants and the health divide in the WHO European Region' (Siegrist et al. 2015). With regard to the supranational level, it was emphasized that coordinated international efforts are required to reduce the impact of neo-liberal policies on labor market standards, wage policies, and income distribution, and that the regulatory influence of international organizations should be enforced in dealing with marked-based financial and economic crises.

The Commission on Social Determinants of Health called for health equity in all policies. All policies should be formulated with regard to the likely impact on health equity. Labour market policies, just discussed, are highly relevant. So, too a recent report from the *International Monetary Found* that recommends *stronger redistribution of income* via progressive taxation. Based on an analysis of economic growth in 153 countries the report concludes that such redistribution measures reduce income inequality which in turn stimulates economic growth (Ostry et al. 2014). An effect of such income redistribution is to improve the income of the worst off which, in turn, will have the likely effect of promoting health equity. A key recommendation of the Marmot Review of Health Inequalities in England, Fair Society Healthy Lives, was that everyone in the population should have the minimum income necessary for a healthy life (Marmot 2010).

Other recommendations of this recent WHO European Report are directed at the *national level*. For instance, work and employment-related *material and psychosocial adversities* should be *monitored* in a systematic and regular way, based on national legislation, using scientifically approved tools. Their health impact should be assessed in collaboration with occupational health and safety professionals, and *measures of improvement* should be *implemented*, using an established implementation cycle (Leka and Jain 2010; Siegrist et al. 2015). Furthermore, recognizing the evidence of persistent social inequalities in the quality of work and the burden of work-related diseases, investments into primary and secondary prevention at work should be prioritized according to need, with *special emphasis on most vulnerable occupational groups*. As lack of control and reward at work were shown to be critical determinants of a variety of stress-related disorders and to be more prevalent among lower occupational status groups, focusing interventions around these dimensions and targeting less privileged groups within the workforce are high priorities. Last, but not least, the solid body of currently available knowledge needs to be disseminated through professional declarations by scientific networks, public media campaigns and related channels to motivate responsible stakeholders, political movements, civil society activities, and the broader public to call for action and to develop targeted initiatives, with a hope that *fair and decent work*, and specifically *justice of exchange at work*, are *moved up on the political agenda*.

To conclude, within a globalized economy the reduction of poor quality of employment and work and the reduction of their adverse effects on workers' health provide substantial challenges to national and international occupational policies. But over the past two or three decades we have witnessed a substantial increase of scientific evidence on causes and consequences of unhealthy work, and enhanced policy efforts to tackle these challenges are emerging at international, national, and local levels. Therefore, there is hope that these efforts will ultimately result in a sizeable reduction of health inequalities and in further growth of sustainable and healthy work.

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