World Health Organization

Health Impact of Psychosocial Hazards at Work: An Overview

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Table of Contents

	Executive Summary	**01**
1.	**Introduction**	**04**
1.1	Defining psychosocial hazards and risks	04
1.2	Exposure to psychosocial hazards – mechanisms	06
1.3	Establishing the basis to estimate the global burden of disease of psychosocial risks	09
2.	**Methodology**	**11**
2.1	Establishing appropriate risk measures and exposure variables	11
2.2	Estimating risk factor levels	24
2.3	Overview of methods	24
2.4	Criteria for identifying relevant studies	24
2.5	Search strategy for studies	25
2.6	Selection of studies	26
3.	**Estimating risk factor - disease relationship**	**30**
3.1	Changing nature of work	30
3.1.1	Impact of new forms of organisation and employment on health	30
3.1.2	Changes in the working population	32
3.2	Psychosocial risks - impact on health and stress	33
3.2.1	Job content	34
3.2.2	Workload and work pace	37
3.2.3	Work schedule: shift work and long work hours	38
3.2.4	Control	43
3.2.5	Environment and equipment	47
3.2.6	Organisational culture and function	49
3.2.7	Interpersonal relationships at work	50
3.2.8	Role in organisation	53
3.2.9	Career development	55
3.2.10	Home-work interface	59
4.	**Assessment of causality: Impact of psychosocial hazards and work-related stress on health**	**63**
4.1	Psychological and social health	65
4.1.1	Burnout	66
4.1.2	Mental health – depression and other common mental disorders	68
4.1.3	Social and behavioural health	73
4.2	Physiological and physical health effects	75
4.2.1	Musculoskeletal disorders	76
4.2.2	Heart disease	81
4.2.3	Metabolic syndrome and diabetes	85
5.	**Extrapolation of health impact of psychosocial risks: Link with previous global burden of disease estimates**	**87**
5.1	Psychosocial risks and heart disease	87
5.2	Psychosocial hazards and lower back pain	87
5.3	Psychosocial hazards and noise	88
6.	**Conclusions**	**89**
	References	**90**

List of Tables

Table 1: Psychosocial hazards 05

Table 2: Summary of questionnaires 12

Table 3: Summary of observational instruments 20

Table 4: Review studies used 26

List of Figures

Figure 1: Psychosocial work environment 07

Figure 2: Risks for work-related stress 09

Figure 3: Causal paths for work-related MSDs 77

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Executive Summary

The working environment and the nature of work itself are both important influences on health (Marmot & Wilkinson, 2006). In recent decades significant changes, closely linked to the organisation and management of work, have taken place in the world of work (EU-OSHA, 2007). These have resulted in emerging risks and new challenges in the field of occupational health and safety. Psychosocial risks at the workplace have been identified as significant emerging risks (EU-OSHA 2007; NIOSH, 2002). Linked to psychosocial risks, issues such as work-related stress and workplace violence are widely recognised as major challenges to occupational health and safety (EU-OSHA, 2007).

Psychosocial hazards are defined by the International Labour Organization (ILO, 1986) in terms of the interactions among job content, work organisation and management, and other environmental and organisational conditions, on the one hand, and the employees' competencies and needs on the other. As such, they refer to those interactions that prove to have a hazardous influence over employees' health through their perceptions and experience (ILO, 1986). A simpler definition of psychosocial hazards might be those aspects of the design and management of work, and its social and organisational contexts that have the potential for causing psychological or physical harm (Cox & Griffiths, 2005). A number of models exist in Europe and elsewhere for the assessment of risks associated with psychosocial hazards (termed psychosocial risks) and their impacts on health and safety of employees and the healthiness of organisations (in terms of, among other things, productivity, quality of products and services and general organisational climate).

Psychosocial risks go hand in hand with the experience of work-related stress. Work-related stress is the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope (WHO, 2003). Longitudinal studies and systematic reviews have indicated that stress at work is associated with heart disease, depression, and musculoskeletal disorders (MSDs) and there is consistent evidence that high job demands, low control, and effort-reward imbalance are risk factors for mental and physical health problems (e.g. Johnson et al., 1996; Kivimäki et al., 2006; Melchoir et al., 2007; Rosengren et al., 2004; Stansfeld & Candy, 2006; Tennant, 2001), thereby leading to further strain on public spending for increased costs on healthcare.

Despite the available evidence, the prevention and management of psychosocial risks has not been high on the policy making agenda. Consequently, the Commission for the Social Determinants of Health (2008) recommended that while occupational health and safety policies remain of critical importance, the evidence strongly suggests the need to expand the remit of occupational health and safety to include work-related stress and harmful behaviours (Commission on Social Determinants of Health, 2008).

In a wider perspective, psychosocial risks are being increasingly acknowledged as major public health concerns in industrialised countries (Leka & Cox, 2008). However, due to processes of globalisation and changes in the nature of work, these risks are not limited to the developed world. For some decades, there has been growing concern about the causes and health consequences of psychosocial risks, particularly in industrialized countries and to a lesser extent and only recently in developing countries (Kortum, 2007). Along with existing difficulties in controlling other more well-known occupational risks, there is a lack of awareness of psychosocial risks (as well as work-related stress, workplace violence and harassment), and shortage of resources to deal with them (WHO, 2007a). Although some research has been conducted in developing countries, particularly in Latin America, there are still not enough in-depth studies to fully analyse both cultural differences and behaviours, which vary from one

country to another. Therefore, at the global level, there is weak epidemiological evidence about the exposure of the working population to the different psychosocial risk factors and the related health outcomes (Concha-Barrientos et al., 2004).

However, there is strong evidence to indicate an association between work-related health complaints and exposure to psychosocial hazards, or to an interaction between physical and psychosocial hazards, to an array of health outcomes at the individual level and at the organisational level (Cox, Griffiths & Rial-González, 2000). Specifically, psychosocial risks in the workplace have been demonstrated to have a possible detrimental impact on workers' physical, mental and social health (e.g. Bonde, 2008; Bosma et al., 1998; Chen, Yu & Wong, 2005; Fischer et al., 2005; Tennant, 2001; Wieclaw et al., 2008); in addition, a growing body of evidence indicates both a direct and indirect role of the psychosocial working environment on organisational health indices (such as absenteeism, sickness absence, productivity, job satisfaction and intention to quit) (e.g., Kivimaki et al. 2003; Spurgeon, Harrington & Cooper, 1997; Vahtera, Pentti & Kivimaki, 2004; van den Berg et al., 2009).

Exposure to physical and psychosocial hazards may affect psychological as well as physical health. The evidence suggests that such effects on health may be mediated by, at least, two processes: first, a direct pathway, and second, an indirect stress-mediated pathway (Cox, Griffiths & Rial-González, 2000). These two mechanisms do offer complimentary explanations of the hazard-health association and in most hazardous situations both operate and interact to varying extents and in various ways (Cox & Cox, 1993; Levi, 1984). Levi (1984) further noted that both additive and synergistic interactions are possible. The outcome of effects that interact additively is simply the sum of the separate effects; however, the outcome of effects that interact synergistically is other than the sum of the separate effects. It may be greater, where one set of effects facilitates or enhances another, or it may be smaller, where one set attenuates or weakens another (Cox, Griffiths & Rial-González, 2000).

This review report focuses on the stress and health outcomes which arise from exposure to psychosocial risks. Even though data are not available worldwide on prevalence of specific psychosocial risk exposures, estimates can be made on the basis of national and international surveillance data to monitor psychosocial risks. This review sets the basis on which estimates of exposure to psychosocial risks may be carried out.

For the purpose of this analysis, studies were sought that assessed the impact of psychosocial risks on health directly or indirectly through the experience of work-related stress. Smaller, more specific studies limited to relatively narrow occupational groups (e.g. nurses, doctors, managers) were checked for consistency with the larger data sets. Literature up to December 2009 was searched for exposure data and exposure-risk relationships, and published statistics of national occupational health and safety institutes were consulted. In addition to this systematic search, a number of reviews and studies were identified to provide supporting evidence to the selected approach.

Studies that were selected have been published in reputable journals (peer-reviewed journals, most of them international); or the information provider is a 'credible source'; and the identity of the 'owner(s)' of the site and/or authors of the paper is obvious; the information is original, and if not, the source is clearly stated. Articles are specifically on investigations of general health outcomes or risk factors as well as investigations of disease specific outcomes for musculoskeletal disorders, mental ill-health and cardiovascular disease.

Randomized Control Trials (RCTs), observational studies, cross-sectional studies, longitudinal studies, prospective studies and meta-analysis studies were investigated. The emphasis was on studies with samples of over 500 participants. Additional studies not meeting the inclusion

criteria have also been included in the report to highlight un-tested trends and possible avenues for further research.

The review specifically considered two areas of health impact: psychological and social health (burnout, depression and other common mental disorders, and social and behavioural health) and physical health (musculoskeletal disorders, cardiovascular disease and metabolic syndrome and diabetes). It also aims to provide a summary of existing estimates of health impacts of psychosocial risks.

When considering theoretical minimum risk levels in relation to psychosocial risks, one should keep in mind that low levels of psychosocial risks are present at every workplace, however they pose a threat to health through lack of recognition of these risks (and consequent inaction), mismanagement of such risks, lack of prevention and to an extent, continuous exposure to such risks in certain occupations. Therefore exposure to such risks in any occupational category cannot be equal to zero. A number of epidemiological and population based studies have presented 'odds ratios', 'hazard ratios', and 'risk ratios'. Data is also available through a large number of cross-sectional studies, however, results from these studies must be regarded with some caution, and causation can only be implied. Despite this drawback, such studies provide valuable evidence.

Overall this report provides comprehensive evidence on the impact of psychosocial hazards on a number of health outcomes. Extrapolation of the health impact of psychosocial risks may not be possible on a global basis, due to the lack of data. However, cross sectional studies have been conducted in different countries and such data support the available evidence base from developed countries. In addition, the nature of psychosocial hazards (being many different ones and affecting health either through the experience of work-related stress or through their interaction with physical hazards at the work environment) makes it difficult to extrapolate their impact in a comprehensive manner for each health outcome. However, the data presented in this report has shown evidence that this is possible in certain cases, such as that of heart diseases and musculoskeletal disorders. It is therefore recommended that further work is devoted in this area and that this report is used as a first step in this process.

1. Introduction

"Throughout the world, most adults—and many children—spend much of their waking hours at work. Work provides a number of economic and other benefits. At the same time, people at work face a variety of hazards owing to chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks, and many and varied psychosocial factors" (Concha-Barrientos et al., 2004: p.1653). The working environment and the nature of work itself are both important influences on health (Marmot & Wilkinson, 2006).

Global socio-political developments of increasing globalisation, the establishment of a free market, the changing nature of work, the development of information and communication technology, and significant demographic changes and their impact on the modern workforce characterise the development of the modern workplace (EU-OSHA, 2007; Kompier, 2006). In recent decades significant changes, closely linked to the organisation and management of work, have taken place in the world of work (EU-OSHA, 2007) and resulted in emerging risks and new challenges in the field of occupational health and safety. Psychosocial risks at the workplace have been identified as significant emerging risks (EU-OSHA 2007; NIOSH, 2002). Linked to psychosocial risks, issues such as work-related stress and workplace violence are widely recognised major challenges to occupational health and safety (EU-OSHA, 2007).

1.1. Defining psychosocial hazards and risks

Since the 1950s psychological aspects of work have increasingly been the subject of research (Johnson, 1996; Sauter et al., 1998). Research in this area gained further impetus with the emergence of psychosocial work environment research and occupational psychology in the 1960s (Johnson & Hall, 1996) with a shift in focus from an individual perspective to the impact of certain aspects of the work environment on health (Cox, Griffiths & Rial-González, 2000).

Psychosocial hazards are defined by the International Labour Organization (ILO, 1986) in terms of the interactions among job content, work organisation and management, and other environmental and organisational conditions, on the one hand, and the employees' competencies and needs on the other. As such, they refer to those interactions that prove to have a hazardous influence over employees' health through their perceptions and experience (ILO, 1986). A simpler definition of psychosocial hazards might be those aspects of the design and management of work, and its social and organisational contexts that have the potential for causing psychological or physical harm (Cox & Griffiths, 2005). There is a reasonable consensus in the literature of the nature of psychosocial hazards (see Table 1) but it should be noted that new forms of work give rise to new hazards – not all of which will yet be represented in scientific publications (Cox, 1993). A number of models exist in Europe and elsewhere for the assessment of risks associated with psychosocial hazards (termed psychosocial risks) and their impacts on health and safety of employees and the healthiness of organisations (in terms of, among other things, productivity, quality of products and services and general organisational climate).

Psychosocial risks go hand in hand with the experience of work-related stress. Work-related stress is the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope (WHO, 2003). In addition, the issue of burnout has also gained prevalence as a result of exposure to a poor psychosocial environment and the resulting work-related stress experience. Burnout has been defined in the literature as a state of physical, emotional and mental exhaustion that results from long-term involvement in work situations that are emotionally demanding (Schaufeli & Greenglass, 2001). Psychosocial risks, work-related stress, violence,

harassment, bullying (or mobbing) are now widely recognised major challenges to occupational health and safety (EU-OSHA, 2007).

Table 1: Psychosocial hazards

PSYCHOSOCIAL HAZARDS	
Job content	Lack of variety or short work cycles, fragmented or meaningless work, under use of skills, high uncertainty, continuous exposure to people through work
Workload & work pace	Work overload or under load, machine pacing, high levels of time pressure, continually subject to deadlines
Work schedule	Shift working, night shifts, inflexible work schedules, unpredictable hours, long or unsociable hours
Control	Low participation in decision making, lack of control over workload, pacing, etc.
Environment & equipment	Inadequate equipment availability, suitability or maintenance; poor environmental conditions such as lack of space, poor lighting, excessive noise
Organisational culture & function	Poor communication, low levels of support for problem solving and personal development, lack of definition of, or agreement on, organisational objectives
Interpersonal relationships at work	Social or physical isolation, poor relationships with superiors, interpersonal conflict, lack of social support, bullying, harassment
Role in organisation	Role ambiguity, role conflict, and responsibility for people
Career development	Career stagnation and uncertainty, under promotion or over promotion, poor pay, job insecurity, low social value to work
Home-work interface	Conflicting demands of work and home, low support at home, dual career problems

Source: Adapted from Leka, Griffiths & Cox (2003)

Nearly one in three of Europe's workers, more than 40 million people, report that they are affected by stress at work (EU-OSHA, 2002). The Fourth European Working Conditions survey (Parent-Thirion et al., 2007) showed that, in 2005, 20% of workers from the first 15 European Union (EU) member states (EU-15) and 30% from the 10 new Member States believed that their health is at risk because of work-related stress. In the 15 Member States of the pre-2004 EU, the cost of stress at work and the related mental health problems was estimated to be on average between 3% and 4% of gross national product, amounting to €265 billion annually (Levi, 2002). On the national level, it is estimated that stress-related diseases are responsible for the loss of 6.5 million working days each year in the United Kingdom, costing employers around €571 million and society as a whole as much as €5.7 billion. In Sweden in 1999, 14% of the 15000 workers on long-term sick leave reported the reason to be stress and mental strain with an associated total cost of sick leave of €2.7 billion (Koukoulaki, 2004). In a recent report by the European Agency for Safety and Health at Work (EU-OSHA, 2009) it is reported that in France stress-related illnesses cost the society between €830 and €1,656 million.

In addition, longitudinal studies and systematic reviews have indicated that stress at work is associated with heart disease, depression, and musculoskeletal disorders (MSDs) and there is consistent evidence that high job demands, low control, and effort-reward imbalance are risk factors for mental and physical health problems (e.g. Johnson et al., 1996; Kivimäki et al., 2006; Melchoir et al., 2007; Rosengren et al., 2004; Stansfeld & Candy, 2006; Tennant, 2001), thereby leading to further strain on public spending for increased costs on healthcare.

Despite the available evidence, the prevention and management of psychosocial risks has not been high on the policy making agenda. Consequently, the Commission for the Social Determinants of Health (2008) recommended that while occupational health and safety policies remain of critical importance, the evidence strongly suggested the need to expand the remit of occupational health and safety to include work-related stress and harmful behaviours (Commission on Social Determinants of Health, 2008). In a wider perspective, psychosocial risks are being increasingly acknowledged as major public health concerns in industrialised countries (Leka & Cox, 2008).

However, due to processes of globalisation and changes in the nature of work, these risks are not limited to the developed world. For some decades, there has been growing concern about the causes and health consequences of psychosocial risks, particularly in industrialized countries and to a lesser extent and only recently in developing countries (Kortum, 2007). Along with existing difficulties in controlling other more well-known occupational risks, there is a lack of awareness of psychosocial risks (as well as work-related stress, workplace violence and harassment), and shortage of resources to deal with them (WHO, 2007a). Although some research has been conducted in developing countries, particularly in Latin America, there are still not enough in-depth studies to fully analyse both cultural differences and behaviours, which vary from one country to another. Therefore, at the global level, there is weak epidemiological evidence about the exposure of the working population to the different psychosocial risk factors and the related health outcomes (Concha-Barrientos et al., 2004).

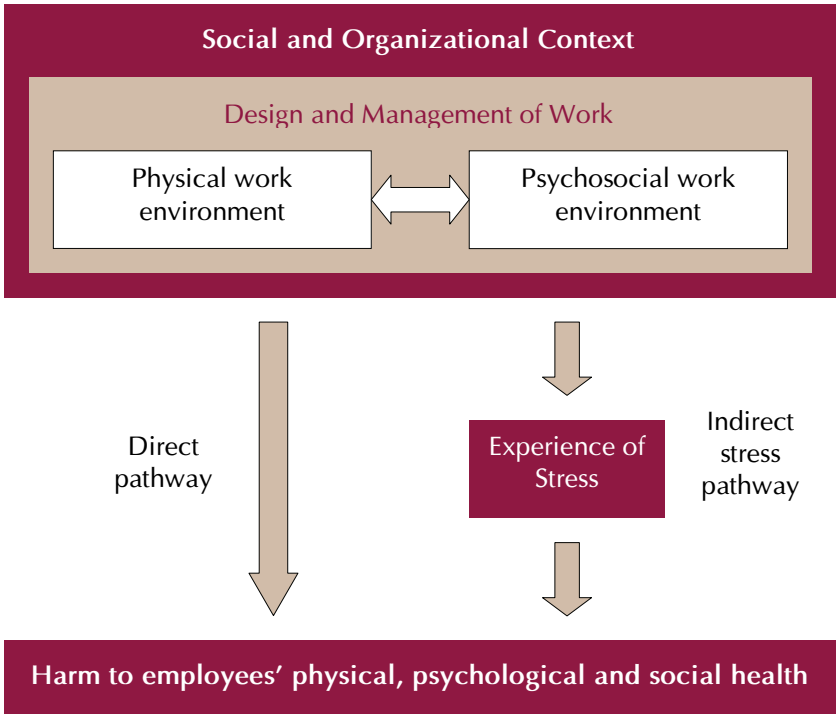
1.2. Exposure to psychosocial hazards – mechanisms

As discussed above, the changes in the nature of working life are varied. They include changes in the working population, changes in the nature of work and work organisation, and changes in the nature of working life. These present a significant challenge for occupational health and safety, due to their direct and indirect impact but also because of the challenge they present for traditional surveillance systems (Dollard et al., 2007). The most salient issue in relation to the consequences of the changing world of work relates to the increased exposure to recognised psychosocial hazards and the emergence of new hazards which need to be identified in order to reduce the associated risks to health and safety (EU-OSHA, 2007).

There is strong evidence to indicate an association between work-related health complaints and exposure to psychosocial hazards, or to an interaction between physical and psychosocial hazards, to an array of health outcomes at the individual level and at the organisational level (Cox, Griffiths & Rial-González, 2000). Specifically, psychosocial risks in the workplace have been demonstrated to have a possible detrimental impact on workers' physical, mental and social health (e.g., Bonde, 2008; Bosma et al., 1998; Chen, Yu & Wong, 2005; Fischer et al., 2005; Tennant, 2001; Wieclaw et al., 2008) in addition, a growing body of evidence indicates both a direct and indirect role of the psychosocial working environment on organisational health indices (such as absenteeism, sickness absence, productivity, job satisfaction and intention to quit) (e.g., Kivimaki et al. 2003; Spurgeon, Harrington & Cooper, 1997; Miche, 2002; Vahtera, Pentti & Kivimaki, 2004; van den Berg et al., 2009).

Exposure to physical and psychosocial hazards may affect psychological as well as physical health. The evidence suggests that such effects on health may be mediated by, at least, two processes: first, a direct pathway, and second, an indirect stress-mediated pathway (see Figure 1) (Cox, Griffiths & Rial-González, 2000). These two mechanisms do offer complimentary explanations of the hazard-health association and in most hazardous situations both operate and interact to varying extents and in various ways (Cox & Cox, 1993; Levi, 1984). Levi (1984) further noted that both additive and synergistic interactions are possible. The outcome of effects that interact additively is simply the sum of the separate effects; however, the outcome of effects that interact synergistically is other than the sum of the separate effects. It may be greater, where one set of effects facilitates or enhances another, or it may be smaller, where one set attenuates or weakens another (Cox, Griffiths & Rial-González, 2000).

Figure 1: Psychosocial work environment



Source: Adapted from Cox, Griffiths & Rial-González (2000)

The consideration of the hazards associated to the most common health complaints of working people enables the understanding of patterns of exposure which provide the means for preventing these problems. It is clear that the causal paths for these ailments are complex and multi-factorial. Factors to consider include environmental exposures and organisational exposures (Leka et al., 2008). Research on the hazard-stress-health relationship has focused on both physical work hazards (e.g. Jones, 1999; Kasl, 1992; Levi, 1981; Warr, 1992) and on psychosocial hazards (e.g. Cox, Griffiths and Rial-González, 2000; Leka et al., 2008; Levi, 1984; NIOSH, 2002). The psychological effects of physical hazards reflect not only their direct action on the brain and their unpleasantness but also the workers' awareness, suspicion or fear that they are being exposed to harm. It is the latter which can give rise to the experience of stress. For example, exposure to chemical risks may have a psychological effect on the worker through their direct effects on the brain, through the unpleasantness of their smell and through

the worker's fear that such exposure might be harmful which in turn may have consequences for health (Cox, Griffiths & Rial-González, 2000).

Stress is presumed to result from a complex set of dynamic phenomena and not just as a consequence of a single external event, acting on a person. The theoretical basis for stress can be interactional — focusing on the structural characteristics of the person's interaction with their work environment, or the basis may also be transactional — focusing on the cognitive processes and emotional reactions governing person-environment interactions (Tabanelli et al., 2008). In the past 20 years two models have dominated the description of the psychosocial work environment and its relation to health. Perhaps the most influential interactional model has been the job strain 'demand-control' hypothesis (Karasek & Theorell, 1990). This involves two orthogonal dimensions: job demands, including work pace and conflicting demands, and decision latitude, including decision authority (control) and skill discretion (variety of work and opportunity for use of skills). It is hypothesized that high decision latitude and low to moderate job demands are good for workers' health, and that the combination of high job demands and low decision latitude would result in worse health. Another well-researched interactional model is the effort-reward imbalance paradigm (Siegrist, 1996). In this model of work stress, the imbalance between high efforts and low rewards at work is the concept which is the crucial course of stress-related diseases, and rewards include money, promotion prospects, job security, and esteem, stress effects are enhanced by a personal coping pattern termed over commitment (Siegrist, 2009; Stansfeld et al., 1999).

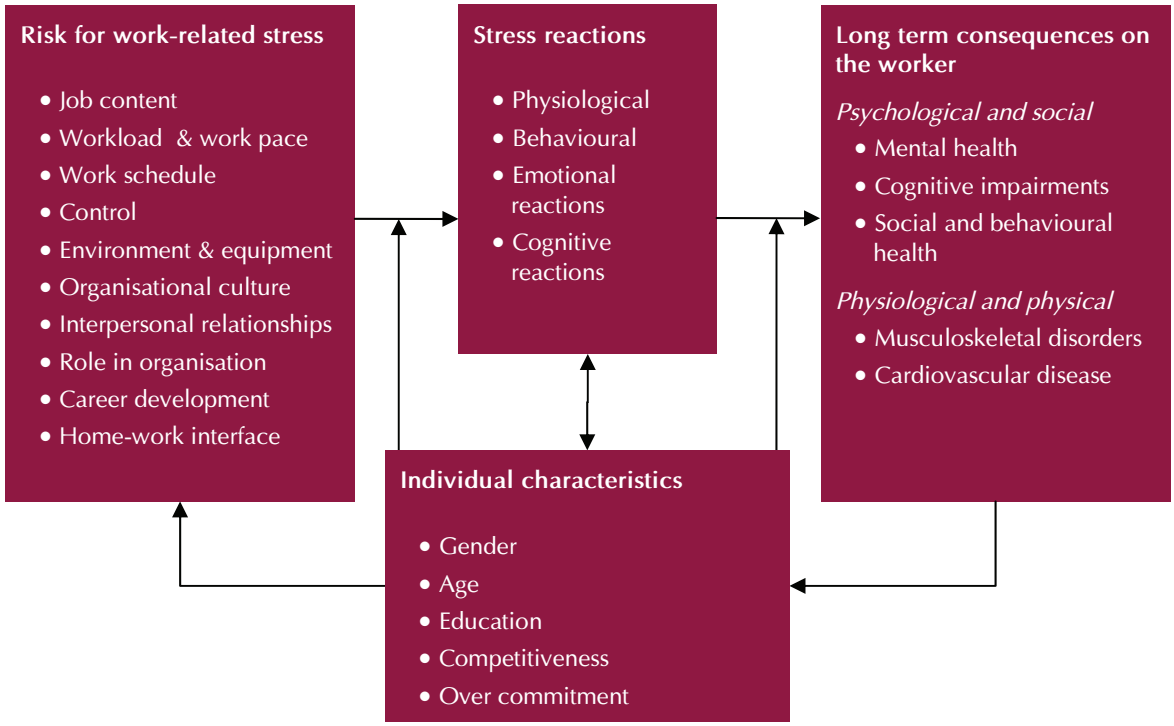
Figure 2, based on these two models, depicts stress as the consequence of the lack of fit between individual needs and demands and those of the environment. A number of studies investigating work-related stress have found links between stress and the incidence of coronary heart disease, mental breakdown, poor health behaviours, job dissatisfaction, accidents, absenteeism, lost productivity, family problems, and certain forms of cancer (Cooper & Cartwright, 1994).

Quick, Horn and Quick (1986) noted that work-related stress can cause behavioural, medical, and psychological problems. Behavioural changes tend to be the earliest and most overt signs of stress, and include: (1) greater alcohol and drug abuse; (2) increased cigarette smoking; (3) accident proneness; and (4) violence. Psychological consequences include: (1) family problems; (2) sleep disturbances; (3) sexual dysfunction; and (4) depression. Medical problems include: (1) hastening the appearance of disease; and (2) worsening the impact of illness. Ganster and Schaubroeck (1991) provided a thorough review of the work stress and employee health literature. They noted that although there has been 'tantalizing' support from a broad literature in behavioural medicine and epidemiology that prolonged exposure to stressful job demands leads to a variety of pathological outcomes, 'close inspection of research investigating specific work-related factors fails to produce a satisfying picture of how, or even whether, certain work experiences lead to physical or mental disorders' (Ganster & Schaubroeck, 1991). Ganster and Schaubroeck concluded that although evidence does not strongly support a job stress and health outcomes link, the indirect evidence from occupational studies showing differences in health and mortality not easily explained by other factors, as well as within subject studies indicating a causal effect of work experiences on physiological and emotional responses, does indicate a work stress effect; a review by EU-OSHA (2000) also reached a similar conclusion.

This review report focuses on the stress and health outcomes which arise from exposure to psychosocial hazards. Psychosocial hazards may affect both psychological and physical health directly or indirectly through the experience of stress, through the dual pathway hazard-harm model as presented in Figure 1. The literature on the direct effects of psychosocial hazards is

presented in section 3 and the literature on the indirect, stress-mediated effects on health is presented in section 4.

Figure 2: Risks for work-related stress



Source: Adapted from Kompier & Marcelissen (1990)

1.3. Establishing the basis to estimate the global burden of disease of psychosocial risks

The burden of disease attributable to a number of environmental and occupational risk factors has now been assessed at global or regional level (Ezzati et al., 2004; Prüss-Üstün & Corvalán, 2006; WHO, 2002). However, due to lack of reliable global data, the global health impacts of some risk factors such as psychosocial risks were not estimated at the global (or regional) level in the 2004 report; even though the WHO comparative risk assessment panel for occupational risk factors acknowledged the threat posed by psychosocial risks, including negative aspects of work organisation, it excluded specific risks or outcomes including ischemic heart disease and other outcomes associated with work-related stress owing to a lack of data. The report published in 2004 stated: "While evidence for a causal relationship is strong, lack of data on accumulated exposure, especially in developing countries, restricted the ability to provide a detailed assessment of attributable mortality and disease burden for these outcomes" (Concha-Barrientos et al., 2004: p.1655).

More specifically, in relation to work-related stress, it stated that "because of lack of available data and difficulties in quantification, it was not possible to conduct a global quantitative analysis for the health consequences of stress at work. The panel concluded that "overall, the evidence indicates that incidence of stress-related cardiovascular disease is likely to be higher

in the blue-collar occupations when the following factors are present: restricted discretion, shiftwork (particularly nightshift), effort-reward imbalance, high demands, poor psychosocial work environment, social isolation, physical inactivity or occupational violence. These risk factors may be interactive" (Concha-Barrientos et al., 2004: p.1655). A follow-up study in 2006, part of the WHO Global Burden of Disease studies, reported that 8% of depression can be attributed globally to environmental factors, in particular occupational stress (Prüss-Üstün & Corvalán, 2006); however, the report did not showcase the impact of psychosocial risks on health in detail.

This review revisits the evidence available and explores what is needed to estimate health impacts of psychosocial risks at the level of population groups in light of the existing evidence base. The report constitutes a synthesis of what is known about the health impact caused by psychosocial risks at the workplace, including its prevalence in as many regions as possible, related health outcomes and their review in terms of strength of evidence. It provides a first orientation of the possible magnitude of health impacts caused by psychosocial risks, and is intended as a reference for future work in this area. This review collates evidence across all WHO regions on exposures to selected psychosocial risk factors (where available), including job control and demand, work organisation, working hours, and relative risks for major health outcomes, including coronary heart disease, depression, and back pain.

2. Methodology

2.1. Establishing appropriate risk measures and exposure variables

Psychosocial risks and work-related stress have been measured in a number of ways. Self-reported questionnaires, usually containing questions regarding presence of risk factors in the work environment, are widely used since they are inexpensive and easy to analyze. An intrinsic limitation of self-reported questionnaires is that they provide "subjective" measures, representing the occupational stress perceptions of individual workers. "Objective" assessments are based on observational approaches, including archival data (e.g. sickness leave, performance measures, accidents), and biological measures (Tabanelli et al., 2008). Since stress activates the pituitary-adrenal cortical system, biological markers are commonly used as objective measures to assess the extent and severity of work-related stress. Measurements of heart rate (variability) and blood pressure, biochemical measures of uric acid, blood sugar, steroid hormones (i.e., cortisol), serum cholesterol, catecholamines (i.e., adrenaline and noradrenalin, epinephrine or norepinephrine), are also considered robust and reliable ways to measure stress responses (Danna & Griffin, 1999). However, most biological assessments are either invasive (e.g. blood samples) or subject to fluctuations for a range of reasons which are not necessarily related to stress levels (e.g. intermittent blood pressure measures) (Cox, Griffiths & Rial-González, 2000). As a result, stress measurement usually involves a range of assessments. The most accurate objective assessments of work-related stress appear to be a combination of physical hormone tests, objective workload measurements, and observations of working conditions that are matched against information from workers (Eurofound, 1997).

A number of large-scale subjective studies of stress have been conducted, based on questionnaire or interview data and which include self-reports of physical health symptoms. Some studies have demonstrated a close correlation between feelings of ill health caused by stress and later ill-health states. For example, the General Health Questionnaire (GHQ) is a very robust instrument that has been repeatedly used in medical and psychosocial studies to assess levels of stress (Goldberg, 1972). The GHQ has pre-set questions that have numerical scores allocated for each response; these are then totalled to give an overall score. This instrument has been repeatedly validated in international studies. NIOSH (1997) has also developed a generic work-related stress questionnaire. Similar instruments include the Occupational Stress Questionnaire (OSQ) (Elo et al. 1992), the Job Stress Survey (JSS) (Speilberger & Vagg, 1991), the Occupational Stress Indicator (OSI) (Cooper et al., 1988) and the General Well-being Questionnaire (GWBQ) (Cox & Gotts, 1987). Use of such instruments may be particularly useful to assist with separation of cause and effect relationships in stress pathways.

Assessment of occupational psychosocial factors and their impact on the health and safety of workers is gaining prominence and is increasingly being acknowledged by various national governments. Psychosocial factors include exposures thought to impact on the well-being and health outcomes of workers (e.g. temporal aspects of employment and the work itself, aspects of work content, group work, supervision, and organizational conditions). Other factors that can be included in an assessment include strain (i.e. workers' psychological and physiological reactions to stressors in terms of anxiety, depression, high blood pressure, heavy smoking, alcohol consumption, etc.) and coping strategies, which make measures of psychosocial risks broader and more detailed than specific stress questionnaires (Tabanelli et al., 2008). Popular examples of instruments assessing psychosocial risks include the Job Content Questionnaire (JCQ) (Karasek et al., 1985), the Effort Reward Imbalance (ERI) Questionnaire, the Copenhagen Psychosocial Questionnaire (Kristensen et al., 2005), QPS Nordic: and the General Nordic Questionnaire for Psychological and Social Factors at Work (Lindstrom et al., 2000). Tables 2 and 3 present a review of the current 'major' measures available to assess work-related stress,

burnout and psychosocial risks using self-report measures (Table 2) and observational measures (Table 3).

Table 2: Summary of questionnaires with references to a guide/description [and year of first publication]

BURNOUT MEASURE (BM) (Pines & Aronson 1988) [1981]	
Objectives	Burnout - Physical exhaustion, emotional exhaustion & mental exhaustion
Measures	Physical exhaustion is characterized by low energy, chronic fatigue, and weakness. Emotional exhaustion, the second component of burnout, involves primarily feelings of helplessness, hopelessness, and entrapment. Mental exhaustion, the third component, is characterized by the development of negative attitudes toward one's self, work, and life itself.
Versions	21-item
Languages	English, Dutch

COPENHAGEN PSYCHOSOCIAL QUESTIONNAIRE (COPSOQ) (Kristensen et al. 2005) [2002]	
Objectives	Psychosocial factors, stress, individual health/well-being, personality factors (coping style, sense of coherence, etc.)
Measures	Cognitive demands; commitment; freedom; demands to hide emotions; emotional demands; feedback; influence; insecurity; satisfaction; meaningfulness; career; predictability; leadership; quantitative demands; role clarity; role conflicts; community feeling; sensorial demands; social relations/support; mental/physical health; coherence; behavioural stress
Versions	Long (141-item) for researchers; medium (95-item) for work-environment professionals; brief (44-item) for workplace
Languages	Dutch, Chinese, Danish, English, Flemish, German, Croatian, Malaysia, Norwegian, Persian, Portuguese, Spanish, Swedish

COPENHAGEN BURNOUT INVERNTORY (CBI) (Kristensen et al., 2005) [2005]	
Objectives	Burnout – Fatigue and Exhaustion
Measures	Personal burnout (6 items), work-related burnout (7 items), and client-related burnout (6 items)
Versions	19-item
Languages	Danish, English, Japanese, Mandarin, Cantonese, Swedish, Finnish, French, Slovenian

EFFORT-REWARD IMBALANCE (ERI) (Siegrist et al. 2004) [1994]

Objectives	Effort-reward relations as determinants of well-being
Measures	3 uni-dimensional scales: effort (6 items on quantitative/qualitative load, overall increase, physical load); reward (11 on financial, esteem, career, security, etc.); overcommitment (6 or 29 items)
Versions	short (23-item), long (46-item)
Languages	German, Chinese, Czech, Danish, Dutch, English, Finish, French, Italian, Japanese, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish

GENERAL NORDIC QUESTIONNAIRE (QPS NORDIC) (Lindstrom 2002) [2000]

Objectives	Psychological/social factors (as potential determinants of motivation, health and well-being)
Measures	Job demands/control, role expectation, Work/individual predictability, social interaction, leadership, communication, organisational culture/climate, work group, organisation-commitment, competence, preference for challenge, work motives/centrality, private life interactions
Versions	Short (34-item); long (123-item)
Languages	English, Danish, Icelandic, Norwegian, Suomi, Swedish, Greek

HSE INDICATOR TOOL (HSE) [2004]

Objectives	Conditions known to be potential determinants of work-related stress
Measures	6 primary stressors: demands; control; support; relationships; role; change
Versions	35-item
Languages	English, Arabic, Bengali, Chinese, Farsi, Gujarati, Hindi, Hungarian, Kurdish, Pashto, Polish, Punjabi, Russian, Tamil, Turkish, Urdu, Welsh

JOB CHARACTERISTICS INDEX (JCI) (Sims et al. 1976)

Objectives	Subjectively perceived job characteristics
Measures	Skill variety; autonomy; feedback; co-worker interactions; task identity; friendships
Versions	30-item

Languages	English

JOB CONTENT QUESTIONNAIRE (JCQ) (Karasek et al. 1998) [1985]

Objectives	Content of respondents' work tasks using high-demand/low-control/low-support model of job strain development
Measures	Three main scales of job stress development: decision latitude; psychological demands; social support. Two scales of work demands: physical demands; job insecurity
Versions	By Karasek: recommended (49-item); long (112-item); original (brief, 27-item). Widely used adaptations of the JCQ include the Swedish Demand-Control Questionnaire (DCQ) (17 items, with five on psychological job demands, six on decision latitude [authority, 2; skill discretion, 4], and six on social support) and the Whitehall version (25 items, with 15 on decision latitude/control, four on job demands, and six on social support) (Landsbergis and Theorell 2000)
Languages	English, Bulgarian, Chinese (incl. Taiwan), Czech, Dutch (incl. Flemish), German, Greek, French (incl. Canada), Iceland, Italian, Japanese, Korean, Malaysian, Norwegian, Polish, Portuguese (incl. Brazil), Russian, Spanish (various), Swedish, Thai.

JOB DIAGNOSTIC SURVEY (JDS) (Hackman and Oldham 1975) [1975]

Objectives	Subjectively perceived job characteristics
Measures	Skill variety; autonomy; task significance; task identity; feedback
Versions	15-item
Languages	English

JOB STRESS SURVEY (JSS) (Vagg and Spielberg 1999) [1994]

Objectives	Severity/frequency of working conditions
Measures	3 main scales: job stress (-index, -severity and -frequency). Plus three job pressure (-index, -severity and -frequency) subscales and three support deficit subscales
Versions	30-item
Languages	English, French

MASLACH BURNOUT INVENTORY (MBI) (Maslach et al. 1996) [1981]

Objectives	Burnout - emotional exhaustion, depersonalization, and reduced personal accomplishment (relabelled as: Exhaustion, Cynicism and Professional competence

Measures	Exhaustion is with five items, Cynicism, is also assessed with five items, and Professional efficacy is assessed with six items.
Versions	16 item MBI-GS, MBI-Human Services Survey (MBI-HSS) designed for use with people working in the human services and health care. MBI-Educators Survey (MBI-ES) developed for use by people working in educational settings.
Languages	Dutch, English, Greek, others

MULTIDIMENSIONAL ORGANISATIONAL HEALTH QUESTIONNAIRE (MOHQ) (Avallone and Pamplomatas 2005) [2003]

Objectives	Indicators of organisational wellbeing
Measures	Environmental comfort, clear goals, competence valorisation, listening, information disponibility, conflict, relationships, problem solving, demand, safety, effectiveness, fairness, job descriptions, social utility, openness to innovation
Versions	139-item
Languages	Italian

NIOSH GENERIC JOB STRESS QUESTIONNAIRE (Hurrell and McLaney 1988) [1988]

Objectives	Job characteristics, psychosocial factors, physical conditions, safety hazards, stress, health and job satisfaction
Measures	Psychosocial exposure (workload, responsibility, role demands, mental demands, conflict, skill underuse, employment opportunities, types of job control, etc.); individual strain (depression, somatic complaints, job dissatisfaction, illnesses); stress-strain mediators (social support, self-esteem)
Versions	Selectable forms (n = 22); total: 246 items
Languages	English, Chinese, Japanese, Korean, Spanish

NOVA WEBA QUESTIONNAIRE (Huys and De Rick 2005) [1992]

Objectives	Identify stress-related risks
Measures	4 main measures: control requirements/job demands (quantitative demands, control problems); control options (autonomy, contacts, organizing tasks, information provision); job composition (completeness of functions, cycle times, craftsmanship, cognitive complexity/mental effort); other risks (uncertainty, time constraints, job-education/experience fit, emotional effort/exhaustion)
Versions	156-item
Languages	Dutch

OCCUPATIONAL STRESS INDEX (OSI) (Belkic 2000) [2003]

Objectives	Occupational stress burdens
Measures	2-dimensional matrix. Vertical: information transmission (sensory input, central decision-making, task performance). Horizontal: stress dimensions (underload, high demand, strictness, extrinsic time pressure, aversive/noxious exposures, vigilance/disaster potential, conflict/uncertainty)
Versions	Generic (65-item) and specific (drivers, physicians, teachers, manufacturing workers, clerical staff, air traffic controllers, airline pilots)
Languages	English, Bosnian, Serbian, Swedish

OCCUPATIONAL STRESS INDICATOR (OSIND) (Cooper et al. 1988) [1988]

Objectives	Stressful working conditions
Measures	3 main measures: sources of pressure scale (intrinsic factors, managerial role, relationships, career/achievement, organisational structure/climate, home-work interface); stress effects (low job satisfaction, poor mental/physical health); stress-strain mediators (coping skills, stress-prone personality)
Versions	167-item
Languages	English, Chinese, Italian

OCCUPATIONAL STRESS INVENTORY (OSINV) (Osipow 1992) [1980]

Objectives	Occupational adjustment in terms of job stressors, personal strain, and coping
Measures	3 dimensions: Occupational Roles Questionnaire (role overload / insufficiency / ambiguity / boundary, responsibility, physical environment); Personal Strain Questionnaire (vocational, psychological, interpersonal and physical strain); Personal Resources Questionnaire (recreation, self-care, social support, rational/cognitive coping)
Versions	Battery of three questionnaires (140 items)
Languages	English, Chinese

OCCUPATIONAL STRESS QUESTIONNAIRE (Elo et al. 1998) [1992]

Objectives	Occupational stress: perceived work/environmental stressors, individual stress reactions, and organisational influence
Measures	Job complexity, autonomy, role clarity, organisational climate, support from superiors, cooperation, work appreciation, work hazards, feedback, time pressure

Versions	56-item
Languages	Finnish; English

OLDENBURG BURNOUT INVENTORY (OLBI) (Halbesleben and Demerouti 2005) [1999]

Objectives	Burnout - exhaustion and disengagement
Measures	Cognitive and physical components of exhaustion: general feelings of emptiness, overtaxing from work, a strong need for rest, and a state of physical exhaustion; and disengagement: distancing oneself from the object and the content of one's work and to negative, cynical attitudes and behaviours toward one's work in general
Versions	13-item
Languages	German, Greek, English

PRESSURE MANAGEMENT INDICATOR (Williams and Cooper 1998) [1998]

Objectives	Workplace pressure
Measures	Effects of pressure (job satisfaction, organisational satisfaction, organisational security, organisational commitment, state of mind, resilience, confidence level, physical symptoms, energy levels); sources of pressure (workload, relationships, recognition, organisational climate, personal responsibility, managerial role, home/work balance, daily hassles); individual differences (drive, impatience, control, influence, problem focus, social support, emotional detachment)
Versions	120-item
Languages	English, "over 20 languages"
Notes	Developed from Occupational Stress Indicator

PSYCHOSOCIAL WORKING CONDITIONS (PWC) (Widerszal-Bazyl and Cieslak 2000) [2000]

Objectives	Stress impact of psychosocial working conditions
Measures	3 main scales: job demands (intellectual, psychosocial, and resulting from overload; role conflict); job control (behavioural/cognitive); social support. Plus two scales adapted from Occupational Stress Questionnaire: well-being, wish-list for change
Versions	36-item
Languages	Polish

STRESS DIAGNOSTIC SURVEY (SDS) (Ivancevich et al. 1983) [1983]

Objectives	Identify specific areas of high job stress in work environment
Measures	2 main measures: individual (role conflict/ambiguity, job scope, time pressure, career, responsibility, qualitative/quantitative overload); organisational (policy, rewards, participation, underuse, supervisory style, organisation structure, human resource development)
Version	80-item
Languages	English

STRESS D'ORGANISATION QUESTIONNAIRE (VOS-D) (PREVENT 2005) [1986]

Objectives	Work conditions to facilitate task accomplishment for challenged workers
Measures	14 modules: overloads, role definition, over-responsibility, conflicting roles, work station immobility, decisional powers, interest in work, job security, support from superiors, from colleagues, job satisfaction, work worries, mental health, physical health
Version	95-item (some open questions)
Languages	Dutch, French

STRESS PROFILE (Setterlind and Larson 1995) [1995]

Objectives	Psychosocial work environment
Measures	4 main measures: external causes of stress (psychosocial work environment, work content, workload/control, leadership climate, physical work environment, family relationships, major life events, daily hassles/satisfactions); reactions (self-perception, sense of coherence); coping skills (problem-focused, emotion-focused, behaviour type, lifestyle); stress reactions (physical, emotional, cognitive, burnout)
Versions	224-item
Languages:	English, Norwegian, Danish, Estonian, Finnish, German, French

STRESS RISK ASSESSMENT QUESTIONNAIRE (SRA) (Stressrisk.com) [2003]

Objectives	Workplace stress
Measures	12 main measures: organisational culture; demands (including physical hazards); control; relationships; organisational change; role; support; health; performance; coping with

	workplace pressures; need for organisational change; stress-reduction suggestions
Versions	50-item
Languages	English

TRAVAIL ET SANTÉ (VAG) (Conseil National du Travail (CNT) 2004; Fédération Générale du Travail de Belgique (FGTB) 2002) [1993]

Objectives	Characteristics of workplace stress
Measures	Task contents; work organisation; physical conditions, safety/equipment; relationships; physical/psychological efforts; work-private life interaction; career; health; work opinion
Versions	Complete (200-item), abridged (41)
Languages	Dutch, French

TRIPOD SIGMA QUESTIONNAIRE (Wiezer and Nelemans 2005) [2003]

Objectives	Stress management tool
Measures	8 scales: procedures; hardware; organisation; communication; training/skills; incompatible goals; social support; individual defences
Versions	166-item
Languages	Dutch

VRAGENLIJST BELEVING EN BEOORDELING VAN DE ARBEID (VBBA) (Van Veldhoven and Broersen 2003) [1994]

Objectives	Causes and consequences of work-environment factors
Measures	8 dimensions: job characteristics (work pace/volume, emotional/mental load, physical effort); variety; autonomy; relationships/communication; job-related problems (task clarity/changes, information, problems); conditions (pay, career, insecurity); satisfaction (pleasure, organisational involvement, turnover); strain (need to recover, worry, sleep quality, emotional reactions, fatigue)
Versions	Full (232-item) and abridged (108-item); plus optional sector-specific items
Languages	Dutch, French (Questionnaire sur le Véçu du Travail; VT)

WORK ENVIRONMENT SCALE (WES) (Moos 1981) [1981]

Objectives	Social climate of work units
Measures	Involvement; peer relations; supervisor support; autonomy; task orientation; work pressure; clarity; control; innovation; physical comfort
Versions	Long (90-item); short (40-item)
Languages	English

WORKING CONDITIONS AND CONTROL QUESTIONNAIRE (WOCCQ) (De Keyser and Hansez 1996) [2001]

Objectives	Psychosocial risk and workers' job-control
Measures	Control of work situation: resources; future; task management; risks to self/others; work planning; time management
Versions	80-item (plus two optional questionnaires)
Languages	French; Dutch, English

Source: Adapted from Tabanelli et al. (2008)

Table 3: Summary of observational instruments with references to a guide/description [and year of first publication]

CANEVAS (Delaunois et al. 2002) [1995]

Type	Company analysis
Objectives	Company stress diagnosis at given moment. Initial global evaluation of situation (service, department, company, organisation) in terms of risks/confirmation of stress
Measures	Activities (task, autonomy, role, make decision, risks); environment (context, organisational structure, career, earnings, interpersonal relation); individual mediators (family stress, personality, values, capacity, experience, health)
Methods	70 items on factual company data (physical environment, information exchange dynamics, company culture, psychosocial factors, working conditions, working hours). Analysis based on four concepts: integration, mastery, transparency, requirements
Languages	French

FINNISH INSTITUTE OF OCCUPATIONAL HEALTH (Hurrell et al. 1998) [1983]

Type	Observational checklist
Objectives	Assessment of job stressors (psychosocial, physical, chemical)

Measures	12 stressors (safety responsibilities, repetitiveness, forced pace, complex decision making, etc.)
Methods	Ratings based on work observations (stressors defined/illustrated in user manual), supplemented by supervisor/worker interviews
Languages	Finnish

POSITION ANALYSIS QUESTIONNAIRE (PAQ) (McCormick et al. 1972) [1972]

Type	Job-analysis
Objectives	Position and job stress evaluations
Measures	195 items:187 regarding activities/environment (information, mental processes, output, relationships, work station, job characteristics), eight compensation
Method	Based on worker/supervisor interviews, analysts rate items' strength in particular job
Languages	English

RHIA/VERA (Leitner and Resch 2005) [1989]

Types	Observational job-stress analysis
Objectives	Describe and evaluate stress factors thought to affect health
Measures	Work barriers, monotonous working conditions, time pressure, adverse environmental factors, time constraints, constraints to physical necessities
Methods	Two parts: manual with all definitions and response sheets, prepared for particular analysis; 2–6 h worksite observations/worker-interviews using semi-standardised protocol (reported on response sheets following user-manual definitions)
Languages	German

SUVAPRO (Delaunois et al. 2002) [1999]

Type	Checklist
Objectives	Screening of company stress situations providing premises for interventions
Measures	Stressors, anti-stress resources; symptoms of stress
Methods	3 documents: (1) For management, questions on accidents, absence, material damage, accidents, job security; deadline stress-related complaints, socially isolated working stations, monotony, responsibilities, work station. (2) For working groups, 3-section

	checklist comprising: stress identification, eliminating causes of stress, improving working conditions. (3) For individuals, 10 sections: "five illustrative cases"; explanation of stress; personal questions to identify stressors; evaluation of symptoms; resource assessment (autonomy, social network, information/participation, physical/mental fitness, organisation/planning/ work motivation); summary results table (and identification of any immediate action); removing stressors (more detailed illustration), developing resources (facilitating organisation, planning/preparation, communication, relaxation/balance), discussion of "five illustrative cases", construction of personal anti-stress program
Languages	French, German, Italian

TRAVAILLEUR ET ORGANISATION (TOMO) (PREVENT 2005) [1994]

Type	Observational checklist
Objectives	Inventory of risks associated with functions/departments (not individual workers)
Measures	(1) Task requirements: work contents (monotony, function, cycles, units, etc.); workload (time pressure, precision/concentration, underload, emotional); responsibility (too much/little, poorly defined, contradictory); knowledge/aptitudes (too high/low). (2) Working relationships: functional contacts (dialogue, support, co-operation); other contacts (possibilities, work environment); superiors (feedback, support, etc.); personal integrity (space, intimacy, discriminations, sexual harassment). (3) Working conditions: remuneration (level, differentiation, etc.); secondary conditions (recreation facilities, etc.); rest-working time (schedules, working time, pauses); career. (4) Regulation possibilities: tasks (modality, rate/rhythm, solution of problems, external disturbances); environment (freedom of movement, work station, interruptions, contact with colleagues); organisation (dialog, working time/schedules, career); information/feedback
Methods	Three documents: (1) inventory of problems, list of 54 items (evaluated by observation, interviews, discussion); (2) 137 preventive actions; (3) 54 items divided four groups of measures (see above)
Languages	Dutch

WEBA (WELZIJN BIJ OF ARBEID) (Delaunois et al. 2002)[1990]

Type	Job-analysis instrument
Objectives	Identify threats to wellbeing in terms of risks of stress and psychic overload and lack of appropriate work-training availability
Measures	7 dimensions: (1) completeness of work function (coherent set of tasks with preparation/support); (2) task organisation (decision-making, communication with superiors/co-workers for problem-solving); (3) avoidance of short-cycle tasks (<90 sec); (4) degree of function difficulty (balance between intensive/straightforward tasks); (5) work autonomy (rate/rhythm, task order, personal working method); (6) social contacts (superiors/co-workers); (7) information availability (individual, departmental and company levels)

Methods	Preliminary screening by questionnaire (to determine risk groups/departments), followed by six steps: (1) task analysis (inventory); (2) task-condition evaluation (work-cycle time, cognitive complexity, autonomy, opportunities for contact, information); (3) and (4) job control problems (capacity vs demands), process disturbances; (5) job evaluation (see measures, above); (6) reporting of results and discussion of priorities and interventions
Languages	French, Dutch

Source: Adapted from Tabanelli et al. (2008)

Theorell and Hasselhorn (2005) following a review of cross sectional self-report assessments of psychosocial conditions and health concluded that these measures have an important role in stress research. Usually they are the first step in the identification of risk exposures and risk groups and in a number of studies such as subjective assessments of psychosocial work characteristics have been ''validated'' by objective assessments. In studies of health outcomes of psychosocial risk they also found that the associations of objective indicators and health outcomes are usually weaker than when subjective indicators are used; despite this, it was highlighted that the degree of association between adverse psychosocial exposure and low health is repeatedly confirmed for both subjective and objective measures. They recommended that research on the health impacts of psychosocial risks is important, and that prospective studies and intervention studies are performed since they may provide more solid evidence. Even in such studies they recommended that it is important that self-reported outcomes are supplemented with more objective outcome measures and that the findings of subjective measures are interpreted with caution as problems like subjectivity and common method variance might affect outcomes (Theorell & Hasselhorn, 2005).

Sickness absence, an objective assessment through archival data, is increasingly being considered as a measure of health (Vahtera & Kivimaki, 2008). Obviously, some sick leave represents voluntary absenteeism not related to physical or mental illness, and some employees work while ill and record no absences. However, this subjective component is an unlikely source of major bias in longer sick leaves requiring physician examination. The psychosocial work environment has been found to predict rates of sickness absence in longitudinal studies (Marmot et al., 1995; North et al., 1996). Records of such absences have been found to be a powerful predictor of all-cause mortality. They are also a strong predictor of specific causes of death, such as cardiovascular disease, cancer, alcohol-related causes and suicide, and future disability retirement (Kivimaki et al., 2003; Vahtera, Pentti & Kivimaki, 2004).

National surveillance of psychosocial risk factors in the workplace is important to record the changing work environment (Tabanelli et al., 2008) and for the development of policies and programmes to prevent stress and promote mental and physical health and well-being at work (Cox, Griffiths & Rial-González, 2000). Many national surveillance systems assess exposure to psychosocial risks, subjective assessment of stress and health, job satisfaction and sickness absence (EU-OSHA - http://osha.europa.eu/en/riskobservatory/osm/system/index_html).

Dollard et al. (2007) reviewed all available national surveillance systems for psychosocial risks and outcomes. They found 35 national systems across 20 different countries and an additional four multi-country systems, specifically from the EU. Along with the findings from the review and recommendations of experts and researchers, they suggested that:

- national surveillance should be the priority for any national research agenda for work-related psychosocial risk management;

- stakeholders should cooperate with international systems operators to work towards the development of ''state of the art'' systems;
- emerging risks for priority inclusion in surveillance systems are: emotional demands/emotional labour; workplace bullying, harassment, and violence; exposure to acute stressors; organizational justice issues; the occurrence and impact of organizational change, including downsizing, mergers, and globalization of work and companies; and positive psychological states of well-being and engagement;
- systems should be flexible in order to identify and assess emerging risk factors/groups;
- more widespread implementation of systems in non-Western industrialized nations;
- consistent with the ''hierarchy of controls,'' greater attention should be given to external or upstream factors; and
- a comprehensive international surveillance system and international instruments should be developed that can assist, for example, in the benchmarking of international labour conditions and also in monitoring the global movement of dirty jobs and their consequences.

Through the availability of data from these national systems and from other large epidemiological studies, it may be possible to assess the contribution of psychosocial risks to the global burden of disease.

2.2. Estimating risk factor levels

Even though data are not available worldwide on prevalence of specific psychosocial risk exposures, estimates can be made on the basis of national and international surveillance data to monitor psychosocial risks. This review sets the basis on which estimates of exposure to psychosocial risks can be carried out.

When considering theoretical minimum risk levels in relation to psychosocial risks, one should keep in mind that low levels of psychosocial risks are present at every workplace, however they pose a threat to health through lack of recognition of these risks (and consequent inaction), mismanagement of such risks, lack of prevention and to an extent, continuous exposure to such risks in certain occupations. Therefore exposure to such risks in any occupational category cannot be equal to zero. A number of epidemiological and population based studies have presented 'odds ratios', 'hazard ratios', and 'risk ratios'. Data is also available through a large number of cross-sectional studies, however, results from these studies must be regarded with some caution, and causation can only be implied. Despite this drawback, such studies provide valuable evidence.

2.3. Overview of methods

This review focuses on psychosocial hazards as identified in Table 1. It provides evidence of the research available relating to the health impact of psychosocial risk at the workplace.

The available data was not extracted at this stage and hence the resulting extrapolations are mainly narrative, and are intended to highlight possible links with other occupational risk factors for which global burden of disease estimates are available.

2.4. Criteria for identifying relevant studies

For the purpose of this analysis, studies were sought that assessed the impact of psychosocial risks on health directly or indirectly through the experience of work-related stress. Smaller, more specific studies limited to relatively narrow occupational groups (e.g. nurses, doctors, managers) were checked for consistency with the larger data sets. Literature up to December

2009 was searched for exposure data and exposure-risk relationships, and published statistics of national occupational health and safety institutes were consulted.

In addition to this systematic search, a number of reviews and studies were identified to provide supporting evidence to the selected approach.

2.5. Search strategy for studies

The search was carried out using a mixed search strategy. Electronic searches were performed using:

(a) online databases (including internet based searches):

Databases: Medline, LILACS, Scielo, African Index Medicus, Index Medicus for the WHO Eastern Mediterranean Region (IMEMR), Virtual Health Library, Index Medicus for South-East Asia Region (IMSEAR), The Western Pacific Region Index Medicus (WPRIM), The Cochrane library, EMBASE, Nehl (National electronic library for health), APA Psychinfo (OVID), Highwire press (open access peer-review journals), ABI/Inform Global (ProQuest).
Search engines: Google Scholar, google web search.

(b) manual search of conference proceedings and internet pages of relevant organisations; these included institutions conducting systematic reviews in the field of public health:

Cochrane Collaboration including different Cochrane Centres,
Centre for Reviews and Dissemination (University of York),
The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre),
Campbell Collaboration,
Centers for Disease Control and Prevention (CDC) with the Guide to Community Preventive Services,
European Academy of Occupational Health Psychology conference proceedings,
ICOH-WOPS conference proceedings.

Websites of key stakeholder organisations in occupational health were also reviewed. Examples of these include the ILO, WHO, the European Agency for Safety and Health at Work, the National Institute for Occupational Safety and Health (NIOSH) and the British Occupational Health Research Foundation (BOHRF), the UK Heath and Safety Executive (HSE), and the Health, Work and Well-being Initiative of the UK Government.

The following keywords were used:

Health outcomes: burnout, anxiety, distress, depression, psychopathology, lower back pain, musculoskeletal disorders (MSDs), heart disease, coronary heart diseases (CHD), cardiovascular diseases (CVD), common mental disorders (CMDs), psychological ill-health.

Psychosocial risks: Lack of variety or short work cycles, uncertainty, high demands, work overload or under load, time pressure, shift work, inflexible work schedules, working hours, low participation in decision making, decision latitude, lack of control, effort-reward imbalance, inadequate equipment availability, poor environmental conditions, poor communication, social or physical isolation, interpersonal conflict, lack of social support, role ambiguity, role conflict, poor pay, job insecurity, work-life balance, workplace violence, harassment, bullying.

Mediators: Stress, work-related stress, work stress, occupational stress.

2.6. Selection of studies

Studies that were selected have been published in English in a reputable journal (peer-reviewed and mainly targeted at international audience); or the information provider is a 'credible source'; and the identity of the 'owner(s)' of the site and/or authors of the paper is obvious; the information is original, and if not, the source is clearly stated. Articles are specifically on investigations of general health outcomes or risk factors as well as investigations of disease specific outcomes for musculoskeletal disorders, mental ill-health and cardiovascular diseases.

Randomized Control Trials (RCTs), observational studies, cross-sectional studies, longitudinal studies and meta-analysis studies were investigated. The emphasis was on studies with large samples of over 500 participants. Additional studies not meeting the inclusion criteria have also been included in the report to highlight un-tested trends and possible avenues for further research.

In total, 55 reviews were used in this report (see Table 4 below). Due to the nature of the report, focusing on a number of psychosocial hazards and their relationship with a number of health outcomes, a review table of all etiological studies is not presented here as it would be too complex. However relevant tables can be found in all review studies discussed in this report and presented in the Table below.

Table 4: Review studies used

AUTHOR(S)	AREA	TITLE
Allen, T.D., Herst, D.E.L., Bruck, C.S., & Sutton, M. (2000).	Work-to-family interface	Consequences associated with work-to-family conflict: A review and agenda for future research
Belkic, K., Landsbergis, P., Schnall, P., Baker, D., Theorell, T., Siegrist, J., Peter, R., & Karasek, R. (2000).	Psychosocial work environment	Psychosocial factors: Review of the empirical data among men
Belkic, K., Landsbergis, P., Schnall, P. & Baker, D. (2004).	Cardiovascular disease	Is job strain a major source of cardiovascular disease risk?
Bonde, J.P. (2008).	Depression	Psychosocial factors at work and risk of depression: A systematic review of the epidemiological evidence
Bongers, P.M., Ijmker, S., van den Heuvel, S. & Blatter, B.M. (2006).	Musculoskeletal disorders	Epidemiology of work related neck and upper limb problems: Psychosocial and personal risk factors (part I) and effective interventions from a bio behavioural perspective (part II)
Bøggild, H. & Knutsson, A. (1999).	Cardiovascular disease	Shift work, risk factors and cardiovascular disease
Bunker, S.J., Colquhoun, D.M., Esler, M.D., Hickie, I.B., Hunt, D., Jelinek, V.M., Oldenburg, B.F., Peach, H.G., Ruth, D., Tennant, C.C. & Tonkin, A.M. (2003).	Coronary heart disease	Stress and coronary heart disease: psychosocial risk factors: National Heart Foundation of Australia position statement update
Cox, T., Griffiths, A, and Rial-	Psychosocial work	Research on work related stress

González, E. (2000).	environment	
Croon, D.E., Sluiter, J, Kuijer, P.P., & Frings-Dresen, M. (2005).	Physical work environment: office layout	The effect of office concepts on worker health and performance: A systematic review of the literature
Cummings, G. & Estabrooks, C.A. (2003).	Organisational Restructuring	The effects of hospital restructuring that included layoffs on individual nurses who remained employed: A systematic review of impact
De Beeck, R.O., & Hermans, V. (2000).	Musculoskeletal disorders	Research on work-related low back disorders
De Lange, A.H., Taris, T.W., Kompier, M.A.J., Houtman, I.L.D., Bongers, P.M. (2003).	Psychosocial work environment: Demand-Control-Support	The very best of the Millennium: Longitudinal research and the Demand-Control-(Support) model
Jonge de Jonge, J., & Kompier, M. A. J. (1997).	Psychosocial work environment: Demand-Control-Support	A critical examination of the demand–control–support model from a work psychological perspective
Deeney, C. & O'Sullivan, L. Work (2009).	Musculoskeletal disorders	Work related psychosocial risks and musculoskeletal disorders: Potential risk factors, causation and evaluation methods
Dollard, M.F. Skinner, N., Tuckey, M.R., & Bailey, T. (2007).	Measurement of exposure to psychosocial risks	National surveillance of psychosocial risk factors in the workplace: An international overview
Eby, L.T., Casper, W.J., Lockwood, A., Bordeaux, C., & Brinley, A. (2005).	Work family interface	Work and family research in IO/OB: Content analysis and review of the literature (1980-2002)
Edwards, D., Burnard, P. (2003).	Psychosocial work environment: mental health nurses	A systematic review of stress and stress management interventions for mental health nurses
Eller, N.H., Netterstrøm, B., Gyntelberg, F., Kristensen, T.S., Nielsen, F., Steptoe, A., & Theorell, T. (2009).	Ischemic heart disease	Work-related psychosocial factors and the development of ischemic heart disease: A systematic review
Everson-Rose, S.A. & Lewis, T.T. (2005).	Cardiovascular disease	Psychosocial factors and cardiovascular diseases
Glass, D.C. & McKnight, J.D. (1998).	Depression and Burnout	Perceived control, depressive symptomatology, and professional burnout: A review of the evidence
Guglielmi, R.S. & Tatrow, K. (1998).	Burnout and health	Occupational stress, burnout, and health in teachers: A methodological and theoretical analysis
Hannigan, B., Edwards, B. & Burnard P. (2004).	Psychosocial work environment: clinical psychologists	Stress and stress management in clinical psychology: Findings from a systematic review
Hemingway, H., & Marmot, M. (1999).	Cardiovascular disease	Evidence based cardiology: Psychosocial factors in the aetiology and prognosis of coronary heart disease: Systematic

		review of prospective cohort studies
Kasl, S.V. (1996).	Cardiovascular disease	The influence of the work environment on cardiovascular health: A historical, conceptual, and methodological perspective
Kivimäki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Väänänen, A., & Vahtera J. (2006).	Cardiovascular disease	Work stress in the aetiology of coronary heart disease: A meta-analysis
Kristensen, T.S. (1996).	Cardiovascular disease	Job stress and cardiovascular disease: A theoretic critical review
Kristensen, T.S., Kronitzer, M., & Alfedsson, L., (1998).	Cardiovascular disease	Social factors, work, stress and cardiovascular disease prevention
Kuoppala, J., Lamminpää, A., Liira, J., & Vainio, H. (2008).	Interpersonal relations: Leadership	Leadership, job well-being, and health effects: A systematic review and a meta-analysis
Kuper, H., Marmot, M., & Hemingway, H. (2002).	Cardiovascular disease	Systematic review of prospective cohort studies of psychosocial factors in the etiology and prognosis of coronary heart disease
Landsbergis, P.A., Cahill, J., & Schnall, P. (1999).	Workload and Work pace	The impact of lean production and related new systems of work organization on worker health
Leiter, M.P. & Harvie, P.L. (1996).	Burnout	Burnout among mental health workers: A review and a research agenda
Lloyd, C., King, R. & Chenoweth, L. (2002).	Burnout	Social work, stress and burnout: A review
Maslach, C., Schaufeli, W.B., & Leiter, M.P. (2001).	Burnout	Job burnout
Murphy, G., & Athanasou, J. (1999).	Career development	The effect of unemployment on mental health
Netterstrøm, B., Conrad, N., Bech, P., Fink, P., Olsen, O., Rugulies, R. & Stansfeld, S. (2008).	Depression	The relation between work-related psychosocial factors and the development of depression
Nishiyama, K., & Johnson, J.V. (1997).	Workload and Work pace	Karoshi-death from overwork: Occupational health consequences of Japanese production management
Quinlan, M., Mayhew, C., & Bohle, P. (2001).	Career development	The global expansion of precarious employment, work disorganization, and consequences for occupational health: A review of recent research
Rhoades, L., & Eisenberger, R. (2002).	Interpersonal relations	Perceived organizational support: A review of the literature
Schaufeli, W.B. & Enzmann, D. (1998).	Burnout	The Burnout companion to study and practice: A critical analysis
Schnall, P., Landsbergis, P., & Baker, D. (1994).	Cardiovascular disease	Job strain and CVD

Schnall, P. L., Belkic, K., Landsbergis, P., & Baker, D. (Eds.). (2000).	Cardiovascular disease	The workplace and cardiovascular disease
Sobeih, T., Salem, S., Genaidy, A., Daraiseh, N., & Shell, R. (2006).	Musculoskeletal disorders	Psychosocial factors and musculoskeletal disorders in the construction industry: A systematic review
Spurgeon, A., & Harrington, J.M. (1989).	Workload and work schedule	Work performance and health of junior hospital doctors: A review of the literature
Spurgeon, A., Harrington, J.M., & Cooper, C.L. (1997).	Work schedule	Health and safety problems associated with long working hours: A review of the current position
Stansfeld, S. & Candy, B. (2006).	Mental health	Psychosocial work environment and mental health: A meta-analytic review
Strike P.C., & Steptoe, A. (2004).	Coronary artery disease	Psychosocial factors in the development of coronary artery disease
Tabanelli, M.C., Depolo, M., Cooke, R.M.T., Sarchielli, G., Bonfiglioli, R., Mattioli, S., & Violante, F.S. (2008).	Measurement of exposure to psychosocial risks	Available instruments for measurement of psychosocial factors in the work environment
Tennant, C. (2000).	Coronary heart disease	Work stress and coronary heart disease
Tennant, C. (2001).	Mental health	Work-related stress and depressive disorders
Tsutsumi, A. & Kawakami, N. (2004).	Psychosocial work environment: Effort–reward imbalance	A review of empirical studies on the model of effort–reward imbalance at work: Reducing occupational stress by implementing a new theory
van den Berg, T.I.J., Elders, L.A.M., de Zwart, B.C.H., & Burdorf, A. (2009).	Psychosocial work environment	The effects of work-related and individual factors on the Work Ability Index: A systematic review
van der Doef, M. P., & Maes, S. (1999).	Psychosocial work environment: Demand-Control-Support	The job demand control (-support) model and psychological well-being: A review of 20 years of empirical research
van der Hulst, M. (2003).	Long working hours	Long work-hours and health
van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. B. (2005).	Psychosocial work environment: Effort–reward imbalance	Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies
Virtanen, M., Kivimäki, M., Joensuu, M., Virtanen, P., Elovainio, M., & Vahtera, J. (2005).	Career development	Temporary employment and health: A review

3. Estimating risk factor - disease relationship

3.1. Changing nature of work

Large scale socio-economic and technological changes in recent years along with increasing trends in restructuring and downsizing has continued in many organizations, resulting in an increase in sub-contracting and outsourcing that have affected workplaces considerably (Sparks, Faragher & Cooper, 2001). They are often collectively referred to as 'the changing world of work'. This term encompasses a wide range of new patterns of work organisation at a variety of levels: teleworking and increased use of information and communication technology (ICT) in the workplace; downsizing, outsourcing, subcontracting and globalisation, with the associated change in employment patterns; demands for workers' flexibility both in terms of number and function or skills; an increasing proportion of the population working in the service sector, and a growing number of older workers; self-regulated work and teamwork, etc. (Cox, Griffiths & Rial-González, 2000).

3.1.1. Impact of new forms of organisation and employment on health

There is a rising concern of the effects the new forms of work organisation and practices, in particular in relation to temporary employment, home working, tele-working, part-time work and precarious employment, may have on the health of workers organisations and communities (Benavides, Benach, Diez-Roux & Roman, 2000; Sauter et al., 2002; WHO, 2005). In Europe an estimated 4.6-7.1% of the working population spend over 50% of their working hours at home (Felstead & Jewson, 2000). Several key benefits of working from home or 'teleworking' have been previously cited: namely, enhanced work-life balance, increased flexibility, reduction in commuting, reduced overheads for employer, increased skill base for employer, and increased productivity. However in contrast, several negative consequential impacts of teleworking and flexible working arrangements on workers' health have in addition been documented such as social isolation, presenteeism, lack of support, career progression, and blurring/undefined boundaries between work and home domains (Ertel, Pech & Ullsperger, 2000; Mann & Holdsworth, 2003; Schultz & Edington, 2007).

Temporary employment has increased in developed countries in the past years (Virtanen et al., 2005; NIOSH, 2002; Quinlan, 2004). Temporary, part-time and precarious employment have been linked to increased job demands, lower job security, reduced control over working conditions and increased likelihood of labour force exit (Benach, Amable, Muntaner & Benavides, 2002; Benavides, Benach, Diez-Roux & Roman, 2000; McDonough & Amick, 2001; Quinlan, 2004; Quinlan, Mayhew & Bohle, 2001). Using longitudinal data from the US-based Panel Study of Income Dynamics (individuals employed at entry into the study from 1984-1990), McDonough and Amick, (2001) examined the risk of a labour market exit when health is compromised. They found that among employment and work conditions, a history of unemployment raised the hazard of leaving the labour force; this outcome was also more likely among women who worked part-time and in dangerous jobs. Among younger men, poor health was positively associated with labour force exit and those engaged in part-time work were thirteen times more likely to leave the labour force than their counterparts working full-time.

In a longitudinal study from 10 towns in Finland (n= 26,592 men and 65,759 women, of whom 1,332 died between 1990 and 2001), Kivimaki et al. (2003) reported that overall mortality was 1.2-1.6 times higher among male and female temporary employees compared with permanent employees. Temporary employment was associated with increased deaths from alcohol-related

and, for men, smoking-related cancer. Corresponding risks were greater for the unemployed. Moving from temporary to permanent employment was associated with a lower risk of death than remaining continuously in permanent employment. In a review of 16 longitudinal studies Murphy and Athanasou (1999) suggested that, despite methodological limitations, unemployment has reliable negative effects on mental health.

New types of work arrangements can be as dangerous as traditional unemployment for workers' health (Benach & Mutaner, 2007). There are early indicators of increased fatigue, depression and headaches among the precariously employed (Aronsson & Goransson, 1999). The balance between work demands, level of control, and economic security are central components in this stress pathway. Precariously employed workers lack control over the extent and length of their employment, their pay and economic security, and their work process. The result of this lack of control and insecurity is extended hours of work when jobs are available, the shaving of wages or profit margins to ensure continued income flow, endemic fatigue when long hours of labour are on offer or required, and on-going anxiety. Among precarious workers, contracts may be willingly accepted to reduce economic insecurity and anxiety, irrespective of short-term negative health consequences (Mayhew, 2003). For the most precariously employed, stress is probably inevitable.

New systems of work organization, such as lean production and total quality management, have been introduced by employers throughout the industrialized world to improve productivity, quality, and profitability. However, few studies have examined the impact of such systems on occupational injuries or illnesses or on job characteristics related to job strain. Landsbergis, Cahill and Schnall (1999) reviewed the literature and suggested that lean production creates intensified work pace and demands and there are only moderate or temporary increases in decision authority and skill levels while decision latitude typically remains low concluding that such work can be considered to have job strain. In jobs with ergonomic stressors, intensification of labour was found to lead to increases in musculoskeletal disorders.

The problem of occupational stress is particular relevant for developing countries and regions undergoing enormous economic and social changes. Taiwan is one such society, with a transformation of the industrial structure from labour-intensive to high-tech, as well as rapid westernization in both work and lifestyle. In this context, recent empirical evidence has already shown that compared to British industrial workers, a large random sample of their Taiwanese counterparts (n=1054) suffered worse physical health and reported better mental health and a similar level of job satisfaction (Lu, Chen & Hsu, 1994: cited in Lu, Tseng and Cooper, 1999).

Pejtersen and Kristensen, (2009) examined the development of the psychosocial work environment in Denmark from 1997-2005. The analyses were based on two national questionnaire surveys (n1=1062; n2=3517) of randomly selected employees who completed the Copenhagen Psychosocial Questionnaire. The findings indicated that quality of leadership and social support from supervisors were the only dimensions that improved over the study period while there was general deterioration in the remaining dimensions. The negative developments were an increase in work pace, less influence (job control), less possibilities for development (skill discretion), lower level of meaning of work, more role conflicts, decreased role clarity, reduced sense of community, less social support from colleagues, increased conflicts at work, more threats of violence and more slander and gossip. This deterioration was seen not just among certain groups of employees but in all subgroups, incorporating gender, age and socioeconomic status. They concluded that there was a strong need to change this negative trend.

3.1.2. Changes in the working population

In recent decades an increasing diversification of the workforce can be observed, due to significant changes in employment patterns (Kompier, 2006; Zahm, 2000) and increased worker mobility (EU-OSHA, 2007). A dramatic change in employment patterns can be observed over recent decades, with the increase of active participation of women in the paid workforce (Zahm, 2000).

The pervasiveness of gender segregation within the labour has resulted in significant differences in both job content and working conditions amongst women and men (EU-OSHA, 2002; Messing, 1998; NIOSH, 2002; Östlin et al., 2007); thereby resulting in differential exposure rates and taxonomy of workplace hazards (for example, exposure to toxic chemicals, ergonomic demands, risk of accidents, and psychosocial risks; Messing, 1998). For example, a European Foundation survey found that men tend to be more exposed to physical and chemical hazards (Kauppinen & Kandolin, 1998) than women; whilst women are more frequently exposed to emotionally demanding work, and to work in low-status occupations with often restricted autonomy, as compared to men (EU-OSHA, 2002). Consequently, this differential exposure to workplace hazards can result in both direct and indirect differential impacts on occupational illness and disease for men and women (EU-OSHA, 2002). For example, evidence indicates that men are three times more likely than women to have serious accidents at work (EUROSTAT, 1999); whilst women are more likely to report work-related upper limb disorders, work-related stress, infectious diseases and skin problems (EU-OSHA, 2002). Harris, Heller, and Braddock (1988) investigated potential gender differences of psychological health problems during a facility closure. Gender had a main effect on psychological well-being, with women reporting more symptoms (although the magnitude was fairly small). Cognitive appraisal, administrative support, and attachment were highly correlated and some gender differences were noted, although gender did not moderate the relationship between psychological health and its determinants.

Differential working conditions amongst men and women have been demonstrated to have differential negative consequences in regards to their health and safety (EU-OSHA, 2002). A cross-sectional survey of 2176 bank employees in the UK revealed statistically different gender differences amongst full-time employees in malaise symptoms; even after controlling for other factors (Emslie, Hunt & Mcintyre, 1999). A cross-sectional study of 7484 workers in Canada found that albeit women reported more frequently high-strain jobs, negative psychosocial work characteristics demonstrated a stronger association to psychological distress among men (Vermeulen & Mustard, 2000).

A second observable and noteworthy trend in the changing demographic nature of the current workforce composition is the increased migration of workers, particularly from developing countries to developed countries. In general it can be observed that legal workers, as compared to illegal workers (including both legal and illegal immigrants and visitors working contrary to their visas), have both better working conditions and access to compensation claims (Guthrie & Quinlan, 2005). Evidence indicates that ethnic minority migrants have different conditions, as compared to white migrants, and there is evidence that they can be less successful in the labour market and report significantly lower levels of psychosocial well-being than the majority population (Shields & Price, 2003). There are also differences in terms of gender of the migrant population, with men more likely to be economically active than women, although this can be associated to cultural differences and not necessarily to discrimination.

The increasing number of migrants, both legal and illegal, can also challenge health and safety in a more indirect manner. Migrants' cultural background, anthropometrics and training may differ from those of the average national of the host country, this may in turn impact their use of

technology developed for these specifications (Gurr, Straker & Moore, 1998; Kogi, 1997; O'Neill, 2000). An additional challenge for migrant workers is that the understanding of safety signals and signs may differ in different cultures, so common symbols used in safety might not be understood in the same manner by some immigrants.

Within many, if not all, industrialised nations a significant demographic change, known as population ageing, can be observed (Ilmarinen, 1999, 2006; NIOSH, 2002). Although the evidence points to an ageing population, the proportion of older workers in the workforce has not increased in line with the demographic change. Evidence suggests that both participation and employment rates of older workers (over 55) have markedly decreased in Europe (Auer & Fortuny, 2000; Griffiths, 1997), as well as in the US (NIOSH, 2002), leading to implementation numerous initiatives by governments in many countries to increase older worker employment. For example, recent evidence in South Australia indicates that the initiatives of government to encourage workers to stay in the workforce longer seem to be effective with a reported increase of 70.2 percent in the 55–59 group and 54.8 percent in the 60–64 ages (Hugo et al., 2009).

The needs of older workers have been demonstrated to differ from those of younger workers; namely, increased exposure to certain psychosocial risks at work; less training over a similar period of time; decreased opportunities to gain further knowledge, expertise and develop new skills; less opportunities for task rotation, less support from supervisors, less access to professional development and discrimination in terms of selection, career development, learning opportunities and redundancy (Chui, Chan, Snape & Redman, 2001; Griffiths, 1997; Maurer, 2001; Molinie, 2003). These differential work environments and conditions can result in differential impacts on occupational health and safety.

The observed incidence of work-related health problems of older workers is generally comparable to that of younger workers (i.e. those between 25 and 44 years old). However, as workers get older, an increase in prevalence of musculoskeletal disorders can be observed (EUROSTAT, 2006), and they are more likely to report work-related stress (however, this has been shown to decrease following retirement; Griffiths, 2007). Additionally, for the cohort of workers post retirement (aged 65 and up), the prevalence of total complaints drops on all categories; a similar trend can be observed in relation to those problems which cause long term absence (except for the case of musculoskeletal disorders; EUROSTAT, 1999). It can be speculated that this observed trend can be explained by the fact that only healthier workers will be likely to continue working following retirement age (Griffiths, 2007).

3.2. Psychosocial risks - impact on health and stress

Work situations are experienced as stressful when they are perceived as involving important work demands which are not well matched to the knowledge and skills (competencies) of workers or their needs, especially when those workers have little control over work and receive little support at work (Cox, Griffiths & Rial-González, 2000). The role of work as a determinant of health has been the subject of extensive research and has been confirmed by studies on the association between poor work conditions and ill health (e.g. Floderous et al., 2009; Karasek et al., 1981; Marmot et al., 1991; Schrijvers et al., 1998; Vahtera, Kivimäki & Pentti, 1997; Wang et al., 2008). Wilkins and Beaudet (1998) assessed work stress experienced by the employed population in Canada (n=9023). They found that among men, job strain was associated with migraine and psychological distress, and among women, with work injury. Job insecurity was associated with migraine among women. High physical demands were related to work injury in both sexes. Low co-worker support was related to migraine among men, and to work injury and psychological distress among women.

The contribution of psychosocial factors to poor health have also been recently analysed using the data from the national French SUMER survey (Niedhammer, Chastang & David, 2008a) who found that low levels of decision latitude, and of social support, and high psychological demands were risk factors for poor self-reported health and long sickness absence. High demands were also found to be associated with work injury while workplace bullying and/or violence from the public also increased the risk of poor health, long sickness absence and work injury. Niedhammer, Chastang, and David (2008b) also studied the contribution of work factors using an integrated approach (including all types of exposures) to social inequalities in three health outcomes: poor self-reported health, long sickness absence, and work injury. Respondents were 14,241 men and 10,245 women drawn from the national French working population. Work factors included job characteristics, and occupational exposures of the physical, ergonomic, biological, chemical, and psychosocial work environment. All work factors were measured through expert evaluation by occupational physicians, except psychosocial work factors, which were self-reported. Strong social gradients were found for all work factors, except for psychological demands, workplace bullying, and aggression from the public. Marked social gradients were also observed for the health outcomes studied, blue collar workers being more likely to report poor self-reported health, long sickness absence, and work injury. The social differences in health were reduced strongly after adjustment for work factors by 24-58% according to sex and health outcomes. The strongest impacts were found for decision latitude, ergonomic, physical, and chemical exposures, as well as for work schedules. They concluded that concerted prevention of occupational risk factors would be useful not only to improve health at work, but also to reduce social inequalities in health.

Bauer et al. (2009) examined the contribution of physical and psychosocial working conditions in explaining the social gradient in self-rated health using data from a representative sample from the Swiss national health survey 2002 (n=10101). Results indicated that both physical and psychosocial working conditions were significant predictors of self-reported health. Nielsen et al. (2006) using data from 52 Danish workplaces (n=1919) during a 2-year period estimated the etiologic fractions to examine the role of specific dimensions of the psychosocial work environment and registered absence from work. Psychological demands, decision authority, skill discretion, social support from colleagues or supervisor, predictability, and meaning of work were assessed with questionnaires at baseline and sickness absence was followed-up in employers' registers. The following etiologic fractions were found in the fully adjusted model: decision authority: 12%; social support from supervisors: 8%; psychological demands: 6%; and predictability: 5%. In total, the seven psychosocial factors explained 29% of all sick-leave days, which strongly suggests that improving the psychosocial work environment may prevent substantial amounts of absence.

There is a reasonable consensus among the various attempts to review the literature on those psychosocial hazards of work which are experienced as stressful and/or otherwise carry the potential for harm. This consensus is summarised in ten different categories of job characteristics, work organisation and management, and other environmental and organisational conditions which may be hazardous (as previously presented in Table 1). Under certain conditions, each of these ten aspects of work has proved stressful and/or directly harmful to health.

3.2.1. Job content

There are several different aspects of job content which are hazardous: these include low value of work, the low use of skills, lack of task variety and repetitiveness in work, uncertainty, lack of opportunity to learn, high attentional demands, conflicting demands and insufficient resources (Cox, Griffiths & Rial-González, 2000). Cox (1985a) reviewed the physical and psychological health effects of such work, and reported that exposure to repetitive and

monotonous work is often associated with the experience of boredom, and, in turn, with anxiety and depression, resentment, and generally poor psychological health. There may also be an increased incidence of postural and musculoskeletal problems, including work-related upper limb disorders, disorders of the digestive system and various changes in health-related behaviours, such as smoking and drinking (Cox, Griffiths & Rial-González, 2000). New studies based on large population samples have further strengthened this evidence base (e.g., Borritz et al., 2006; Smith et al., 2000; Theorell et al. 2003)

Further, uncertainty in work, in the form of lack of feedback on performance, is also a source of stress particularly when it extends across a long period of time (Warr, 1992). Such uncertainty may be expressed in ways other than lack of performance feedback, and may partly underpin the effects of other hazardous job characteristics; for example, uncertainty about desirable behaviours (role ambiguity) and uncertainty about future (job insecurity and redundancy). Uncertainty and abstractness in advanced manufacturing technology has also been shown to produce psychological strain (Mullarkey et al., 1997). Similarly, Pilkington et al. (2001) identified increased workload and restructuring as major contributors to stress. An Australian survey found restructuring, involuntary redundancies, increases in workload, organisational and technological changes, widespread downsizing, job insecurity, lack of training; long hours, poor occupational health and safety, and political/economic changes could all lead to excessive stress (ACTU, 1998).

Hu and Schaufeli (2010) studied the impact of past and future job insecurity on Chinese family business workers' mental health (n=557). They found that the negative effects of past job insecurity on employee well-being (i.e., emotional exhaustion, job dissatisfaction, poor organization commitment, and intention to quit) were exclusively due to the fear of future job insecurity. That is, anticipated downsizing fully mediates the relationship between past downsizing and employee well-being therefore demonstrating that future job insecurity plays a more important role as far as poor mental health of Chinese workers is concerned than past job insecurity.

Job insecurity and fear of redundancy can be major sources of anxiety, particularly if organisations expect, at the same time, commitment from their employees. The sense of inequity may exacerbate the experience of stress (Porter, 1990). A number of insights for the precariously employed have been gained from studies of the health consequences from threatened redundancy, and unemployment. In general, there is growing evidence to indicate that job insecurity and short-term contractual relationships have a negative effect over workers' health (Virtanen et al., 2005). Quinlan and his colleagues (2001) conducted a review and found that 87.8% of the reviewed studies on downsizing, organisational restructuring and job insecurity were related to ill health indicators. Similar results were observed in relation to temporary work, where 58.3% of the studies demonstrated a negative association with ill-health indicators. Virtanen and colleagues (2005) systematically reviewed the relationship between temporary work contracts and a variety of health outcomes. The results of the review demonstrated evidence of an association between temporary employment and psychological morbidity, as compared to permanent workers and temporary workers were also found to have a significantly higher risk of occupational injuries.

Theorell et al. (2003) using data from the WOLF study (n=5720) provided evidence to show that downsizing of staff is associated with lowered medically certified sick leave in female employees. Using multiple logistic regression they found an increased likelihood of having no medically certified sick leave (15 days or more) in women during the year following both downsizing and expansion. Analyses of women with and without high cardiovascular score showed that downsizing had a more pronounced effect on reduced long term sick leave among those with high than among those without low cardiovascular score. In general, a relationship

between job insecurity and ill health has been consistently observed (Sverke, Hellgren & Naeswall, 2002). More evidence of the impact of job insecurity and unemployment on health is presented in section 3.2.9.

Continuous exposure to people due to the nature of one's occupation and consequent job content, such as doctors and other health care professionals, policemen, hotel staff etc., also poses a risk to health. A large random community survey of 17,000 people in the Bristol area of the UK found that workers with higher levels of education had increased levels of stress (Smith et al., 2000). The occupations with the greatest proportions of high stress were teachers, nurses and managers (Smith et al., 2000).

In a systematic review of sources of stressors for clinical psychologists, Hannigan, Edwards and Burnard (2004) reported that sources of stress for clinical psychologists included client characteristics, excessive workloads, professional self-doubt and poor management. They found that mental health work is stress-provoking and up to 40% of UK clinical psychologists participating in studies reviewed were found to be experiencing high levels of distress. Coping strategies included talking with colleagues, and other "active" approaches to personal stress management, however, organizational and professional factors may militate against psychologists seeking and receiving support at work.

In a study to explore the impact of poor mental health on nurses, a cross-sectional survey was distributed to 4407 nurses across 8 general hospitals located in Metropolitan Tokyo and other cities in Japan. Those nurses classified as being in 'mentally poor health' reported significantly higher rates of medical errors as compared to those nurses classified as 'mentally in good health' in relation to: drug-administration errors, incorrect operation of medical equipment, errors in patient identification, and needlestick injuries (Suzuki et al., 2004). Another nurses' health study with a focus on shift work followed a cohort of 79,109 females and found an approximate 1.4 fold increase in the risk of non-fatal IHD and 1.2-fold increase in fatal IHD for all who had ever worked on rotating night shifts; however, allowing for potential over-adjustment, the authors concluded that elevated risk followed 6 years of rotating night shifts (Lehto et al., as cited in Nurminen & Karjalainen, 2001).

Lin et al. (2009) investigated the job strain profile and its determinants which included the worker characteristics and the psychosocial working environments of staff working in disability institutions in Taiwan (n=1243). The results show that many staff characteristics were correlated with job strain, such as staff working hours, age, gender, job title, educational level, religion, in-job training, working years in disability institutions and effort-reward imbalance factors. Organizational factors, such as geographical, institutional ownership and accreditation performance and size were also correlated with staff's job strain. In a multiple logistic regression model of the job strain, the authors found that the factors of financial reward (high compare to low, OR=0.95, 95% CI=0.928-0.975), extrinsic effort (high compare to low, OR=1.072, 95% CI=1.072-1.158), perceived job stress (sometimes stressful compare to no stress, OR=2.305, 95% CI=1.161-4.575; very stressful compare to no stress, OR=3.931, 95% CI=1.738-8.893) of the staff were significantly correlated to high job strain.

In an earlier study, Ramirez et al. (1996) examined the relationship between consultants' (n=882 specialist doctors) mental health and their job stress and satisfaction, as well as their job and demographic characteristics. Findings indicated that job satisfaction significantly protected consultants' mental health against job stress. Three sources of stress which were found: feeling overloaded, and its effect on home life; feeling poorly managed and resourced; and dealing with patients' suffering, were associated with both burnout and psychiatric morbidity.

Similar findings have been reported in studies with police officers. Gershon et al. (2009) estimated the effects of perceived work stress in police officers (n=1072) and determined the impact of coping on both perceived work stress and health. Exposure to critical incidents, workplace discrimination, lack of cooperation among co-workers, and job dissatisfaction correlated significantly with perceived work stress. Work stress was significantly associated with adverse outcomes, including depression and intimate partner abuse. Officers who relied on negative or avoidant coping mechanisms reported both higher levels of perceived work stress and adverse health outcomes. Berg et al. (2005) assessed the most severe and frequent police stressors in the Norwegian police service (n=3272). Results indicated that work injuries were appraised as the most stressful but least frequent stressor and job pressure was reported the least severe but most frequent stressor. Older police officers reported more job pressure severity and fewer work injuries. The police in districts where peer support was planned but not implemented, and who worked in districts with more than 50,000 inhabitants, perceived the lack of support more severely than others.

Joseph at al. (2009) also investigated police work in relation to subclinical atherosclerosis through the Buffalo Cardio-Metabolic Occupational Police Stress (BCOPS) study. Employment as an urban police officer was hypothesized to be associated with increased structural subclinical cardiovascular disease (CVD), measured by carotid artery intima-media thickness (IMT). The sample of men and women consisted of police officers (n = 312) and the general population (n = 318), free of clinical CVD. Officers had elevated levels of age-adjusted CVD risk factors (blood pressure, total cholesterol, smoking prevalence) compared with the population sample. In age-, gender-, and traditional risk factor-adjusted models, police officers exhibited increased mean common carotid IMT (police = 0.67 mm, population = 0.64 mm; P = 0.03) and mean maximum carotid IMT (police = 0.99 mm, population = 0.95 mm; P = 0.13).

3.2.2 Workload and work pace

Workload was one of the first aspects of work to receive attention, on its impact on workers' health (Stewart, 1976), and it has long been clear that both work overload and work underload can be problematic (Frankenhauser, 1975; Frankenhauser & Gardell, 1975; Jones et al., 1998; Lundberg & Forsman, 1979; Szabo et al., 1983). French and his colleagues, among others, have made a further distinction between quantitative and qualitative workload (French & Caplan, 1970; French et al., 1974). Both have been associated with the experience of stress (Cox, Griffiths & Rial- González, 2000). Quantitative workload refers to the amount of work to be done while qualitative workload refers to the difficulty of that work. The two dimensions of workload are independent and it is possible to have work which involves quantitative overload and qualitative underload. Much short cycle repetitive assembly work is of this nature, and there is strong evidence that it offers a threat to both physical and psychological health. Glowinkowski and Cooper (1986) also noted that work overload or underload can lower self-esteem and increase smoking and various physical and psychological problems. Kahn and Byosiere (1990) have extended this line of argument by suggesting that workload is a function of quality, quantity and time.

Jones et al. (1998) found that workers reporting high levels of stress and stress-related illnesses were 41/2 times more likely to report problems with "working to deadlines" and "having too much work" than the general working population. Managers often cope with work overload by working longer hours and although this may offer a short term solution to the immediate problem, long working hours –if sustained– may in themselves become problematic (Cox, Griffiths & Rial-González, 2000). A longitudinal study of male and female bus drivers by Rydstedt, Johansson and Evans (1998) found that over an 18-month period, changes in workload influenced spillover of fatigue from work to leisure, perceived effort at work, and psychosomatic symptoms. Additionally, there were no detectable gender differences or any

interactions between gender and stressors, and controls for negative affectivity did not alter any of the results.

The relationship between production management and sudden death due to cardiovascular and cerebrovascular disease, deaths called 'karoshi' in Japanese, meaning "death from overwork" has been an important topic of debate since the 1970s. In a review of karoshi (Nishiyama & Johnson, 1997), discussed the connections to specific ideological and organizational characteristics of Japanese production management, and suggested the job strain mechanism as a possible pathway between karoshi and production management. Hammer et al. (2004) examined the contributions of organizational level norms about work requirements and social relations, and work–family conflict, to job stress and subjective health symptoms in a sample of 1,346 employees from 56 firms in the Norwegian food and beverage industry. The findings showed that organizational level norms, especially those controlling work performance (leading to an increase in workload), had an impact on job stress over and above the immediate demands and social support employees experienced in their jobs.

Workload has to be considered in relation to work pace; that is the speed at which work has to be completed and the nature and control of the pacing requirement: self-, systems- or machine-paced (Cox, Griffiths & Rial-González, 2000). Within limits, control may be the decisive factor in determining health (Sauter et al., 1989). There is strong evidence that machine- and systems-paced work, particularly if of high rate, is detrimental to both psychological and physical health (Bradley, 1989; Cox, 1985a, 1985b; Smith et al., 1981; Smith, 1985). Schriber and Gutek (1987) have identified a number of temporal dimensions that can be measured in organisational settings. Time urgency is usually treated as a property of the person (for example, in relation to Type A behaviour) but it may well also be a property of the job. Johansson and Aronsson (1984) have suggested that VDT workers experience more time urgency in their work than do other occupational groups. Furthermore, Gael (1988) and Landy (1989), using task analysis, have demonstrated that differences in time demands of tasks can be readily identified with large and homogeneous samples of industrial workers.

3.2.3 Work schedule: shift work and long work hours

Much of the literature on work schedule relates to shift (and night) working and long working hours. Stress commonly follows extensive shift work, long hours of labour, job tasks that require interruption to sleep patterns, and resulting fatigue. The increased stress risk is caused by difficulties in inverting biological circadian rhythms, reduced length and poor quality of daytime sleep, and conflicting work/home demands. Fatigue can have a dual effect and both predispose a worker to stress and exacerbate the extent of any pre-existing condition. Stress and fatigue are likely to be greatest among nightshift workers, with 75% of night workers experiencing sleepiness on every night shift (Akerstedt, 1995, 1988, 1985).

Early studies on the effect of shift work on health (Harrington, 1978; Johnson, 1981; Monk & Tepas, 1985; Rutenfranz et al., 1977, 1985) concluded that while good evidence existed to show that shift work, particularly night work, caused disruption of circadian rhythms and sleep patterns, the evidence for there being any major effect on health was limited. The research did however indicate evidence of a link between night work and digestive disorders, and between shift work in general and fatigue. The Bristol survey found that respondents with high work stress are likely to also report working at night more frequently than those in the low stress group (Smith et al., 2000). In a more recent study of nightshift nurses, Kobayashi et al. (1999) found that the cortisol and NK cell activity levels were low during the night shift, suggesting that night shift work is highly stressful and may prejudicial to biodefence. There have been a number of substantive studies of shift work among nurses which have detailed a range of deleterious effects (Bohle, 1999).

In a recent study on the differences between day and non-day workers (n=4590) in exposure to physical and psychosocial work factors in the Danish eldercare sector, Nabe-Nielsen et al. (2009) found that compared with day workers-fixed non-day workers were more exposed to low job control, low support from leaders, physical and psychological violence, and high physical demands. Non-day workers were, however, less exposed to high demands. These differences remained after control for age, job title, and workplace. The authors also suggested that these findings highlighted the importance of adequate adjustment for work factors when the health effects of shift work are studied. Previously in a longitudinal study, Shields (2002) explored the characteristics of shift workers and compared stress factors and health behaviours of shift and regular daytime workers. Based on the analysis of people followed over four years, it was found that men who worked an evening, rotating or irregular shift had increased odds of been diagnosed with a chronic condition over a four-year period. While for both males and females, an evening shift was associated with increases in psychological distress levels over two years.

Thomas, Hertzman and Power (2009) examined the effect of night work, long working hours, psychosocial work stress on an 'objective stress measure', cortisol secretion in mid-life using data from a British birth cohort (n=7916, in paid employment at 45 years). They measured salivary cortisol twice on the same day to capture the post-waking decline, facilitating the analysis of different cortisol patterns: (1) time 1 (T1, 45 minutes post-waking); (2) time 2 (T2, 3hours after T1); (3) average 3-hour exposure from T1 to T2 cortisol; and (4) T1 to T2 change. To identify altered diurnal cortisol patterns THEY calculated: (1) flat T1-T2 change in cortisol; (2) top 5% T1; (3) bottom 5% T1; and (4) T1 hypo-secretion or hyper-secretion. Models were adjusted for socioeconomic position at birth and in adulthood, qualifications, marital status, dependent children, and smoking status. The results indicated that 25% of men and 8% of women were exposed to more than one workplace factor (night work, extended work hours, job strain). Night work was associated with a 4.28% (95% CI 1.21 to 7.45) increase in average 3hour cortisol secretion independently of job strain or work hours. Night workers not exposed to job strain had elevated T1 cortisol (5.81%, 95% CI 1.61 to 10.19), although for T2 cortisol it was night workers exposed to low job control who had elevated levels (11.72%, 95% CI 4.40 to 19.55). The findings suggest that night work is associated with elevated cortisol secretion and that cortisol dysregulation may exist in subgroups with specific combinations of stressors, such as a combination with long working hours.

Older workers usually find it more difficult to tolerate disturbances to circadian rhythm, and may have slower responses, be sleepier, and have greater difficulty with precision and attention tasks. For example, long-distance truck drivers over age 55 have an exponential increase in risk of fatal crashes (Mayhew, 1993). Work/non-work conflicts are an additional stressor, for example, women shift workers with responsibility for children may more frequently have their sleep interrupted (Bohle, 1999). The risk of fatigue and stress is exacerbated by rapidly rotating shifts with repeated late finish/early start shift combinations being more stressful than nightshift (Bohle, 1999). Stress also arises because of shorter daytime sleep periods, or as a result of poorer quality sleep which begins during the morning at the inverse point of the normal circadian rhythm (Akerstedt, 1995).

The increasing popularity of twelve-hour shifts may result in an increased prevalence of fatigue and hence an increased prevalence of stress (especially among those doing overtime). The negative health consequences from working twelve-hour night shifts are likely to be far greater than those employed on 12-hour day shifts. However, minimal scientific assessments of the health consequences of twelve-hour shifts have been conducted. The Bristol survey found that about 30% of highly stressed workers indicated that they often had to work long or unsociable hours, compared to 17% of the low stress group (Smith et al., 2000), however, it is important to note that the 'healthy worker' effect may confound most nightshift impact studies.

Most shift workers self-report chronically impaired health and well being (Bohle, 1999; Akerstedt, 1995, 1988, 1985). Nevertheless, there is considerable debate about the contribution of shift work to a range of physical diseases, including CHD. Boggild and Knutsson (1999) reviewed 17 studies dealing with shift work and cardiovascular disease risk. They suggested that methodological problems such as selection bias, exposure classification, outcome classification, and the appropriateness of comparison groups are present in most of these studies. They found that, on balance, shift workers were found to have a 40% increase in risk. Possible causal mechanisms of this risk via known cardiovascular risk factors related to circadian rhythms, disturbed socio-temporal patterns, social support, stress, health behaviours (smoking, diet, alcohol, exercise), and biochemical changes (cholesterol, triglycerides, etc). They concluded that the risk is probably multifactorial, and that the literature has focused on the behaviour of shift workers, thus neglecting other possible causal connections.

Research in Finland has identified that shift workers have an excess risk of coronary heart disease of between 30-50% in comparison with day workers, although there are some variations between groups (Tenkanen et al., 1997). The causative mechanism indicated was disturbances to circadian rhythms (Tenkanen et al., 1997). The risk of CHD increases with greater experience of shiftwork (Knutsson, 1989). However, shift workers also have higher levels of other risk factors for CHD, including dietary differences (Knutsson, 1989). Others argue that '… shift work is a ''quite definite'' causal risk factor for IHD … shiftwork seems to entail about a 40% increase in IHD risk' (Nurminen & Karjalainen, 2001). A Finnish study of 1,806 men identified that shift-work persistently accentuated other risk factors for ischemic heart disease (IHD) including smoking, lack of physical activity and obesity. Thus it is crucially important that epidemiological studies adjust for potentially confounding effects from social class, lifestyle factors, smoking, and other cardiovascular risk factors (Knutsson et al., 1988; Nurminen & Karjalainen, 2001). Bøggild et al. (2001) examined whether shift work is associated with other work environment factors related to heart disease in a random sample of the Danish population (n=5940). They found that at least one group of shift workers had a higher prevalence of nearly every unfavourable work environment factor that was investigated (both physical and psychosocial), with dust exposure and quantitative demands being the only exceptions. Conflicts at work and low decision latitude were higher among all the groups of shift workers, and all-day walking or standing work and part-time jobs were more often found among female shift workers.

Peter et al. (1999) looked at associations between shift work, chronic psychosocial work stress, and two important cardiovascular risk factors, hypertension and atherogenic lipids. The hypothesis was tested that psychosocial work stress, as defined by the model of effort-reward imbalance, mediates the effects of shift work on cardiovascular risk. Altogether 2288 male participants aged 30-55 years in the baseline screening of the Swedish WOLF (work organization, lipids, and fibrinogen) study underwent a clinical examination and answered a standardized questionnaire measuring shiftwork schedules, effort-reward imbalance at work, and health-adverse behaviour. In addition to the direct effects of shift work on cardiovascular risk, mediating effects of effort-reward imbalance at work were found. The respective odds ratios (OR) ranged from 2.18 to 2.27 for hypertension and from 1.34 to 1.45 for atherogenic lipids. While the effects remained significant after extensive confounder control concerning hypertension, part of the observed effect on atherogenic lipids was due to behavioural influences.

Another work-related risk factor for hypertension identified in the past few years is long work hours. Yang et al. (2006) in an analysis of work hours and self-reported hypertension among a US working population sample (n=24205) found a positive association between hours worked per week and likelihood of having self-reported hypertension. Compared with those working between 11 and 39 hours per week, individuals working 40 hours per week were 14% more

likely (CI: 1.01 to 1.28) to report hypertension, those who worked between 41 and 50 hours per week were 17% more likely (CI: 1.04 to 1.33) to report hypertension, and those who worked >or=51 hours per week were 29% more likely (CI: 1.10 to 1.52) to report hypertension after controlling for confounding variables. These findings clearly suggest that increased work hours may act as a risk factor for hypertension.

Average annual working hours in the United States were found to exceed the average for Japan and all of Western Europe, except for the Czech Republic and Hungary (ILO, 2000). The Fourth European Working Conditions Report indicated that a high proportion of workers across the EU work long hours (17% work more than 48 hours per week). The data also revealed that health problems (stress and back ache) increased with the hours worked. The sectors most affected by long working hours were agriculture, hotels and restaurants and construction (all with more than 20% of workers in this category) (Eurofound, 2007).

Earlier research has focused on some occupational groups, such as junior doctors, are cause for special concern. For example, Spurgeon and Harrington (1989) reviewed the effects of long working hours on the performance and health of junior hospital doctors. In the United Kingdom, particular work rotas meant that until recently junior doctors were working spells of around 102 hours. Spurgeon and Harrington (1989) concluded that a number of studies have shown that a significant proportion of newly qualified doctors develop some degree of psychological ill health. They argue that this may be related to sleep loss which probably increases doctors' vulnerability to other work hazards. To address this a task force was established by the NHS to bring about significant reductions in the numbers of hours worked by junior doctors, but Fielden and Peckar (1999) still found a direct link between the number of hours worked and stress levels (although the number of hours worked was positively related to the perceived availability of social support). However, despite having access to higher levels of effective social support, junior hospital doctors faced significantly greater sources of stress and poorer mental health than their senior counterparts.

There is an association between long hours of work and death from coronary heart disease; for example, Breslow and Buell (1960) found that individuals under 45 years of age who worked more than 48 hours a week had twice the risk of death from coronary heart disease than similar individuals who worked 40 or fewer hours per week. Another study of young coronary patients revealed that one in four had been working at two jobs and an additional two in five had been working more than 60 hours a week (Russek & Zohman, 1958).

Control over work schedules is an important factor in job design and work organisation. Such control may be offered by flexitime arrangements (Landy, 1989). Results of a meta-analysis of work hours and health studies by Sparks, Cooper, Fried, and Shirom (1997) found a small, but significant, positive trend of increased health symptoms with increasing hours of work. These health symptoms covered a broad range from mild psychosomatic symptoms (e.g., headache) to more severe health problems (e.g., myocardial infarction). In another review, Spurgeon et al. (1997) conclude that the attitudes and motivation of the people concerned, the job requirements, and other aspects of the organisational and cultural climate are likely to influence the level and nature of health and performance outcomes. However, they also suggested that there is currently sufficient evidence to raise concerns about the risks to health and safety of long working hours.

Umehara et al. (2007) in a cross-sectional study explored the work-related factors associated with job stress among paediatricians in Japan (n=590 working more than 35 hours/week), as determined by the demand-control-support model and psychosomatic symptoms. Results showed that longer working hours per week were significantly associated with greater job demand, lower job control and more psychosomatic symptoms. After adjusting for working

hours, more workdays with no overtime was significantly associated with lower job demand, greater job control and fewer psychosomatic symptoms therefore suggesting that workdays with no overtime were a protective factor which may facilitate recovery.

Kawakami et al. (1999) studied the effects of overtime, psychosocial working conditions on the occurrence of non-insulin dependent diabetes mellitus in Japanese men (n=2194) in an eight year prospective study. They found that age adjusted incidence of non-insulin dependent diabetes mellitus was significantly higher in those who worked overtime more than 50 hours per month than in those who worked 25 hours or less per month. The findings also indicated that those who worked overtime more than 50 hours per month had 3.7 times higher risk of non-insulin dependent diabetes mellitus after controlling for known risk factors.

Grosch et al. (2006) analysed the association of long hours of work in the U.S. with demographic and organizational characteristics, psychosocial working conditions, and health using data from a quality of work life (QWL) module developed for the 2002 General Social Survey (n=1744). They created five groups based on total hours worked per week: part-time (1-34 hr/week), full-time (35-40 hr/week), lower overtime (41-48 hr/week), medium overtime (49-69 hr/week), and higher overtime (70+ hr/week) and examined the association between these five groups and several measures of health and well-being. Results indicated that overtime work was characterized by higher levels of job stress and perceptions of overwork, but was also associated with increased levels of participation in decision making and opportunities to develop special abilities. Several significant associations were found between hours of work and measures of health and well-being, particularly for respondents in the higher overtime group, highlighting the impact of long working hours on health. Working long hours has also been shown to have an impact on cognitive functioning (Virtanen et al., 2009). Using baseline and follow-up data from the Whitehall II study1 and adjusting for several potential confounding factors, they found that working more than 55 hours per week (as compared to 40 hours per week) was associated with lower scores in the vocabulary test at both baseline and follow-up and also in a decline in performance on a reasoning test.

Shields (1999) examined associations between long working hours, depression and changes in selected health behaviours (changes in weight, smoking, drinking and exercise, while controlling for potential socioeconomic and work-related confounders such as education, income, occupation, shift work and self-employment) over a two year period in a sample of adult workers aged 25 to 54 who worked 35 hours or more per week (n=3830). It was observed that women who worked long hours had increased odds of subsequently experiencing depression. Moving from standard to long hours was associated with unhealthy weight gain for men, with an increase in smoking for both men and women, and with an increase in drinking for women.

Long working hours have also been found to have a negative impact on sleep patterns (duration, quality) of individuals (Cox, Griffiths & Rial-González, 2000). Virtanen et al. (2009) examined the extent to which exposure to long working hours had an impact on short sleep, difficulty falling asleep, frequent waking, early waking and waking without feeling refreshed. They used data from 2 measurements of working hours (phase 3, 1991-1994 and phase 5, 1997-1999) and 2 measurements of subjective sleep disturbances (phase 5 and phase 7, 2002-2004) from the Whitehall II. The sample consisted of full time workers free of sleep disturbances at phase 5 and employed at phases 5 and 7 (n = 937-1594) or at phases 3, 5, and 7 (n = 886-1510). They found that working more than 55 hours a week, compared with working 35-40 hours a week, was related to incident sleep disturbances. Adjusting for

[1] The 'Whitehall studies' are based on a major longitudinal research project that began in 1967 in the UK. The second Whitehall study has tracked over 10,000 UK civil servants employed in twenty departments since 1985. The work characteristics identified in the Whitehall studies have been identified as good predictors of future physical, psychological and social functioning.

confounding demographics, exposure to long working hours was associated with odds ratio 1.98 (1.05, 3.76) for shortened sleeping hours, 3.68 (1.58, 8.58) for difficulty falling asleep, and 1.98 (1.04, 3.77) for waking without feeling refreshed. Repeat exposure to long working hours was associated with odds ratio 3.24 (1.45, 7.27) for shortened sleep, 6.66 (2.64, 16.83) for difficulty falling asleep, and 2.23 (1.16, 4.31) for early morning awakenings. However, sleep disturbances may also be caused by other work-related factors. Akerstedt et al. (2002) examined the multivariate relationship between disturbed sleep and different work-related and background/life style factors in a cross-sectional study in a sample of 5720 healthy employed men and women living in the greater Stockholm area. The results showed that high work demands (OR = 2.15) and physical effort at work (OR = 1.94) were risk indicators for disturbed sleep, while high social support was associated with reduced risk (OR = 0.44). The authors also suggested that the inability to stop worrying about work during free time may be an important link in the relation between stress and sleep.

As can be seen, spending a lot of time at work has a direct impact on health as well as on health related behaviours. Long working hours can also have an indirect effect on health as shown by Fell et al. (2007) in an interesting study, which explored the relationship between work hours and utilization of general practitioners in four Canadian provinces. 3,008 men and 2,609 women participated in the study for a year. Seventy-nine percent of men and ninety two percent of women made at least one visit to a GP during the study year. Overall, 35 percent of men and 12 percent of women worked long hours. The lowest incidence rates of GP use in men and women were among those who worked long, standard hours (>45 hours/week on average, primarily in a standard daytime shift) (men: 8.47 per 1,000 person-days; women: 13.63 per 1,000 person-days). White-collar workers with long work hours visited a GP significantly less often than white-collar workers with regular hours. This relationship between long work hours and GP utilization also varied by occupation.

However, it is important to note that although many studies examine the associations between long work hours and health (Harrington, 2001), van der Hulst (2003) in a review of 27 empirical studies, cautioned that the evidence is inconclusive because many studies did not control for potential confounders, even though these studies showed that long work hours are associated with adverse health as measured by several indicators (cardiovascular disease, diabetes, disability retirement, subjectively reported physical health, subjective fatigue). Furthermore, they reported that evidence exists for an association between long work hours and physiological changes (cardiovascular and immunologic parameters) and changes in health-related behaviour (reduced sleep hours). Support for the physiological recovery mechanism seems stronger than support for the behavioural life-style mechanism. However, due to the gaps in the current evidence and the methodological shortcomings of the studies in the review, they suggested the need for further research.

3.2.4. Control

Decision latitude and control are important issues in job design and work organisation. They are often reflected in the extent to which employees can participate in decision-making affecting their work. However, there are other aspects to participation such as status which may also affect health and behaviour (Cox Griffiths & Rial-González, 2000). The experience of low control at work or of loss of control – low decision latitude – has been repeatedly associated with the experience of stress, and with anxiety, depression, apathy and exhaustion, low self esteem and increased incidence of cardiovascular symptoms (Ganster, 1989; Karasek & Theorell, 1990; Sauter et al., 1989; Terry & Jimmieson, 1999). Interestingly, in a study of 244 occupations in Sweden, men consistently reported higher levels of control than women, even within female stereotyped jobs (Hall, 1991). Following on from the work of Karasek, among others, it is often implied that increasing workers' control is universally beneficial. For example,

Cox (1990) and Warr (1992) have argued that workers should, ideally, be empowered to plan their work, and control their workloads, make decisions about how that work should be completed and how problems should be tackled. However, it has been argued by Neufeld and Paterson, (1989) that control can also be a double-edged sword: the demands implied by the choices involved in controlling situations can themselves be a source of stress.

Initially Karasek (1979, 1981) and Aronsson (1989) identified inter-relationships between the amount of control allowed on-the-job (or decision latitude) and work demands and how they interacted to influence health status and the development of stress. The research literature indicates that lack of control is a core independent variable determining levels of stress, health behaviours and ill-health consequences (Aronsson, 1999a, 1999b, 1989; Aronsson & Goransson 1999; Karasek 1981, 1979; Marmot et al., 1997; Stansfeld et al., 2000; Syme, 1997).

Rugulies et al. (2006) analyzed the impact of psychosocial work characteristics on the incidence of severe depressive symptoms among 4,133 (49% women) employees from a representative sample of the Danish workforce between 1995 and 2000. They found that women with low influence at work (relative risk (RR) = 2.17, 95% confidence interval (CI): 1.23, 3.82) and low supervisor support (RR = 2.03, 95% CI: 1.20, 3.43) were at increased risk for severe depressive symptoms.

Bosma et al. (1997) explored the role of low job control and risk of coronary heart disease in the Whitehall II study (n= 6,895 men and 3,413 women, followed up over 5 years). They reported that men and women with low job control, either self reported or independently assessed, had a higher risk of newly reported coronary heart disease during follow up. Job control assessed on two occasions three years apart, although inter-correlated, had cumulative effects on newly reported disease. Subjects with low job control on both occasions had an odds ratio for any subsequent coronary event of 1.93 (1.34 to 2.77) compared with participants with high job control at both occasions. Using the same data, Bosma, Stansfeld and Marmot (1998) examined the role of several personal characteristics in the association between low job control and coronary heart disease among male and female British civil servants and found that men and women with low job control at baseline had 1.5 to 1.8 higher risks of new heart disease during the 5.3-year follow-up. They also found that psychological attributes, such as hostility, negative affectivity, minor psychiatric disorder, and coping, and personal characteristics were not confounders, intermediate factors, or effect modifiers and affected this association very little, leading to the plausible conclusion that increasing job control could, in principle, lower risks of heart disease for all employees.

Analysis of longitudinal data from the second 'Whitehall study' has also confirmed that occupations characterised by low control (but not high demand) were associated with increased CHD risk independently of socio-economic status and coronary risk factors (Marmot et al., 1997). In the second Whitehall study, three indicators of CHD were assessed: angina, severe chest pain, and medically diagnosed ischaemia. The coronary risk factors measured included smoking status, serum cholesterol, body-mass index, hypertension, and physical activity; the civil servants were simultaneously grouped and ranked into three categories (Marmot et al., 1997). The overall findings were that there was an inverse gradient in CHD risk by grade of employment, with low control (which was closely linked with position in the hierarchy) making an important contribution to CHD. Marmot et al. (1997) concluded that low control is involved in the process that links socioeconomic status with CHD. Similarly a Swedish study of myocardial infarction identified that the combination of high self-reported demands and low self-reported decision latitude was an independent predictor of risk after all adjustments (Theorell et al., 1998). More recently Andersen et al. (2004) found that decision

authority and skill discretion were strongly related to socioeconomic position and the effect on risk of myocardial infarction was partially mediated by skill discretion.

Tsutsumi et al. (2003) examined the associations between job characteristics defined by the job demand-control model and health behaviours in a cross-sectional analysis of 6,759 Japanese rural workers. High psychological demands were associated with heavy smoking, exaggerated prevalence of alcohol drinking, and high work-related physical activity. Low job control was associated with lower consumption of vegetables, a smaller quantity number of cigarettes smoked, and a low level of work-related physical activity. The results further indicated a possible association between psychosocial job characteristics and health behaviours.

Cognitive processes and emotional reactions have also been included in the demand-control pathway. Levels of anxiety and psychiatric morbidity (as measured by the General Health Questionnaire-GHQ) were found to be higher in lower employment grades where there was lower decision latitude in the Whitehall studies (Stansfeld et al., 2000). In both men and women, high job demands, comprised of measures of work pace and conflicting demands, were associated with increased risk of psychiatric disorder. Further, low decision latitude was associated with markedly increased risk of poor general mental health at follow up (Stansfeld et al., 2000). Other studies have identified more equivocal findings, perhaps due to a time lag following changing levels of involvement in decision-making (Parkes & Sparkes, 1998).

Amick et al. (1998) also found work high in psychological demands and low in level of control to been associated with a variety of deleterious health consequences. In a study of San Francisco bus drivers, lack of control led to hypertension, back pain, and gastro-intestinal problems (Syme, 1997). Smith, Kaminstein and Makadok (1995) found that jobs high on demand but low in decision latitude are sources of stress, as are some jobs that do have high decision making latitude but deal with a multitude of variables simultaneously (e.g., police, air traffic controllers, and nurses). Theorell (1998) predicted that future working life experiences will be increasingly polarised into two groups: (a) those who have high demands and also hold high level of control over their work, and (b) those with low demands and low levels of control, and that the differences in health between these two groups are in the process of becoming even wider (Theorell, 1998).

Research suggests that where there are greater opportunities for participating in decision-making, greater satisfaction and higher feelings of self-esteem are reported, while non-participation appears related to work-related stress and overall poor physical health (Cox, Griffiths & Rial-González, 2000). French et al. (1982) have reported that lack of participation shows a strong relationship to job dissatisfaction but that this effect may be mediated by other variables relating to the overall person-environment fit.

Further, a German study of blue-collar workers (n=516) identified that effort-reward imbalance was strongly related to new coronary incidents, increased hypertension, atherogenic lipids, and reduced cardiovascular responsiveness (Siegrist et al., 1991). Stansfeld et al. (1999) examined the impact of work on the risk of future psychiatric disorder using data from the Whitehall II study, from three phases (baseline phase 1: 1985-8; first follow up phase 2: 1989; and second follow up phase 3: 1991-3). Results led to the conclusion that high job demands and effort-reward imbalance were risk factors for future psychiatric disorder while social support and control at work have a positive effect to 'protect' mental health. Results from the Whitehall II study also indicated that effort-reward imbalance was associated with increased alcohol dependence, psychiatric morbidity, coronary heart disease, sickness absence, and poor health functioning (Kuper et al., 2002, 2002a). Conversely, increased control over work tasks had a protective effect (Stansfeld et al., 2000). Tsutsumi and Kawakami (2004) in a review of empirical studies on the model of effort–reward imbalance at work, which included an analysis

of large-scale epidemiological studies and studies with large representative population-based samples, confirmed that stressful work environments (in relation to effort-reward imbalance) predicted health conditions among a wide range of working populations after adjusting for possible confounding factors in each survey. Van Vegchel et al., (2005) in a review of 45 studies also found that the extrinsic effort–reward imbalance hypothesis (high efforts in combination with low rewards increase the risk of poor health) has gained considerable empirical support. However, results for the intrinsic overcommitment hypothesis (a high level of overcommitment may increase the risk of poor health overcommitment) remain inconsistent and the moderating effect of overcommitment on the relation between effort–reward imbalance and employee health has been scarcely examined.

In a comparison of psychosocial work characteristics and self rated health in four post-communist countries (Poland, Czech Republic, Lithuania and Hungary, n=3941), Pikhart et al. (2001), found that effort/reward imbalance at work was a powerful determinant of self rated health in these post-communist populations. Li, Yang and Cho (2006) also found the harmful effects of job strain and effort reward imbalance on health functioning in Chinese physicians. Although the cross sectional design does not allow firm causality, these studies suggest that the effect of the psychosocial work environment is not confined to Western populations. Oxenstierna et al. (2005) studied the health of employees in eight contrasting situations that differ with regard to support from superiors and from workmates and with regard to decision authority using a large sample of Swedish employees (n = 53,371). They found that employees who reported below median decision authority had higher prevalence of pains after work and general physical symptoms as well as a higher incidence of long-term sick leave than those with higher decision authority in all subgroups. Those with good support from both workmates and superiors had lower symptom prevalence and long-term sick leave incidence than those with poor support. The groups with either poor support from superiors or from workmates were in an intermediate category with regard to symptom prevalence. The group with good support from superiors but weak support from workmates, however, had as high long-term sick leave incidence as the group with poor support from both superiors and workmates. The patterns were similar for men and women.

Recent evidence also shows that high decision authority increases the risk of ill health. Marchand, Demers and Durand (2005) analysed the relationship between occupation, work conditions and the experience of psychological distress using longitudinal data derived from Statistics Canada's National Population Health Survey followed four times between 1994-1995 and 2000-2001 (n=6359). They found that in the workplace, job insecurity and social support were important determinants of distress, but greater decision authority increased the risk of psychological distress. Joensuu et al. (in press) examined whether components of job control and work-related social support could predict medically-certified mental disorders using a sample of 13868 forest company employees with no previous hospital admissions for mental disorders, over a mean follow-up period of 15.1years. After adjusting for confounders, they reported that high skill discretion was associated with a reduced risk of hospital admission for mental disorders hazard risk 'HR' 0.74 (0.58-0.95), while high decision authority was associated with an elevated risk HR 1.48 (1.17-1.87). Diagnosis-specific analyses showed high skill discretion to associate with a reduced risk of both depressive and non-depressive, non-alcohol-related mental disorders. High decision authority was a risk factor for alcohol-related and depressive disorders. Good co-worker support was associated with a reduced risk of non-depressive non-alcohol-related mental disorders while supervisor support was not associated with any mental disorders.

Low decision latitude has also been reported to be a feature of high strain jobs. For e.g. Ibrahim et al. (2001) explored the associations of high strain jobs with self-rated health for working women (n = 4043) and men (n = 4230) in the 1994/95 Canadian National Population Health

Survey (NPHS). Workers were classified into high strain and other jobs using the upper and lower tertiles of psychological demands and decision latitude on the JCQ. After adjusting for potential confounders, high job strain was consistently found to be associated with worse self-rated health in both models for each gender, while high strain work was reported by 11% of women and 9% of men. Campo Weiser and Koenig (2009) studied the impact of job strain in US based physical therapists (n=882) in a prospective cohort study with a 1-year follow-up period. Results showed that, compared with national averages, the physical therapists reported moderate job demands and high levels of job control. About 16% of the therapists reported changing jobs during follow-up and associated risk factors for turnover included high job demands, low job control, job strain, female sex, and younger age.

3.2.5. Environment and equipment

A wide variety of physical hazards have been extensively studied for their effects on the psychological experience of stress and on health (Gobel et al., 1998; Holt, 1982; Neale et al., 1983). Results from the Fourth European Working Conditions survey (Eurofound, 2007) indicated that employees with a high level of exposure to physical risk are more likely to report that their health is at risk as a result of their work.

Overall, there is evidence to suggest that poor physical working conditions, in general, can affect both workers' experience of stress and their psychological and physical health (Warr, 1992). For example, Lu (2008) carried out a study on occupational exposure (physical, chemical and ergonomic) and health problems among workers in export processing zones (n=500). The top five hazards were reported to be ergonomic hazards (72.2%), heat (66.6%), overwork (66.6%), poor ventilation (54.8%), and chemical exposure (50.8%). The most common illnesses reported were gastrointestinal problems (57.4%), backache (56%), headache (53.2%), and fatigue/weakness (53.2%). An association between work-related factors, occupational illnesses, and psychosocial problems was also found.

However, there are few studies which directly establish the hazard-stress-harm pathway. Some studies have suggested that the effects of physical hazards on the experience of stress and on health are not related (Cox, Griffiths & Rial-González, 2000). Althouse and Hurrell (1977), for example, compared coal miners in the United States with workers in jobs of similar status (n=938). Despite a difference in the levels of physical dangerousness of the two types of work (exposure of workers to possible injury and death), there were no differences in experience of stress although miners did report significantly more symptoms of ill health such as irritation and somatic complaints. In the case of some hazards, such as temperature and humidity (Biersner et al., 1971), it is the extremes of physical work conditions which are associated with the experience of stress and with effects on health (Holt, 1982; Szabo et al., 1983). In the case of others it is more simply the presence of the hazard or even the perceived threat of its presence which is associated with the experience of stress. An example is provided by doctors' and nurses' reports of anxiety in relation to dealing with patients who might be infected with the human immunodeficiency virus (Cox et al., 1993; Kegeles et al., 1989). Physical hazards not only interact with one another in producing their effects, but may also interact with psychosocial hazards (e.g., Melamed et al., 1999; Schrijvers et al., 1998). They also have a direct effect on health.

Laaksonen et al. (2008) examined gender differences in sickness absence spells of various lengths and sought to explain these differences by health status, working conditions and family-related factors (n= 5470 female and 1464 male) in a 4-year follow up study. They found that physical work demands explained female excess in medically confirmed absence spells of all lengths, as did work fatigue in spells longer than two weeks. Also, physical health problems, physical work demands and work fatigue were more prevalent in women than in men, but their

impact on sickness absence was similar in both genders. In a previous study, Lund et al. (2006) examined the effects of the physical work environment on long term sickness absence and investigated the interaction between physical and psychosocial risk factors in a prospective cohort study among employees in Denmark with a follow-up period of 18 months (n=5357). During the study period, 348 participants (6.9%) developed long term sickness absence; of these, 194 (55.7%) were women and 154 (44.3%) were men. For both female and male employees, risk of onset of long term sickness absence was increased by extreme bending or twisting of the neck or back, working mainly standing or squatting, lifting or carrying loads, and pushing or pulling loads. The results also indicated that dealing with psychosocial stressors simultaneously may improve physical intervention efforts further for female employees.

Lee et al. (2005) also reported the prevalence of musculoskeletal disorders (over one year) arising from strenuous working environments in Taiwanese industries (n=17669). Overall the prevalence of neck (14.8%), shoulder (16.6%), and hand (12.4%) disorders were higher than those of the upper back (7.1%) and elbow (8.3%) among those who sought medical treatment due to the complaint. Workers in construction and agriculture-related industries showed a higher prevalence of upper extremity disorders. After adjusting for confounding variables, job content, physical working condition, a harmonious interpersonal relationship at the workplace and organizational problems were found to be significant determinants of upper extremity disorders in manufacturing and service industries. Male workers in manufacturing industries showed more concern about physical working conditions while female workers in public administration emphasized problems of job content and interpersonal relationships. More detail on the relationship between the physical and the psychosocial work environment and MSDs is presented in section 4.2.1.

The physical layout of workplaces, i.e. office lay-out (e.g. open lay-out versus cellular office) has also been found to have an effect on health. Croon et al. (2005) systematically reviewed the literature to examine the effect of office concepts on worker health and performance, part of which focused on how office layout affected the office workers' job demands, job resources, short and long term reactions. They found strong evidence that working in open workplaces reduces privacy and job satisfaction while limited evidence that was available indicated that working in open workplaces intensifies cognitive workload and worsens interpersonal relations, close distance between workstations intensifies cognitive workload and reduces privacy and desk-sharing improves communication. Pejtersen et al. (2006) studied the indoor climate, the psychosocial work environment and occupants' symptoms in offices using cross-sectional questionnaire survey. The sample consisted of 2301 office occupants distributed in eleven naturally and eleven mechanically ventilated office buildings of which nine buildings had mainly cellular offices; five of the buildings had mainly open-plan offices, whereas eight buildings had a mixture of cellular, multi-person and open-plan offices. The findings indicated that occupants in open-plan offices were more likely to perceive thermal discomfort, poor air quality and noise and that occupants complained more frequently about central nervous system and mucous membrane symptoms than occupants in multi-person and cellular offices. They concluded that open-plan offices may not be suited for all job types.

Noise can act as a physical and a psychological stimulus (Akerstedt & Landstrom, 1998; Kasl, 1992; Kryter, 1972). Smith (1991) suggests that the (non auditory) health effects of noise may often reflect psychological reactions to the noise–stress as well as objective exposure levels. High levels of noise directly damage the middle and inner ears with consequent impairment of hearing (Jones, 1983). Less severe noise may interfere with speech perception and communication (Jones, 1999) and, particularly if it is prolonged, may give rise to the experience of stress, and to anxiety, irritability and tension, increase fatigue and impair performance efficiency (Ahasan et al., 1999; Barreto et al., 1997; Glass & Singer, 1972).

Smith (1991) has concluded that there is considerable evidence that acute noise exposure produces physiological responses which, if prolonged, could have harmful effects on health. Furthermore, intervention and epidemiological studies suggest that noise can have harmful effects on health (Cohen, 1976; Concha-Barrientos et al., 2004; Wallhagen et al., 1997). However, very little is known about the social consequences, including sickness absence, of noise exposure (Clausen et al., 2009). In an effort to address this gap, Clausen et al. (2009) investigated the association between self-reported noise exposure and long-term sickness absence (n=5357). The analyses showed that self-reported noise exposure was significantly associated with long-term sickness absence for both men and women when adjusting for demographic factors and health behaviour. After further adjustment for physical workload at work the association between noise exposure and sickness absence disappeared for women, but not for men. Men that reported to be exposed to loud noise between one-quarter and three-quarters of their time at work had an increased risk of 43% for sickness absence of two weeks or longer compared to men that reported never to be exposed to loud noise.

3.2.6 Organisational culture and function

Sources of stress relating to organisational structure and climate may result from organisational culture and management style (Cooper & Cartwright, 1994). Blanchard (1993) discussed how a "bad boss" can make people sick by subjecting them to unnecessary stress by behaving unpredictably, eroding workers' sense of self-confidence and self-worth, placing workers in win-lose situations, or providing too much or too little stimulation. At times, simply working within an organisation can be perceived as a threat to individual freedom, autonomy and identity (Hingley & Cooper, 1986).

Studies on employees' perceptions and descriptions of their organisations suggest that these revolve around three distinct aspects of organisational function and culture: the organisation as a task environment, as a problem-solving environment and as a development environment (Cox & Howarth, 1990; Cox & Leiter, 1992). The available evidence suggests that if the organisation is perceived to be poor in respect to these environments, then this is likely to be associated with increased levels of stress. On the other hand, if the organisation is perceived to be good in these respects then the relationship between the experience of stress and the report of symptoms of ill-health is attenuated (Cox & Kuk, 1991). Kasl (1992) has listed various aspects of organisation which he believes may be hazardous; for example, organisational size and structure (having a flat structure with relatively few levels), cumbersome and arbitrary procedures, and role-related issues.

Kuoppala et al. (2008) in a systematic review of the literature on the association between leadership and well-being at work and work-related health found that there is a relative lack of well-founded prospective studies targeting the association between leadership and employee health, but the few available good studies suggest an important role of leadership on employee job satisfaction, job well-being, sickness absence, and disability pensions. Based on the available data they calculated risk ratios (RR), which indicated that there was moderate evidence to support that leadership is associated with job well-being RR 1.40 (1.36 to 1.57), sick leave RR 0.73 (0.70 to 0.89), and disability pension RR 0.46 (0.42 to 0.59). In a study to explore the associations between appraised leadership styles, psychosocial work factors and musculoskeletal pain among subordinates (n=2403), Fjell et al. (2007) reported that poor appraisals of managers and their leadership styles were associated with high levels of musculoskeletal pain among both female and male subordinates in different public service sectors. There is therefore a great need of further studies of the mechanisms behind the relationships between the leadership styles and their impact on health among the genders.

Overall, much of the effect of organisation and function and culture on workers is transmitted through the behaviour of managers and supervisors. There is evidence, for example, that management behaviour and supervisory styles have a substantial impact on the emotional well-being of workers (Landy, 1992; Corey & Wolf, 1992). Such an influence may be partly a reflection of their handling of the job context and job content issues (Cox, Griffiths & Rial-González, 2000). Following this argument, any effect of style might be largely a reflection of more general issues of interpersonal relationships.

3.2.7. Interpersonal relationships at work

3.2.7.1. Relationships with superiors, subordinates and colleagues

Three important sets of relationships have been identified: relationships with superiors, relationships with subordinates and relationships with colleagues (Sauter et al., 1992); and have been highlighted as potential stressors (Danna & Griffin, 1999). It has been argued strongly that good relationships amongst workers and members of work groups are essential for both individual and organisational health (Cooper, 1981). A survey by the Ministry of Labour in Japan (1987) revealed that 52% of the women interviewed had experienced anxiety and stress, the main cause being unsatisfactory interpersonal relations at work (61%). Similarly, Jones et al. (1998) found that workers reporting high levels of stress and stress-related illnesses were 6.5 times more likely to report 'lack of support from people in charge at work' than the general working population. Low interpersonal support at work has been found to be associated with high anxiety, emotional exhaustion, job tension and low job satisfaction and increased risk of cardiovascular disease (e.g., Beehr & Newman, 1978; Davidson & Cooper, 1981; Pearse, 1977; Warr, 1992). Studies have found that mistrust of co-workers is related to high role ambiguity, poor communication, low job satisfaction, and poor psychological well-being (Cooper & Cartwright, 1994). Strong emotions, such as workplace jealousy and envy amongst employees, have even been blamed for pathological outcomes such as workplace violence and harassment (Vecchio, 1995). Employee relationships offering support and attachment have very positive effects.

Social relationships both at work and outside the workplace are most commonly viewed as playing a moderating role, and adverse effects of exposure to other psychosocial hazards are more likely or more pronounced when relationships provide little support (Cobb & Kasl, 1977; Cohen & Willis, 1985; House & Wells, 1978). Karasek and colleagues (1982) in a study of over 1,000 male workers in Sweden, showed that support from supervisors and co-workers buffered the effects of job demands on depression and job satisfaction. However, other research suggests a more direct effect of social support in offsetting the adverse effects of working conditions (Ganster et al., 1986). In a meta-analytical study of 68 previous papers, Viswesvaran et al. (1999) confirmed the presence of three general constructs (stressors, strains and social support). Their results indicated that social support had a threefold effect on work stressor-strain relations: it reduced the strains experienced, mitigated perceived stressors, and moderated the stressor-strain relationship.

Lobban et al. (1998) found that supervisory styles (in terms of providing direction and communicating with employees) may play a more dominant role in the stress process than is currently appreciated. They also suggest that supervisory relationships, either directly or mediated by other job characteristics, have significant additional influence on occupational stress that cannot be explained by the role or demand/latitude variables. Buck (1972) has reported that the 'considerate' behaviour of superiors appears to contribute inversely to workers' feelings of job pressure. Workers' participation in decision making results in them reporting greater job satisfaction and stronger feelings of self-esteem (Buck, 1972; French & Caplan, 1970, 1972; Margolis et al., 1974). However, Donaldson and Gowler (1975) consider

that pressure on managers to 'manage by participation' actually places them under increased pressure, and may cause feelings of resentment and anxiety. Robertson and Cooper (1983) discuss how competition at work, particularly among managers, may inhibit problem sharing and increase stress.

Sundin et al. (2006) explored factors that influence the level of social support available and/or perceived by employees in different organisations. This cross-sectional study investigated the relationship between on the one hand, organisational, individual and socio-demographic factors and on the other, the level of social support at the workplace, i.e., the degree of supervisor support and a supportive work atmosphere. Organisational variables (job demands, job control, job content), individual (self-esteem, mistrust) and socio-demographic variables (type of employer, occupational position, age, gender and educational level) were used as independent variables in the analyses. The sample consisted of 16,144 individuals at a variety of different organisations in Sweden, who had responded to a questionnaire covering different psychosocial and psychological stress factors ("the Stress Profile"). Multiple hierarchical regression analyses were performed separately for each of the two dependent variables, which yielded almost identical results, and indicated that organisational determinants, particularly perceived job control, had the largest impact on the degree of social support.

Rhoades and Eisenberger (2002) reviewed more than 70 studies concerning employees' general belief that their work organization values their contribution and cares about their well-being (perceived organizational support; POS). A meta-analysis indicated that 3 major categories of beneficial treatment received by employees (i.e., fairness, supervisor support, and organizational rewards and favourable job conditions) were associated with POS. POS, in turn, was related to outcomes favourable to employees (e.g., job satisfaction, positive mood) and the organization (e.g., affective commitment, performance, and lessened withdrawal behaviour). These relationships depended on processes assumed by organizational support theory: employees' belief that the organization's actions were discretionary, feeling of obligation to aid the organization, fulfilment of socio-emotional needs, and performance-reward expectancies.

The relationship between social support and health has been thoroughly examined over the last two decades and is well documented (Cox, Griffiths & Rial-González, 2000). It has been shown that those with lower levels of social support have higher rates of many different diseases; the aetiological factor being the link between a wide range of psychosocial factors and diminished functioning of the immune system (Syme, 1996). Because people with weak social support are more vulnerable to a wide range of disease agents, including stress-related conditions, the provision of supports at work should have a preventive effect (Peterson, 1999). For example, Netterstrom's study of bus drivers in Denmark found that the introduction of wide-ranging democracy at work resulted in a 2/3 decrease in illness absence with a marked increase in job satisfaction (Netterstrom, 1999).

Stansfeld et al. (1997) explored social support and psychiatric sickness absence in British civil servants using the Whitehall II dataset. Sociodemographic factors, health and social support were measured at baseline, and short and long spells of sickness absence were measured prospectively over a 5-year period. The participants were a subsample of 4202 male and female civil servants, aged 35-55 years at baseline. Support from colleagues and supervisors at work was found to be related to lower risk of short spells of psychiatric sickness absence, particularly for those also receiving high levels of negative aspects of close relationships from their closest person outside work. Negative aspects of close relationships from the closest person increased the risk of taking long spells of psychiatric sickness absence in men.

Gadalla (2009) examined determinants and correlates of psychological distress focusing on the roles of psychosocial resources, such as sense of mastery (the extent that people feel in control

of their lives) and social support in mediating and/or moderating the effects of life stressors, such as unfavourable socioeconomic conditions (SES), poor physical health and chronic daily stress on individuals' level of distress. The above examination was conducted for men and women separately and the results were compared. The study was based on secondary analyses of data collected by Statistics Canada in two cycles of the National Population Health Survey: 2002/2003 and 2004/2005. The sample used included 2535 men and 3200 women between the ages of 25 and 64 years. Higher levels of mastery and social support were found to be associated with less depressive symptoms for both men and women. While perceived social support decreased the likelihood of distress for men directly, it decreased women's likelihood of distress by increasing their mastery.

Ibrahim, Smith and Muntaner (2009) examined the reciprocal relationships between work variables and health outcomes and whether these differ by social class (measured by occupational grouping). Longitudinal data from the 1994/95 - 2002/03 Canadian National Population Health Survey (NPHS) was used. Karasek's work stress variables were measured in the 1994/95 (cycle 1, time 1), 2000/01 (cycle 4, time 2) and 2002/03 (cycle 5, time 3) surveys. Analyses were limited to 2556 respondents aged 18-56 at time 1 and who remained in the same social class (as defined by occupational position) for all the three time points. Work variables used were job strain ratio, work social support and job insecurity while health outcomes included distress, depression and self-rated health. Analyses controlled for age, gender, marital status and work status. A differential burden of work psychosocial factors and health outcomes was found by social class. Low work social support and job insecurity were more detrimental to health for respondents in lower social class positions.

Ylipää, Arnetz and Preber (1999) examined how different personal, physical, and psychosocial work-associated factors are related to good general health, well-being, and musculoskeletal disorders in 575 dental hygienists who were randomly sampled from the Swedish Dental Hygienists' Association. The results showed that high clinical-practice fraction, active leisure, and high management support increased the odds for good general health, while work and family overload decreased the odds. Management support and mastery of work increased the odds for well-being, while work and family overload and high work efficiency decreased them.

Fielden and Peckar (1999) in a study on the link between the number of hours worked and stress levels in junior doctors found that junior hospital doctors used social support as a coping strategy significantly more often than senior hospital doctors, with both perceiving the hospital environment as a more effective source of social support than the home environment.

3.2.7.2 Violence and bullying at work

There is growing literature on violence in the workplace (Beale et al., 1998, 1999; Chappell & Di Martino, 2000; Cox & Leather, 1994; Leather et al., 1998; Standing & Nicolini, 1997) and on the related issue of post traumatic stress disorder (Figley, 1985). There is strong evidence that exposure to violence in the workplace can cause damage to psychological as well as physical health (Leather et al., 1999). Occupational violence has been linked to elevated stress levels. The incidence of violence is hotly debated, and largely dependent on the definition used. A widely accepted typology separates violence into three categories: 'external' (such as occurs during armed 'hold-ups'); client-initiated (for example when a patient attacks a nurse); and 'internal' (e.g. when a worker bullies or subjects an apprentice to degrading or violent initiation rites) (CAL/OSHA, 1998).

In a study for the ILO, Chappell and Di Martino (2000) found that there appeared to be a general rising trend in the incidence of occupational violence across industrialised countries. At best, one in five incidents are reported; with the non-reported incidents commonly known as

the 'dark' figure. Even allowing for significant under-reporting, it is clear that the incidence and severity of the different types of occupational violence varies significantly between different developed countries. Attempts at extrapolation from developed to developing countries are fraught with difficulty; nevertheless where the risk factors are higher (poverty, unemployment etc.), the incidence of occupational violence is likely to be increased (Chappell & Di Martino, 2000; Hoel et al., 2001).

The stress that results from occupational violence has been estimated to contribute to between 10% to 30% of workers' compensation claims. Stress resulting from verbal abuse is particularly common. Hoel et al. (2001) have estimated that at least 10% of European workers are currently subjected to bullying. Exposure to workplace bullying is associated with anxiety, depression, insomnia and stress (Hoel et al., 2001). Further, up to 40% of targets of bullying in a large-scale Norwegian survey had contemplated suicide (Einarsen et al., 1994). Similarly, the Bristol survey found that there was a significantly greater proportion of respondents in the high stress group agreeing that they had been physically or emotionally affected by bullying at work (Smith et al., 2000).

Ortega et al. (2009) examined the prevalence of workplace bullying and risk groups using data from the second Danish Psychosocial Work Environment study. The sample consisted of 3,429 employees between 20 and 59-years. The study showed that 8.3% of the respondents had been bullied within the past year; 1.6% of the sample reported daily to weekly bullying. Co-workers (71.5%) and managers/supervisors (32.4%) were most often reported as perpetrators of bullying, but bullying from subordinates (6%) was also reported. Significant differences were found in the prevalence of bullying for both occupational status and work process. Unskilled workers reported the highest prevalence of bullying, while managers/supervisors the lowest prevalence. People working with things (male-dominated occupations) and people working with clients/patients (female-dominated occupations) reported higher prevalence of bullying than people working with symbols or customers. No significant gender or age differences were found.

The incidence of post-traumatic stress disorder (PTSD) has been widely documented; it suffices to note here that PTSD following violent events at work is relatively common, disabling, results in long-term stress, and the incidence is likely to increase if 'external' violence becomes more common (Flannery, 1996; Raphael, 1991; Rippon, 2000). For example, rising levels of drug addiction may result in increased hold-ups of 'convenience' stores, or terrorist acts may become more widespread. If the incidence of occupational violence increases as expected, stress-related ill health consequences will inevitably multiply. Any already stressful work situations can be exacerbated if workers are unable to control the risks, for example when school teachers cannot expel students (NIOSH, 2002).

The outcomes of sexual harassment appear to be similar to those following bullying, including impairment of health and well-being, depression, anxiety, and loss of concentration (Barling et al., 1996; Richman et al., 1999; Schneider et al., 1997). Further, sexual harassment is a significant stressor for women. For minority groups, racial discrimination is a stronger predictor of health outcomes than are traditional job stresses (Hoel et al., 2001).

3.2.8. Role in organisation

The evidence that 'role in organisation' is a potential psychosocial hazard relates largely to issues of role ambiguity[2] and role conflict[3] (Ingersoll et al., 1999; Jackson & Schuler, 1985;

[2] Role ambiguity manifests itself in a general confusion about appropriate objectives, a lack of clarity regarding expectations, and a general uncertainty about the scope and responsibilities of the job

Kahn, 1973; Kahn et al., 1964). However, other potentially hazardous aspects of role have been identified including role overload, role insufficiency and responsibility for other people. French et al. (1982) have concluded that such variables are among the most powerful predictors of psychological health. Measures of all five aspects of role were used in a study of white collar workers by Bhalla et al. (1991). They were related to workers' reports of strain, job satisfaction and organisational commitment. The data suggested that overall role ambiguity, role conflict and role insufficiency were more strongly related to the outcome variables than were role overload or responsibility for other people.

Kahn et al. (1964) found that workers who suffered from role ambiguity were more likely to experience lower job satisfaction, a greater incidence of job-related tension, greater feelings of futility and lower levels of self-confidence. French and Caplan (1970) found that role ambiguity was related to a similar cluster of symptoms. They also showed that role ambiguity was related to increased blood pressure and higher pulse rates. Later research by Margolis et al. (1974) found a number of significant relationships between role ambiguity and symptoms of depression and low job motivation and intention to leave the job. Cooper and Marshall (1976) have pointed out that although the correlations reported in all these studies were significant and together paint a consistent picture, they were not particularly strong (only accounting for about 2-5% of the data variance).

Kahn and his colleagues (1964) have shown that the greater role conflict in men, the lower job satisfaction and the greater job-related tension. French and Caplan (1970) found that mean heart rate was strongly related to perceived level of role conflict. It may also be related to increased risk of cardiovascular ill health (Ivancevich & Matteson, 1980). For example, Shirom et al. (1973), in a large study of Israeli men drawn from a range of occupations, found that there was a significant relationship between role conflict and incidence of coronary heart disease but only for white-collar workers. Cooper and Smith (1986) concluded that white-collar workers are more prone to role conflict than are manual workers. Kahn et al. (1964) have suggested that those in 'boundary roles' (links between organisational levels or departments), such as foremen, are particularly prone to experience stress. Such roles have a high potential for conflict, and Margolis and Kroes (1974) found that foremen were seven times more likely to develop ulcers than shop floor workers.

Role ambiguity, role conflict, and the degree of responsibility for others are also major sources of potential stress (Cooper & Cartwright, 1994; Glowinkowski & Cooper, 1986). In a meta-analysis of research conducted on role ambiguity and role conflict in work settings, Jackson and Schuler (1985) found that average correlations between role ambiguity and role conflict and affective reactions (e.g., job satisfaction, tension/anxiety, commitment, involvement, and propensity to leave) were greater than for correlations with behavioural reactions (e.g., absence and performance). The average correlations for role ambiguity were also higher than those for role conflict, and they were not necessarily associated with the same individual or organisational variables. These results also indicated that most of the relationships describing potential causes and consequences of role ambiguity and role conflict are most likely to be influenced by moderator variables. Frone, Russell and Cooper (1995) found that job involvement moderated the relationship between role ambiguity and physical health, role ambiguity and heavy alcohol use, and work pressure and heavy alcohol use, with high levels of involvement having an exacerbating affect. Lund et al. (2006) in a study with 5,357 found that long-term sickness absence among female employees was associated with role conflict, low reward, and poor management quality.

[3] Role conflict occurs when the individual is required to play a role which conflicts with their values, or when the various roles that they play are incompatible with one another.

Jamal (1990) found that work overload, role ambiguity, conflict, and resource inadequacy were significantly related to job satisfaction, organizational commitment, psychosomatic health problems, and turnover in a sample of nurses. Emotional exhaustion has been found to occur under conditions of role ambiguity and role conflict (Kelloway & Barling, 1991). The impact of responsibility for others in care-giving roles has also been examined. For example, in a study of U.S. dentists, Cooper, Mallinger and Kahn (1978) found that a high level of conflict originating from the dentist's idealized caring/healing and the actuality of their infliction of pain during dental procedures was a major predictor of abnormally high blood pressure. In a group of nurse managers, Baglioni, Cooper and Hingley (1990) found a potential role conflict between patient care goals and managerial goals. Levels of anxiety and somatisation were related to the interaction of role ambiguity and exit pressures of caregivers working in group home for the mentally ill (Price & Hooijberg, 1992).

Recent findings from the Japan Work Stress and Health Cohort Study (Inoue, et al., in press) indicate that job control and role ambiguity may be important predictors of long-term sick leave due to depressive disorders among male employees, independent of depressive symptoms and neuroticism. During 5.14 years of follow-up on average, 47 incident cases of sick leave of 30 days or more due to depressive disorders were observed. High job control at baseline was associated with a lower risk of long-term sick leave due to depressive disorders, after adjusting for demographic variables, depressive symptoms, and neuroticism at baseline (hazard ratio, 0.28; 0.11-0.71); high role ambiguity was associated with the higher risk (hazard ratio, 3.49; 1.43-8.49).

Role insufficiency[4] has been reported to lead to feelings of stress (Brook, 1973) and is associated with psychological strain and low job satisfaction and organisational commitment (Bhalla et al., 1991). Wardell et al. (1964) showed that 'responsibility for people', compared to responsibility for things, was likely to lead to greater risk of coronary heart disease. French and Caplan (1970) found that responsibility for people was significantly related to heavy smoking, raised diastolic blood pressure and elevated serum cholesterol levels.

3.2.9. Career development

The lack of expected career development may be a source of stress, particularly in organisations which emphasise the relationship between career development and competence or worth. Two major clusters of potential sources of stress have been identified in this area: first, lack of job security and obsolescence (fear of redundancy and forced early retirement); and, second, status incongruity (under or over promotion, and frustration at having reached the career ceiling). These have been related to adverse psychological effects as well as poor physical health as pointed out in a review by Cox, Griffiths and Rial-González (2000) which also highlighted that job insecurity and career development have become sources of occupational stress with multiple negative outcomes (e.g., job dissatisfaction, poor work performance, etc.). This is likely the result of organisational restructuring through mergers, acquisitions, and downsizing prevalent in corporations in recent years, as introduced in section 3.2.1. The European Expert Group on Health in Restructuring acknowledged that the health dimension of enterprise restructuring is a widely neglected area of research, intervention and public concern (Kieselbach et al., 2009) and emphasised the importance of considering the impact of restructuring on individual and organisational health. Literature on the impact of job insecurity and unemployment on stress and health is presented in this section.

In a meta-analysis of job insecurity and its consequences, Sverke, Hellgren and Näswall (2002) found that job insecurity has detrimental consequences for employees' job attitudes,

[4] Role insufficiency refers to a failure of the organisation to make full use of the individual's abilities and training.

organizational attitudes, health, and, to some extent, their behavioural relationship with the organization. Further analyses also suggested that the behavioural consequences of insecurity are more detrimental among manual, as compared with non-manual workers. Rugulies et al. (2006) analyzed the impact of psychosocial work characteristics on the incidence of severe depressive symptoms among 4,133 (51% men) employees from a representative sample of the Danish workforce between 1995 and 2000. They found that among men, job insecurity predicted severe depressive symptoms RR = 2.04 (1.02, 4.07). They carried out another study to further explore the link between job insecurity and a decline in self-rated health using data from the Danish Work Environment Cohort Study (n>3000) in a five year follow up period (Rugulies et al., 2008). They found that women with job insecurity had an increased risk of a decline in health at follow-up, after adjustment for all covariates (OR = 1.78, 1.24 to 2.54). Effect estimates were strongest among women 50 years of age or younger with poor labour market chances (OR = 2.13, 1.32 to 3.45). Among men, effects were found for men aged 50 years or younger with poor labour market chances who showed an OR of 1.64 (0.95 to 2.84) for a decline in health.

In the Bristol survey, it was found that respondents in the high stress group were more likely to be worried about losing their job (Smith et al., 2000). Borg, Kristensen and Burr (2000) analysed data from 5001 Danish employees over a 5-year period and found that high levels of perceived job insecurity were significantly related to lowered self-rated general health. McDonough (2000) found perceived job insecurity to be associated with lower scores in self-rated general health and increases in both distress and the use of medications among a national sample of Canadian workers. Virtanen et al. (2002) examined the relation of contractual and perceived employment security to employee health in municipal sector employees in eight Finnish towns. The sample consisted of 5981 employees with a permanent contract and 2786 employees with a non-permanent contract (2194 fixed term contract, 682 government subsidised contract). They found that when compared with permanent employees, fixed term men and women had better self rated health (men odds ratio 0.70; 0.50 to 0.98, women 0.70; 0.60 to 0.82) and less chronic disease (men 0.69; 0.52 to 0.91; women 0.89; 0.79 to 1.02), but women had more psychological distress (1.26; 1.09 to 1.45). The only difference between subsidised employees and permanent employees was the high level of psychological distress in women (1.35; 1.09 to 1.68). Low perceived employment security was associated with poor health. The association of low perceived security with psychological distress was significantly stronger in permanent employees than among fixed term and subsidised employees, indicating that perceived security is more important for mental health among employees with a permanent contract.

Ferrie et al. (2002) studied effects of chronic job insecurity and change in job security on self reported health, minor psychiatric morbidity, physiological measures, and health related behaviours using data from the Whitehall II study in 931 women and 2429 men who responded to a question on job insecurity in 1995/96 and again in 1997/99. The findings indicated that loss of job security had adverse effect on self reported health and minor psychiatric morbidity, which were not completely reversed by removal of the threat and which tended to increase with chronic exposure to the stressor. More specifically, self reported morbidity was higher among participants who lost job security and those exposed to chronic job insecurity had the highest self reported morbidity. Changes in the physiological measures were limited to an increase in blood pressure among women who lost job security and a decrease in body mass index among women reporting chronic job insecurity.

Job insecurity and its association with health among employees has also been found in the Taiwanese general population (n=8705 men and 5986 women aged between 25 and 65 years) (Cheng et al., 2005). The findings indicated that the overall prevalence of job insecurity was high (50%). Job insecurity was more prevalent among employees with lower education

attainment, in blue-collar and construction workers, those employed in smaller companies, and in older women. Insecure employees also reported lower job control, higher job demands, and poor workplace social support, as compared with those who held secure positions. Regression analyses showed that job insecurity was strongly associated with poor health, even with adjustment of age, job control, job demands, and work place social support. The deleterious effects of job insecurity appeared to be stronger in men than women, in women who held managerial or professional jobs than women in other employment grades, and in those working in larger companies than smaller ones. The findings of this study are similar to the studies in other countries, and also suggest that perceived job insecurity is an important source of stress, and it is accompanied with adverse psychosocial work conditions and poor health.

Organisational instability owing to restructuring, expansion and downsizing has been associated with ill-health and increased sickness absence. In a systematic review of impact of the effects of hospital restructuring that included layoffs on individual nurses who remained employed (Cummings & Estabrooks, 2003), it was found that main effects of restructuring were significant decreases in job satisfaction, professional efficacy, ability to provide quality care, physical and emotional health, and increases in turnover, and disruption to healthcare team relationships. Nurses with fewer years of experience or who experienced multiple episodes of restructuring also experienced greater effects. Westerlund et al. (2004) looked at the long-term relation between workplace expansion and morbidity (n=24036). The study confirmed earlier findings that downsizing is associated with health risks. It also showed that repeated exposure to rapid personnel expansion, possibly connected with centralisation of functions, statistically predicted long-term sickness absence and hospital admission.

An association between organisational instability and cardiovascular risk factors was reported by Westerlund, Theorell and Alfredsson (2004) in a Swedish sample of 3,904 white collar employees. They created five categories of workplaces using interview data from managers and union representatives (Stable: characterised by a good financial situation, operating in a stable market, leading to high job security; Changing/Growing: characterised by optimism, low mean values for both skill discretion and decision authority, combined with high psychological demands leading to high job strain; Threatened Private: characterised by relatively low psychological demands in combination with low skill discretion and low decision latitude., 'Questioned Public', plus 'Small Firms') and compared them to job strain, blood pressure, serum cholesterol, triglycerides, and fibrinogen among employees. They found that 'stable' organizations had the lowest level of job strain and the healthiest profile of cardiovascular risk factors. Compared with the 'Stable' group, employees in 'Changing/Growing' companies had higher job strain (0.28 SD, $p<0.001$), the findings also indicate that organizational stability per se could be a key factor in the high strain due to rapid reorganization and understaffing. Also, in addition to traditional measures of organizational instability, expansion in a favourable economic climate, appeared to be adversely correlated with job strain and psychophysiology. In the 'Threatened Private' group, job strain (0.30 SD, $p<0.001$), cholesterol (0.18 mmol/l, $p<0.05$) and triglycerides (0.09 mmol/l, $p<0.05$) were found to be elevated. The 'Questioned Public' group had higher cholesterol (0.22 mmol/l, $p<0.01$), triglycerides (0.10 mmol/l, $p<0.01$) and fibrinogen (0.13 mmol/l, $p<0.05$). In 'Small Firms', job strain (0.30 SD, $p<0.001$), cholesterol (0.28 mmol/l, $p<0.001$), triglycerides (0.14 mmol/l, $p<0.001$) and fibrinogen (0.19 mmol/l, $p<0.001$) were elevated.

A number of studies have also been carried out on the effect of job security and financial security (leading to unemployment) and on the negative impact of unemployment. Noting that past research has found that paid employment can have beneficial consequences for psychological well-being for men and women, Adelmann (1987) investigated the facets of paid employment that led to this effect. She found that even though patterns differed between men and women, overall results indicated that occupational characteristics (personal income,

complexity, and control) are related to psychological well-being (happiness, self-confidence, and lack of vulnerability to negative experiences) in employed men and women even after controlling for the effects of age and education. Linn, Sandifer and Stein (1985) compared psychological and health data of a sample of who became unemployed after entering the study with a matched employed sample. They found that after unemployment, symptoms of somatization, depression, and anxiety were significantly greater in the unemployed than employed. Furthermore, unemployed men made significantly more visits to their physicians, took more medications, and spent more days in bed sick than did employed individuals even though the number of diagnoses in the two groups were similar. In a study using epidemiologic data, Dooley, Catalano and Wilson (1994) also reported that becoming unemployed increased the risk of depressive symptoms and of becoming clinically depressed by over two times as compared to being employed. More recent studies on the affects of unemployment show similar findings.

In a study of over 2000 Swiss employees, Domenighetti, D'Avanzo, and Bisig (2000) found that psychosocial stress induced by perceived job insecurity had negative effects on 10 different self-reported indicators of health and health-related behaviours. The also found that fear of unemployment had a stronger unfavourable effect on health for highly educated employees than for the less educated. Ferrie et al. (1995) examined the health effects of anticipation of job change and non-employment using longitudinal data from the Whitehall II study, where 666 members of one department threatened with early privatisation were compared with members of the 19 other departments. Results indicated that self reported health status, tended to deteriorate among employees anticipating privatisation when compared with that of the rest of the cohort. In a more recent study using data from Whitehall II, Ferrie et al. (2003) also examined the contribution of job and financial insecurity to socioeconomic gradients in morbidity (n=6770). They found steep gradients in job insecurity among employed participants, and in financial insecurity among both employed and non-employed participants, particularly non-employed men. With the exception of depression, adjustment for job insecurity had little effect on the employment grade gradients in morbidity. However, financial insecurity contributed substantially to gradients in self-rated health, longstanding illness, and depression in both employed and non-employed men, and additionally to GHQ score and diastolic blood pressure in the latter. Adjustment for financial insecurity in non-employed women substantially attenuated gradients in self-rated health, GHQ score and depression. Gradients in the sub-population of non-employed participants tended to be steeper than gradients for participants in employment.

Monden (2005) investigated the extent to which social variations in self-assessed health changed during the 1990s in three Baltic countries Estonia, Latvia and Lithuania using data from the Norbalt Living Conditions Survey I (1994) and II (1999) (n = 16 970). The results indicated substantial and significant associations with poor health and economic activity. Differences in self-assessed health were stable between 1994 and 1999, except for the relatively worse position of the economically non-active in 1999. The reasons suggested for this included a stronger health selection in the labour market and/or a deterioration of the health of the unemployed. In Canada, Breslin and Mustard (2003) using data from the National Population Health Survey (n>6000 followed up 2 years later) similarly found that among the 31- to 55-year-olds, becoming unemployed led to increases in distress and, to some extent, clinical depression at follow-up. In a more recent Canadian study to estimate the impact of major depressive episodes on subsequent employment status in Canada (over 10 years), using data from the National Population Health Survey), Patten et al. (2009) found that major depressive episodes were associated with an increased risk of movement to nonworking status. People aged 26 to 45 years with major depressive episodes had more than double the risk of this transition (HR = 2.6; 1.8 to 3.6). The probability of transition to nonworking status was higher, but the relative effect was smaller in people aged 46 to 65 years (HR = 1.2; 0.7 to 2.0).

Similarly, Scutella and Wooden (2008), using data from the first five waves (n=13,969; 11,993; 11,190; 10,565 and 10,392) of the Household, Income and Labour Dynamics in Australia Survey (HILDA), found unemployment to be associated with poorer self-assessed mental health outcomes.

Rodrigueza, Frongillob and Chandrac (2001) found that in the US (n=8029), men and women not working and receiving means-tested or welfare benefits are more likely to report depression in both the short and long term. In Spain, Artazcoz et al. (2004) (n=3881 employed and 638 unemployed workers) reported that unemployment had more of an effect on the mental health of men (age-adjusted odds ratio [OR] = 2.98; 2.30, 3.87) than on that of women (OR = 1.51; 1.11, 2.06). Gender differences in effects were related to family responsibilities and social class.

Another aspect of career development that has been investigated is poor pay. While most workers will complain about levels of pay, the extremes of poor pay clearly have an effect on the worker's ability to remain healthy (Lynch et al., 1997b; Warr, 1992). Method or schedule of payment may also be a source of stress (for example, piece work) and may interact in its effects with the rate of working (Kasl, 1992). Status incongruity, specifically promotional lag, has also been shown to be significantly related to psychiatric illness. Recent evidence also suggests that for working poor employees, job insecurity was the single significant correlate of depressive symptoms after controlling for other demographic and work environment variables. For working non-poor employees, high psychological demands and low supervisor and co-worker support were associated with depressive symptoms (Simmons & Swanberg, 2009). Similar results on the negative impact on health have also been found in Finland (n=940) which also indicated that men with demanding work that produces little economic reward have significantly greater progression of carotid atherosclerosis than more advantaged men (Lynch et al., 1997a).

3.2.10. Home-work interface

The link between work and home is increasingly being recognised as a potential source of stress, particularly for dual career couples and those experiencing financial difficulties or life crises (Cooper & Cartwright, 1994; Frone et al., 1992). The concept of the work-home interface (or "work-home interference", WHI) relates not only to domestic life and the family but also to the broader domain of life outside of work (Cox, Griffiths & Rial-González, 2000). WHI in research studies has been often considered as a stressor that together with other stressors has adverse effects on health and well-being. It has also been positioned as a stress-reaction (i.e., an indicator of strain), particularly caused by work-related stressors, while in more elaborate models it has been considered a mediator in the stressor–strain relation, particularly between job stressors (e.g., work overload, time pressure) and indicators of impaired psychological health, including psychosomatic complaints, depressive symptoms, and occupational burnout (Demerouti, Bakker & Bulters, 2004).

Eby et al. (2005) carried out a review of 190 work–family studies published in Industrial Organizational/Organizational Behaviour journals from 1980 to 2002. They demonstrated that work–family relationships were complex and multivariate studies are needed to examine how work influences family and vice versa. Experiences in both work and family domains are related to work outcomes as well as family outcomes although domain-specific (i.e., work to work, family to family) effects appeared to be stronger and more consistent, thereby highlighting the importance of considering both domain-specific predictors (e.g., work stressors as predictors of work-to-family conflict) as well as crossover effects across domains (e.g., work stressors as predictors of family functioning) in future WHI research.

Work-to-family conflict occurs when efforts to fulfil the demands of the employee role interfere with the ability to fulfil the demands of the roles as a spouse, parent, or carer. Frequent work-to-family conflict may represent an impediment to successfully meeting family-related demands and responsibilities, and may undermine a person's ability to construct and maintain a positive family-related self-image; further, as both employee and family roles represent core components of adult identity, impediments to work and family related identity formation and maintenance are likely to be experienced as stressful (Frone, Russel & Cooper, 1995). Hingley and Cooper (1986) have argued that problems relating to the interface between work and the family either involve resolving conflicts of demands on time and commitment, or revolve around issues of support.

Hammer et al. (2004) examined the contributions of organizational level norms about work requirements and social relations, and work–family conflict, to job stress and subjective health symptoms in a sample of 1,346 employees from 56 firms in the Norwegian food and beverage industry. The findings showed that organizational norms governing work performance and social relations, and work-to-family and family-to-work conflict, explained significant amounts of variance for job stress. Both work-to-family and family-to-work conflict contributed significantly to the explanation of individual and organizational level variance in job stress. Individual level variables of work–family conflict explained considerable between-firms variance in employee job stress suggesting that this relationship may be stronger in some firms and weaker in others. Further findings indicated that work-to-family conflict was significantly related to health symptoms, but family-to-work conflict and organizational norms were not. It was concluded that when organizational norms contain expectations about high productivity, constant job attendance, commitment to serve the organization's needs, and a message that only the strongest ones survive, work-to-family conflict would be more strongly related to job stress. Further, Demerouti, Bakker & Bulters, (2004) also reported that work pressure leads to WHI and exhaustion, and, vice versa, exhaustion to results in more WHI and work pressure over time, providing evidence for the 'loss spiral' resulting from WHI.

Kinnunen and Mauno (1998) examined the prevalence, antecedents, and consequences of work-family conflict among employed women and men in Finland (n=501). The results showed that work-family conflict was more prevalent than family-work conflict among both sexes with no gender differences. Family-work conflict had negative consequences on family well-being, and work-family conflict, in particular, on occupational well-being. The findings suggest that in particular improvements in working life are needed to prevent problems in the work-family interface. In a large study using data from the Swedish surveys of living conditions, Floderus and colleagues (2009) studied self-reported health, fatigue and symptoms of anxiety in women (n=6515) with and without children in relation to their work status (employed, student, job seeker or homemaker), work hours and having an employed partner, as each of these factors would affect the work-family interface. The results showed that having children increased the odds of poor self-rated health and fatigue in employed women, female students and job seekers, while the presence of a working partner marginally buffered the effects. In dual-earner couples, mothers reported anxiety symptoms less often than women without children. The odds of poor self-rated health and fatigue increased with increasing number of children in employed women, and in women working 40 hours or more.

Jansen et al. (2003) examined the risk factors for the onset of work-family conflict and consequences in terms of need for recovery and prolonged fatigue for men and women separately in a two-year follow-up data from the Maastricht Cohort Study on "Fatigue at Work" (n = 12,095). The findings indicated that for men, several work-related demands, shift work, job insecurity, conflicts with co-workers or supervisor, having full responsibility for housekeeping, and having to care for a chronically ill child or other family member at home were risk factors for the onset of work-family conflict, whereas decision latitude and co-worker and supervisor

social support protected against work-family conflict. In women, physical demands, overtime work, commuting time to work, and having dependent children were risk factors for work-family conflict, whereas domestic help protected against work-family conflict. Work-family conflict was further shown to be a strong risk factor for the onset of elevated need for recovery from work and fatigue.

Frone et al. (1996) argued that on the basis of identity theory, researchers need to simultaneously examine both work-to-family and family-to-work conflict to fully understand the impact of the work-family interface on employee health. In a comprehensive review of the stress-related health outcomes associated with work-family conflict Allen et al. (2000) demonstrated the widespread and serious consequences associated with work-family conflict including psychological strain, anxiety and depression, somatic complaints, elevated blood pressure, and alcohol abuse.

Frone (2000) further examined the relation between work-family conflict and several types of psychiatric disorders through survey data (National Comorbidity Survey) from a representative national sample of 2,700 employed adults in the US, who were either married or the parent of a child 18 years old or younger. Findings revealed that both work-to-family and family-to-work conflict were positively related to having a mood, anxiety, and substance dependence disorder. Depending on the type of work-family conflict and type of disorder, employees who reported experiencing work-family conflict often were 1.99-29.66 times more likely than were employees who reported no work-family conflict to experience a clinically significant mental health problem.

Using family resilience theory, Grzywacz and Bass (2003) also examined the effects of work-family conflict and work-family facilitation on mental health among working adults to gain a better understanding of work-family fit. Data from the National Survey of Midlife Development in the United States (MI-DUS: n=1986) were used to compare different combinations of work-family conflict and work-family facilitation. Results suggested that family to work facilitation was a family protective factor that offset and buffered the deleterious effects of work-family conflict on mental health. The results further suggested that adult mental health is optimized when family to work facilitation is high and family to work and work to family conflict is low.

Chandola et al. (2004) carried out a large comparative study to examine whether work-to-family and family-to-work conflict explains the effects of different role combinations on mental health among male and female public sector employees in Britain, Finland, and Japan. Using cross-sectional data (Japan: n=1865, Finland: n=5885 and UK: n=6955), the results indicated that both work-to-family and family-to-work conflict had an effect on the mental health of men and women independently of each other. There was evidence that the effect of family-to-work conflict on mental health in the UK cohort was stronger for women, while little evidence of gender differences in either type of conflict was found within the Japanese and Finnish cohorts. Single fathers in all three cohorts and of single mothers in the Finnish cohort had poor mental health, and this was partly explained by their higher levels of family-to-work conflict. Japanese women had the greatest conflict and poorest mental health while Finnish women had the lowest conflict and best mental health.

To explore the impact of work-family conflicts on health behaviours Lallukka et al. (in press) carried out a more recent comparison among British (n=3397), Finnish (n=4958), and Japanese (n=2901) employees. They reported that work-family conflicts had few and inconsistent associations with unhealthy behaviours in all three cohorts. In the Finnish cohort, strong work-family conflicts were associated with current smoking among men. Women with strong conflicts had more often unhealthy food habits and were more often heavy drinkers than women with weaker conflicts. Likewise, British women with strong work-family conflicts were

more often heavy drinkers. More research is needed to explore these links further and to identify their causal mechanisms.

4. Assessment of causality: Impact of psychosocial hazards and work-related stress on health

A growing body of evidence demonstrates that a poor psychosocial working environment and work-related stress can have both a direct and indirect impact on workers' physical health and mental well-being. The Fourth European Working Conditions survey (Eurofound, 2007) found that one out of five workers from the EU15 and almost one in three from the 10 new member states believed their health was at risk due to work-related stress. Reports indicate that work-related stress alone affects more than 40 million individuals across the European Union, costing an estimated €20 billion a year in lost time and health bills; it is among the most commonly reported causes of occupational illness by workers (EuroFound, 2007).

Another European survey reported that 90% of the respondents thought that in their countries stress was a major cause of ill health (Iavicoli et al., 2004). It is estimated that stress-related diseases are responsible for the loss of 6.5 million working days each year in the UK, costing employers around €571 million and society as much as €5.7 billion. In the Netherlands, Koningsveld et al. (2003) calculated that costs of absenteeism and disability amounted to €12 billion. The largest costs related to work-related sick leave and disability, mainly caused by psychological and musculoskeletal disorders, each accounting for about 22% (€3 billion) of the total costs. Evidently, absenteeism and disability, due to psychological and musculoskeletal disorders, are a major problem in Dutch society costing the Dutch 3% their total GNP. In Austria, 1.2 million workers reported suffering from work-related stress associated with time pressure. In Denmark, 8% of employees reported being 'often' emotionally exhausted. In Germany, 98% of works councils claimed that stress and pressure of work had increased in recent years and 85% cited longer working hours. In Spain, 32% of workers described their work as stressful. In Sweden, 9 out of 10 white-collar workers reported working against the clock in their daily tasks, and 40% skip lunch breaks (Koukoulaki, 2004).

Béjean and Sultan-Taïeb (2005) evaluated the costs of work-related stress in France. Three illnesses, cardiovascular diseases, depression, musculoskeletal diseases and back pain that may result from exposure to stress were identified and the proportions of cases attributable to the risk factor were calculated from epidemiological studies. Their findings indicated that of a working population of 23.53 million in France some 310,000-393,400 persons (1.3-1.7%) were affected by illnesses attributable to work-related stress, and that 2,300-3,600 persons died as a result of their illness. Work-related stress was estimated to cost society between 1,167 million and 1,975 million in France, or 14.4-24.2% of the total spending of social security occupational illnesses and work injuries.

The experience of stress can alter the way the person feels, thinks and behaves, and can also produce changes in their physiological function (Cincirpini et al., 1984; Sauter & Murphy, 1995; Stainbrook & Green, 1983; Stansfeld et al., 1999). Many of these changes simply represent, in themselves, a modest dysfunction and possibly some associated discomfort. Many are easily reversible although still damaging to the quality of life at the time. However, for some workers and under some circumstances, they might translate into poor performance at work, into other psychological and social problems and into poor physical health (e.g., Devereux et al., 1999). Nevertheless, the overall strength of the relationship between the experience of stress and its antecedents on one hand and health on the other is consistent but moderate (Cox, Griffiths & Rial-González, 2000).

There is a close overlap between fatigue, depression and stress from work. The ILO (2000) estimates that at least 10% of working age adults in the US, the UK, Germany and Poland suffer from clinical depression, anxiety, stress or burnout each year. Mental health difficulties are now one of the three leading causes of disability, along with cardiovascular disease and musculoskeletal injuries (ILO, 2000). For example, between 15% to 30% of UK workers are suffering from anxiety or depression at any one time, and 50% of the Finnish labour force reports some symptoms with 7% suffering from severe burnout (HSE, 2000; ILO, 2000; Smith et al., 2000). The ILO (2000) argues that changes taking place in the labour market - due partly to the effects of economic globalisation - are a major cause.

In the US, research has shown that 26% of workers were 'often' or 'very often' burned out or stressed by their work, also 29% of employees self-reported that they were 'quite a bit' or 'extremely' stressed at work (NIOSH, 1999). An ILO (2000) report states that 40% of US workers find their jobs very of extremely stressful. Similarly in Australia, 26% of employees felt stressed by their work, and 50% considered that the stressors had increased in intensity over the previous twelve months (ACTU, 2000; Moorehead et al., 1997). Very few studies have been conducted in developing countries and regions (Cheng et al., 2005; Li et al., 2007), and hence estimations must be drawn from the substantive studies conducted in more developed countries.

In the UK Bristol study, it was found that those in the high stress group were significantly more likely to agree that they have suffered from an illness that was caused by, or made worse by work over the last year. One of the overall findings was that high occupational stress was significantly associated with a number of work characteristics (e.g. long hours of labour, high exposure to noise, having to work fast, high skill level required, taking the initiative, not being given sufficient information, having to combine different tasks, high workload, responsibility, frequent interruptions, overtime, being treated unfairly, no respect from others, and inadequate support) that have been identified with occupational stress in the existing literature (Smith et al., 2000).

A number of large-scale studies of stress have been conducted in Europe with the data suggesting that, overall, stress accounts for up to 30% of all work-related illness (Hoel et al., 2001). The prevalence of work-related stress presents a significant burden on the workforce of developed countries, and the incidence appears to be steadily increasing over time (Eurofound 2007). Other European research indicates that stress is likely to affect greater numbers of workers in the future, with more costs off-loaded to society at large (EU-OSHA, 2002). Similarly in the UK, the stress levels have increased over the last three years and workplace stress is now a problem in nine out of 10 organisations (Pilkington et al., 2001).

Using epidemiological data from five countries (Belgium, n=3796; France, n=10,174; Sweden, n=960; UK, n=3697 and Germany, n=316) Siegrist et al. (2004) found significantly elevated odds ratios of poor health in employees scoring high on the effort reward imbalance (ERI) scales. They also reported that non-reciprocity or imbalance between high efforts spent and low rewards received were psychometrically well-justified measures of work-related stress grounded in sociological theory is available for comparative socio-epidemiologic investigations. In another European comparison, also using epidemiological data from four studies (covering six countries, n=18494) Salavecz et al. (in press) compared the association of work stress with self-rated health in western European (UK and Germany) and post-communist countries (Poland, Russia, Czech Republic and Hungary). They reported that high effort-reward imbalance at work, i.e. high level of stress, was associated with poor self-rated health. The adjusted odds ratios for the highest versus lowest quartile of the effort-reward ratio were 3.8 (1.9 to 7.7) in Hungary, 3.6 (2.3 to 5.7) in the Czech Republic, 2.5 (1.5 to 4.1) in the UK, 2.3 (1.6 to 3.5) in Germany, 1.5 (1.0 to 2.1) in Poland and 1.4 (1.1 to 1.8) in Russia and the

between countries were statistically significant. A similar pattern was also found for the effect of overcommitment on poor health.

In a study investigating the effects of the Job Demand-Control (JD-C) Model and the ERI Model on employee well-being, De Jonge et al. (2000), conducted a cross-sectional survey on large representative sample of 11,636 employed Dutch men and women. They found that employees reporting high job demands (i.e. psychological and physical demands) and low job control had elevated risks of emotional exhaustion, psychosomatic and physical health complaints and job dissatisfaction (odds ratios ranged from 2.89 to 10.94). Odds ratios were generally higher in employees reporting both high (psychological and physical) efforts and low rewards (i.e. poor salary, job insecurity and low work support): they ranged from 3.23 to 15.43. Furthermore, overcommitted people had higher risks of poor well-being due to a high effort-low reward mismatch (ORs: 3.57-20.81) than their less committed counterparts (ORs: 3.01-12.71). They also found that high efforts and low occupational rewards were stronger predictors of poor well-being than low job control when both job stress models were simultaneously adjusted.

In China, Yu et al. (2008) investigated the effects of the JDC model and the ERI model on worker's well-being using self-report data for psychosocial work conditions and well-being in a sample of 878 workers. They found that workers reporting high job demands and low job control or high efforts and low rewards had elevated risks of job dissatisfaction, psychosomatic complaints and depressive symptoms. Odds ratios were generally higher in workers reporting both high efforts and low rewards. Furthermore, low reward proved to be a stronger predictor of poor well-being when both job stress models were simultaneously adjusted.

Overall, the data indicate that lower-level workers have a higher incidence of stress, in addition to other ill-health conditions linked with their lower socio-economic status. The European Foundation (1998, 2005, 2007) has repeatedly identified that 'high strain jobs' are most likely to create occupational stress: work performed by skilled blue-collar workers, transport, catering and metal manufacturing. Similarly, a Danish survey of over 1,100 people found that lower-level workers had the highest incidence of stress-related ill-health, disproving the theory that it is particularly people in senior positions who are at risk of stress and thrombosis (Janus, 1997). Muncer et al. (2001) also indicated that a range of health occupations suffer increased levels of stress compared with other groups of workers. Stress-related disability claims are also the most rapidly growing form of occupational illness within the workers' compensation system (King, 1995).

This section summarises the literature on the possible health and health-related effects of stress under two headings: psychological and social effects, and physiological and physical effects.

4.1. Psychological and social health

Research indicates that psychosocial working conditions may have a detrimental impact on both affective and cognitive outcomes such as anxiety, depression, distress, burnout, decision-making, and attention (Cox, Griffiths & Rial-González, 2000). Stansfeld and Candy (2006) examined the link between psychosocial work factors and mental disorders by conducting a meta-analysis of published longitudinal studies. In total 11 papers met the strict inclusion criteria and were included in the review. Job strain, low decision latitude, low social support, high psychological demands, effort-reward imbalance and high job insecurity were identified as strong predictors of mental ill-health. The strongest effects were observed for two specific workplace stressors: namely, job strain and effort-reward imbalance. The following section will explore the impact on workers' mental health and cognitive functioning.

4.1.1. Burnout

The incidence of burnout and its recognition has increased substantially over the last few years, however there is a great discrepancy between published opinion and what is regarded as certain knowledge (Weber & Jaekel-Reinhard, 2000). Major contributions for identifying and classifying burnout have been published (Maslach et al., 2001; Schaufeli & Enzmann, 1998). Burnout has become a synonym for psychosomatic, psychological symptoms and social consequences of a long-lasting workload exceeding an individual's capacity (Hillert, 2008). Maslach and Jackson (1981) described burnout as the result of chronic stress (at the workplace) which has not been successfully dealt with, characterized by exhaustion and depersonalization (negativism/cynicism) and is found predominantly in caring and social professions (e.g. social workers, teachers, nurses, doctors, dentists. As such, burnout is included in 10th International Classification of Diseases (ICD 10) as an undefined-additional diagnostic term under the section on factors influencing health status and contact with health services. The ICD section Z.73.0 describes it as 'Burnout-state of total exhaustion' (WHO, 2007b).

However, it should be noted that burnout is not only limited to the health services. Research suggests that the basic structure of burnout is the same across occupations, namely the combination of exhaustion and withdrawal. In health service work these dimensions are related to working with people, since they constitute the object of the employee's job, and manifest themselves in exhaustion resulting from interpersonal strain (emotional exhaustion) and withdrawal from recipients (depersonalization). In other professions the core symptoms of burnout manifest themselves as exhaustion and withdrawal (cynicism) from work in general (Schaufeli & Taris, 2005).

Although there is no universally accepted definition of burnout, most researchers define it as a state of physical, emotional and mental exhaustion that results from long-term involvement in work situations that are emotionally demanding (Schaufeli & Greenglass, 2001). The lack of a binding definition and the difficulty in separating burnout from other health disorders are major problems for research and practice. Furthermore, potential causal factors are still the subject of much controversy (Weber & Jaekel-Reinhard, 2000).

In a 5-year prospective intervention study comprising 2,391 employees from different organizations in the human service sector: social security offices, psychiatric prison, institutions for severely disabled, hospitals, and homecare services, Borritz and colleagues (2006) estimated burnout among employees in human service work using the design and baseline findings of the PUMA study. Results indicated that midwives and homecare workers had high levels on both work- and client-related burnout. Prison officers had the highest level on client-related burnout. Supervisors and office assistants had low levels on both scales. Work burnout showed the highest correlations with job satisfaction ($r = -0.51$), quantitative demands ($r = 0.48$), role-conflicts ($r = 0.44$), and emotional demands ($r = 0.42$), while sickness absence was 13.9 vs. 6.0 days among participants in the highest and lowest work burnout quartile, respectively.

Similarly, Lloyd, King and Chenoweth (2002), in a review found that available empirical research suggested that social workers may experience higher levels of stress and resulting burnout than comparable occupational groups. Factors identified as contributing to stress and burnout included the nature of social work practice, especially tension between philosophy and work demands and the organization of the work environment. Evidence from the Whitehall II study showed that high-demand jobs with low levels of control led to the poorest outcomes, including stress, burnout, and poor physical health. Conversely low demands with a high level of control result in decreased stress risk (Rick et al., 2001).

Visser et al. (2003) investigated levels of job stress and job satisfaction among medical specialists, the factors contributing to stress and satisfaction and the effect of stress and satisfaction on burnout, using a questionnaire sample (n=2400 Dutch medical specialists). Of the respondents, 55% acknowledged high levels of stress, and perceived working conditions were more important, explaining 24% of the variance in job stress and 34% of the variance in job satisfaction. Among perceived working conditions, the interference of work on home life (odds ratio [OR] 1.54, 95% confidence interval [CI] 1.35–1.76) and not being able to live up to one's professional standards (OR 1.57, 95% CI 1.37–1.80) were most related to stress. Feeling poorly managed and resourced (OR 2.07, 95% CI 1.76–2.43) diminished job satisfaction. Burnout was explained by both high stress and low satisfaction (41% of variance explained) rather than by stress alone.

Social patterns of pay systems have also been found to be associated with psychosocial job characteristics and burnout among paid employees in Taiwan (Yeh, Cheng & Chen, 2009). Yeh, Cheng & Chen (2009) studied a total of 8906 men and 6382 women aged 25-65 years and pay systems (classified into three categories, i.e., fixed salary, performance-based pay and piece-rated or time-based pay (without a basic salary). Results indicated that among the three pay systems, employees earning through a performance-based pay were found to have the longest working hours, highest level of job control, and highest percentage of workers who perceived high stress at work. Those remunerated through a piece-rated/time-based pay were found to have the lowest job control, shortest working hours, highest job insecurity, lowest potential for career growth, and lowest job satisfaction. The results of multivariate regression analyses showed that employees earning through performance-based and piece-rated pay systems showed higher scores for personal burnout and work-related burnout, as compared to those who were given fixed salaries, after adjusting for age, education, marital status, employment grade, job characteristics, and family care workloads.

A great deal of research has also been devoted to the understanding of factors contributing to burnout and to its consequences for individuals and their health, largely focusing on health workers; most of these have been discussed in section 3. Early research indicated that stress and burnout were significant factors in the development of both physical and psychological illness (McGrath et al., 1989). The link between work-related stress and physical health has been clearly established; however, research on the link between burnout, conceptualized as a form of job stress, and health is limited. The few studies that have been conducted have found that physical health outcomes are predicted primarily by the exhaustion dimension of burnout (which is considered to be the individual stress component of the burnout). Taken as a whole, the body of research does not, at present, build a strong case for the argument that burnout causes physical illness, however, it indicates that it may affect mental health (Maslach, 2001).

Middeldorp, Cath & Boomsma (2006) investigated the association between employment, burnout and anxious depression and to what extent they are caused by shared etiological factors using a sample of 4,309 Dutch twins and 1,008 siblings. Findings indicated that employment and anxious depression were both influenced by genetic and individual-specific environmental factors. Associations between employment and anxious depression as well as between burnout and anxious depression were found to be due to overlapping genetic and individual-specific environmental factors. They concluded that work related circumstances, e.g. financial strain or work-family conflict, might be of importance in burnout and anxious depression. These results support the notion that a genetic vulnerability for depression also increases the risk for exposure to high-risk environments, such as unemployment.

Peterson et al. (2008) carried out a cross-sectional study to investigate how burnout relates to self-reported physical and mental health, sleep disturbance, memory and lifestyle factors, using a sample of Swedish County Council employees (n = 6118). They found that self-reported

depression, anxiety, sleep disturbance, memory impairment and neck and back pain were much higher in burnout and exhausted groups as compared to disengaged and non-burnout groups. Employees with burnout had most symptoms, compared with those who experienced only exhaustion, disengagement from work or no burnout, highlighting the importance of actions that need to be taken to prevent and combat burnout.

While burnout is a problem that is specific to the work context, in contrast depression tends to pervade every domain of a person's life (Maslach, Schaufeli & Leiter, 2001). Factor analytic studies of items measuring burnout and depression (Schaufeli & Enzmann, 1998) have generally found each construct to load on different factors, indicating that they probably tap different domains. A meta-analytic review (Glass & McKnight, 1996) suggested that depressive affect and burnout may share a common aetiology, and that their shared variance may be due to their concurrent development. Shirom (2005) therefore recommended that research on burnout must use well-validated measures of depressive symptomatology in the research design, to guard against the possibility that the relationships between burnout and its correlates are not due to effects of depression.

4.1.2. Mental health – depression and other common mental disorders

Depression is one of the leading causes of disability and is projected by the WHO to become the second leading cause of the global burden of disease by 2020 (Murray & Lopez, 1996). Work-related stress, depression and anxiety can be directly associated to the exposure to psychosocial hazards at work (Cox, Griffiths & Leka, 2005; Cox, Griffiths & Rial-González, 2000; Devereux et al., 2004; Middeldorp, Cath & Boomsma, 2006; Netterstrøm et al., 2008). In the UK approximately 15-30% of workers will experience some form of mental health issues during their working lives (D'Souza, Stradzdins, Lim, Broom & Rodgers, 2003), resulting in an estimated 80 million working days lost ever year, costing employers £1-2 billion per annum (Stansfeld, Fuhrer, Shipley & Marmot, 1999).

One of the classic studies in this area is that by Colligan et al. (1977) who conducted a survey, by occupation, of all first admissions to 22 of the 27 community mental health centres in Tennessee (USA), from January 1972 through June 1974. 8,450 cases were considered from 130 different occupational groups. Occupations were ranked according to estimated admission rate per 1000 workers and by z scores. Z scores were calculated for observed against expected frequencies of admission on the basis of the relative frequency of members of the groups in the population. These rates were then compared and the top 30 ranks reported. The group with by far the highest rate was health technology technicians, and five others in the top 30 were relatively low status health care occupations. Many of the occupations which were represented in the top 30 also involved continual interaction with others (patients, clients, customers, etc.), including human service occupations.

Across research findings, work characteristics such as lack of job control, low decision latitude, low skill discretion, job strain, and effort reward imbalance have been found to be associated with the risk of depression, poor health functioning, anxiety, distress, fatigue, job dissatisfaction, burnout and sickness absence (D'Souza et al., 2003; Kuper et al., 2002a; Mausner-Dorsch & Eaton, 2000; Peter & Siegrist, 2000; Stansfeld et al., 1998, 1999; Wieclaw et al., 2008).

A longitudinal study, conducted in the UK (Stansfeld, et al., 1999) may provide insight into the causal relationship between work characteristics and the aetiology of psychiatric disorders. In the Whitehall II study, demands at work were found to increase the risk of psychiatric disorders, whilst social support and high decision authority decreased the relative risk. Additionally, high efforts and low rewards were associated with increased risk of psychiatric

morbidity. This also held true on the association with poor health functioning in the Whitehall II study (Kuper et al., 2002a; Kivimaki et al., 2007; Stansfeld et al., 1998).

Niedhammer et al. (1998) carried out a study to establish whether psychosocial factors at work were predictors of depressive symptoms in a prospective cohort of men (n=8422) and women (n=3130) employed in a wide variety of occupations in France. This prospective cohort study followed the GAZEL cohort by means of annual self-administered questionnaires and independent data obtained from the medical and personnel departments of the company. After adjustment for potential confounding variables, the results indicated high levels of psychological demands, low levels of decision latitude, and low levels of social support at work were significant predictors of subsequent depressive symptoms in both the men and the women.

Several studies examining the relationship between work-related stress, job stain and mental health have been carried out in Canada. Wang (2005) used data from the longitudinal cohort of the Canadian National Population Health Survey (NPHS) (n = 6663) to explore the relationship between work stress and major depressive episodes (MDE). Work stress was found to be significantly associated with the risk of MDE in multivariate analysis (odds ratio = 2.35, 95% confidence interval 1.54-3.77). Wang et al. (2008) also used data from the Canadian national mental health survey to examine the gender-specific relationships between work stress dimensions and mental disorders in the working population (n = 24277). This analysis estimated the gender-specific associations between work stress, major depression, anxiety disorders and any mental disorder, adjusting for the effects of demographic, socioeconomic, psychological and clinical variables. Mental disorders were assessed using a modified version of the World Mental Health Composite International Diagnostic Interview. In multivariate analysis, male workers who reported high demand and low control in the workplace were more likely to have had major depression (OR 1.74, 95% CI 1.12 to 2.69) and any depressive or anxiety disorders (OR 1.47, 95% CI 1.05 to 2.04) in the past 12 months. In women, high demand and low control was only associated with having any depressive or anxiety disorder (OR 1.39, 95% CI 1.05 to 1.84). Job insecurity was positively associated with major depression in men but not in women. Imbalance between work and family life was the strongest factor associated with having mental disorders, regardless of gender.

Wang et al. (2009) also examined data from the longitudinal cohort of the Canadian National Population Health Survey from 1994-1995 to 2004-2005. Survey participants were classified into 4 groups by changes in job strain status from 1994-1995 to 2000-2001 (no change in low job strain, no change in high job strain, changing from high to low job strain, and changing from low to high job strain). The incidence proportion of major depressive episodes in each of the 4 groups was 4.0%, 8.0%, 4.4%, and 6.9%, respectively. Participants who reported a change from high to low job strain had a risk of major depression similar to those exposed to persistently low job strain. Among those exposed to persistent high job strain, only participants who reported good or excellent health at baseline had a higher risk of major depression, but those who reported fair or poor health did not. Self-rated health was found to be a strong predictor of depression and to play an important role in the relation between job strain and depression.

Shields (2006) also explored stress and depression in the Canadian employed population aged 18 to 75. Data from the 2002 Canadian Community Health Survey: Mental Health and Well-being and the longitudinal component of the 1994/95 through 2002/03 National Population Health Survey were used. Stress levels were calculated by sex, age and employment characteristics. Multivariate analyses were used to examine associations between stress and depression in 2002, and between stress and incident depression over a two-year period, while controlling for age, employment characteristics, and factors originating outside the workplace.

In 2002, women reported higher levels of job strain and general day-to-day stress. When the various sources of stress were considered simultaneously, along with other possible confounders, for both sexes, high levels of general day-to-day stress and low levels of co-worker support were associated with higher odds of depression, as was high job strain for men. Over a two-year period, men with high strain jobs and women with high personal stress and low co-worker support had elevated odds of incident depression.

In another study using the Canadian Community Health Survey 1.2 (n=24324), Blackmore et al. (2007) determined that 4.6% of the original sample of workers (weighted n=745,948) meet the criteria for major depressive episodes in the study year. They further examined the association between psychosocial work-stress variables and these episodes and found high job strain was significantly associated with depression among men (OR=2.38, 1.29-4.37), and lack of social support at work was significantly associated with depression in both genders (men, OR=2.70, 1.55-4.71; women, OR=2.37, 1.71-3.29). Women with low levels of decision authority were more likely to have depression (OR=1.59, 1.06-2.39) than were women with high levels of authority. The findings highlighted that gender differences affect work-stress factors that increase risk for depression.

Dewa, Lin, Kooehoon and Goldner (2007) examined the association of chronic work stress, psychiatric disorders and chronic physical conditions with disability among workers. By doing so, this study sought to understand how these factors are associated with worker disability when they are experienced alone versus in combination with one another. The study population was also drawn from the Canadian Community Health Survey 1.2 (n=22,118). The relationship between chronic work stress, chronic physical conditions, and psychiatric disorders and disability in the past 14 days was examined for working respondents by using logistic regressions controlling for socio-demographic characteristics, region, and occupation. Thirty-one percent of respondents experienced chronic work stress either alone or in combination with a chronic physical condition, a psychiatric disorder, or both. Forty-six percent reported at least one chronic physical condition either alone or in combination. Finally, 11% had a psychiatric disorder. Compared with the group with none of the factors, those with an increasing number of combined conditions had increasing odds of disability after the analysis controlled for socio-demographic characteristics, occupation, and region. According to the findings of this study, the presence of chronic work stress seems to amplify effects of psychiatric disorders and chronic physical conditions on disability. In addition, psychiatric disorders co-occurring with physical illness seem to be associated with significantly higher odds of disability.

Miho et al. (1999) explored perceived stress and mental health in precision machine workers in Japan. A 2-year cohort study was conducted. Initially, a survey including the general health questionnaire (GHQ) and a questionnaire about perceived job stress was carried out. Of 462 workers who initially showed a GHQ score of < or = 7,310 were successfully followed up for 2 years. The 2 year risks of developing mental ill health (a GHQ score > or = 8) were assessed relative to perceived job stress. The overall 2-year risk for developing mental ill health was high at 57.7%. Workers who reported aspects of perceived job stress showed a greater 2-year risk than those without stress. Multiple logistic regression analyses showed that some components of perceived job stress were associated with a higher 2-year risk, among which "not allowed to make mistakes" showed the largest adjusted odds ratio (OR) (95% confidence interval (95% CI) of 2.37 (1.32 to 4.29). "Poor relationship with superior" had a significant effect on mental health only in women, with an adjusted OR (95% CI) of 3.79 (1.65 to 8.73).

Kopp et al. (2008) conducted a representative study in the Hungarian population (3153 male and 2710 female economically active Hungarians) to analyse the association between work-related factors and self-reported mental and physical health after controlling for negative affect

and hostility as personality traits. In both genders negative affect was the most important correlate of depression, well-being and self-reported health, whereas hostility was closely associated only with depression. Job insecurity, low control and low social support at work, weekend work hours, job-related life events and dissatisfaction with work and with boss were independent mental health risk factors, but there were important gender differences. Job related factors seem to be equally important predictors of mental health as social support from family.

In Korea, Park et al. (2009) conducted a study to investigate the association between depressive symptoms and job stress, as measured by the Korean occupational stress scale, among Korean employees in small- and medium-sized enterprises, and examined which components of stress are involved in the risk for depression among a sample (n=3013) of working men and women. After adjustment for confounding variables, results indicated that job stress played a significant role in increasing the risk of depressive symptoms. Most of subscales of job stress contributed to an increased risk of depressive symptoms, and job insecurity (male; OR = 2.02, 1.61-2.40, female; OR = 1.95, 1.42-2.70). The findings also revealed different effects for males and females; for males, job demands (OR = 1.68, 1.43-2.20), inadequate social support (OR = 1.55, 1.23-1.94), and lack of rewards (OR = 1.88, 1.48-2.37) were associated with depressive symptoms, whereas for females, organisational injustice (OR = 1.62, 1.14-2.30) was associated with depressive symptoms.

Considering the paucity of longitudinal studies that explicitly examine the causal relationships between job demands, job control, supervisor support and mental health, De Lange et al. (2004) carried out a 4-wave longitudinal panel study using a heterogeneous sample of 668 Dutch employees. The results of the study provide evidence for reciprocal causal relationships between work characteristics and mental health, although the effects of work characteristics on well-being were found to be causally predominant. The results also emphasized the need for a dynamic view of the relationship between work and health; the authors highlighted that the one-directional viewpoint in many work stress models does not seem to fully capture the relations between work characteristics and well-being.

Similar findings were observed by Stansfeld and Candy (2006) in their meta-analysis of longitudinal studies examining work-related psychosocial risks and common mental health disorders. High demands paired with low decision authority and low rewards paired with high effort were found to be prospective risk factors for common mental health disorders. As observed in the previous studies, the impact of these psychosocial risks on mental health was found to differ among men and women.

There is increasing evidence to support the predictive power of social epidemiological models such as Effort-Reward Imbalance (Siegrist, 1996) and the Job-Strain Model (Karasek & Theorell, 1990) for explaining occupational stress. Calnan, Wainwright and Almond (2000) examined the power of the two different models both separately and in combination for explaining job satisfaction and mental distress in general medical practice. This analysis was based on data collected from a postal survey of the members of staff (n=1089) of 81 practices, which were randomly selected from all general practices in the National Health Service Executive South East region. The results show that while both models were predictors of mental distress and job satisfaction the models that combined different dimensions were the strongest predictors.

Elovainio et al. (2009) used the Whitehall II data to explore cumulative exposure to high strain and active jobs as predictors of cognitive function in middle-aged men and women. A high-strain job (a combination of high job demands and low job control) was expected to increase the risk of health problems, whereas an active job (high demands and high control) was hypothesised to be associated with a greater capacity to learn. Data on 4146 British civil servants (2989 men and 1157 women) aged 35-55 years at baseline were used. Cumulative

exposure to both high-strain and active jobs was assessed at phases 1 (1985-1988), 2 (1989-1990) and 3 (1991-1993). Cognitive performance was assessed at phases 5 (1997-1999) and 7 (2003-2004) using the following tests: verbal memory, inductive reasoning (Alice Heim), verbal meaning (Mill Hill), phonemic and semantic fluency. Analyses were adjusted for age, sex and employment grade. Longer exposure to high job strain and shorter exposure to active jobs were associated with lower scores in most of the cognitive performance tests. However, these associations disappeared on adjustment for employment grade. Phonemic fluency was an exception to this pattern. Associations between exposure to an active job and phonemic fluency at both follow-up phases were robust to adjustment for employment grade. However, there was no association between exposure to active jobs and change in phonemic fluency score between the follow-up phases after adjustment for employment grade.

Virtanen et al. (2007) explored the influence of job strain and psychological distress on sickness absence among Finnish employees. This prospective study was assessed using the General Health Questionnaire (GHQ-12), which identified psychological distress as a predictor of sickness absence and the effect of work-unit measures of job strain on sickness absence among cases. Survey data were collected on work stress, indicated by high job strain, for a cohort of public sector employees (6,663 women, 1,323 men), aged 18 to 62 at baseline in 2000-2002, identified as GHQ-12 cases. Co-worker assessments of job strain were used to control for bias due to response style. A 2-year follow-up included recorded long-term (>7 days) medically certified sickness absence. Adjustments were made for age, socioeconomic position, baseline chronic physical disease, smoking, and heavy alcohol consumption. Cases with psychological distress had 1.3 to 1.4 times higher incidence of long-term sickness absence than non cases. Among cases, high job strain predicted sickness absence (hazard ratio 1.17 in women, 1.41 in men). The significant effect of job strain on sickness absence was found among workers in high socioeconomic positions (hazard ratio 1.54 for women, 1.58 for men) but not among employees in low socioeconomic positions (hazard ratio 1.06 for women, 1.31 for men). Overall, psychological distress was found to have an independent effect on medically certified sickness absence.

LaMontagne et al. (2008) used standard population attributable risk (PAR) methods to estimate the proportion of depression attributable to job strain in a sample of working Australians. The aim of the study was to assess the contribution of job strain to mental health inequalities by (a) estimating the proportion of depression attributable to job strain (low control and high demand jobs), (b) assessing variation in attributable risk by occupational skill level, and (c) comparing numbers of job strain–attributable depression cases to numbers of compensated 'mental stress' claims. They used the adjusted Odds Ratio (OR) of 1.82 for job strain in relation to depression derived from a meta-analysis and combined it with exposure prevalence data. Job strain exposure prevalence was determined from a 2003 population-based telephone survey of workers (n = 1101, 66% response rate) using validated measures of job control and psychological demands. Estimates of absolute numbers of prevalent cases of depression and successful stress-related workers' compensation claims were obtained from publicly available Australian government sources. They estimated that the overall job strain-population PAR for depression was 13.2% for males (1.1-28.1) and 17.2% (1.5-34.9) for females. There was a clear gradient of increasing PAR with decreasing occupational skill level. Estimation of job strain–attributable cases (21,437) versus "mental stress" compensation claims (696) suggested that claims statistics underestimate job strain–attributable depression by roughly 30-fold.

The research presented above clearly indicates that psychosocial risks, work-related stress, job strain and associated depression risks represent a substantial, preventable, and inequitably distributed public health problem. The social patterning of job strain-attributable depression parallels the social patterning of mental illness, suggesting that job strain is an important contributor to mental health inequalities. Furthermore, the numbers of compensated 'mental

stress' claims compared to job strain-attributable depression cases suggest that there is substantial under-recognition and under-compensation of job strain-attributable depression (LaMontagne et al., 2008).

4.1.3. Social and behavioural health

Exposure to psychosocial risks has been linked to an wide array of unhealthy behaviours (e.g. Kouvonen et al., 2005, 2006) such as physical inactivity, excessive drinking and smoking, poor diet and sleep (Cox, Griffiths & Rial-González, 2000). In 2003, a cross-sectional survey of 12110 individuals from 26 worksites examined the relationship between perceived stress (quantified by the measurement of individual perceived degree of control) and health behaviours. The results demonstrated that self-reported high levels of stress were associated with, across both sexes, higher fat diet, less frequent exercise, cigarette smoking, recent smoking increases, less self-efficacy to quite smoking, and less self-efficacy to not smoke when stressed (Ng & Jeffery, 2003). Examined collectively there is considerable evidence that poor psychosocial working conditions are related to an increase in detrimental health behaviours; with a possible direct or indirect impact on the development or exacerbation of physical health conditions (e.g., coronary heart disease) and psychological health (e.g., depression).

Macleod et al. (2001) examined the association between perceived psychological stress and cause specific mortality in a population where perceived stress was not associated with material disadvantage using a prospective observational study with follow up of 21 years and repeat screening of half the cohort five years from baseline (n=5388 initial screening and n=2595 second screening. Measures included perceived psychological stress, coronary risk factors, and indices of life course socioeconomic position. At first screening, the authors found that behavioural risk (higher smoking and alcohol consumption, lower exercise) was positively associated with stress. This relation was less apparent at second screening. Higher stress at first screening showed an apparent protective relation with all cause mortality and with most categories of cause specific mortality. In general, these estimates were found to be attenuated on adjustment for social position. This pattern was also seen in relation to cumulative stress at first and second screening and with stress that increased between first and second screening. Thus leading to the conclusion that this implausible protective relation between higher levels of stress, which were associated with increased smoking, and mortality from smoking related cancers, was probably a product of confounding and therefore, of no causal significance.

However, studies which operationalise psychosocial stress at work by the demand-control model and the effort-reward imbalance model, generally provide modest support to the associations between stress and adverse health risk behaviours. Siegrist and Rödel (2006) reviewed 46 studies published between 1989 and 2006 on the associations between psychosocial stress at work and health risk behaviour, in particular cigarette smoking, alcohol consumption and overweight. Psychosocial stress at work was measured by the demand-control model and the effort-reward imbalance model while health risk behaviour was analyzed in the broader context of a health-related western lifestyle with socially and economically patterned practices of consumption. Overall, the review, only modestly supported the hypothesis of a consistent association between work stress and health risk behaviour. The relatively strongest relationships were found with regard to heavy alcohol consumption among men, overweight, and the co-manifestation of several risks. Based on these conclusions they emphasised on the need to reduce stressful experience in the framework of worksite health promotion programs.

Head, Stansfeld and Siegrist (2004) examined whether a stressful psychosocial work environment predicts alcohol dependence. The Whitehall II occupational cohort of London based civil servants (1985-88) was measured in 1991-93 using the CAGE questionnaire. The

psychosocial work environment was measured by self report questions on the job demand-support-control model and on the model of effort-reward imbalance. Potential mediators including physical illness and poor mental health (GHQ) were measured at follow up in 1989. Effort-reward imbalance at work was associated with alcohol dependence in men after adjustment for employment grade and other baseline factors related to alcohol dependence. Although effort-reward imbalance predicted future longstanding illness, poor mental health and negative aspects of close relationships, the association between effort-reward imbalance and alcohol dependence in men was only partially mediated through these health and social support measures. In women, low decision latitude was related to alcohol dependence to some extent, but alcohol dependence among women was more prevalent in higher occupational grades. Men with high job demands or with low work social support had a slightly reduced risk of alcohol dependence. No association was found between objectively assessed demands, job control, and alcohol dependence in either men or women.

Radi, Ostry and Lamontagne (2007) assessed the relationships between current smoking status and psychosocial working conditions in a representative sample of working Australians. A cross-sectional population-based telephone survey was conducted (66% response rate, N = 1,101). Job stress was measured using the demand/control, effort/reward imbalance (ERI), and job pressure models. Multiple regression modelling was conducted for smoking status (current versus non-smokers, and a more restricted analysis of current versus former-smokers) and daily smoking intensity outcomes in relation to job stress measures, working hours, shift work, and other independent variables. After adjustment for age, education, martial status, and hostility, high job strain was positively associated with current smoking in men only. Employment in active jobs was associated with decreased odds of smoking among women only. High strain jobs were associated with decreased odds of current smoking compared to former smoking in women. In men, extreme and moderate job pressure were related to current smoking compared to current non-smoking, and moderate job pressure was associated with current smoking compared with former smokers. Other working conditions associated with smoking were excessive working hours in men and physical demand in women. Daily smoking intensity in current smokers was associated with high psychological demand and with ERI in women. These results suggest that job stress is related to smoking status at the population level, with different patterns in men and women.

Rugulies et al. (2009) explored whether adverse psychosocial working conditions, defined by the model of effort-reward imbalance, increase the risk of sleep disturbances in the Danish workforce. Analyses were conducted both cross-sectionally and prospectively in a representative sample of Danish employees. The cross-sectional sample included 2614 participants (50% women) aged 18-59 years, of whom 263 had sleep disturbances. Of the 2351 participants initially free of sleep disturbances, 304 (12.9%) developed sleep disturbances during the 5-year follow-up. Data were analyzed with gender-stratified, multivariate logistic and linear regression analyses, adjusted for numerous covariates. Cross-sectionally, a one standard deviation increase in the ERI ratio was associated with sleep disturbances among both men [odds ratio (OR)=1.65, 95% confidence interval (CI)=1.20-2.27] and women (OR=1.82, 95% CI=1.46-2.28). In the prospective analysis, a 1 S.D. increase of the ERI ratio at baseline predicted the onset of sleep disturbances among men (OR=1.39, 95% CI=1.03-1.87) but not among women (OR=0.97, 95% CI=0.76-1.24). So, among men, ERI was found to be a risk factor for the development of sleep disturbances in the Danish workforce. Among women, an association between ERI and sleep disturbances was restricted to the cross-sectional sample.

Physical activity is regarded as an important component of a healthy lifestyle. Wemme and Rosvall (2005) hypothesised that psychosocial stressors would act as barriers to physical activity. They investigated the association between work and non-work related stressors, respectively, in relation to low leisure time physical activity in a general population sample

(n=13715). Overall, they found that psychosocial factors not related to work showed strong associations with low leisure time physical activity. Work related stressors showed weaker associations with low leisure time physical activity in women, while non-work related psychosocial stressors showed stronger associations. However, male subjects were found to be more likely to have low leisure time physical activity if exposed to overtime work, "passive" work situation, "job strain", and "a wish to change profession". Adjustment for confounders (socioeconomic status, marital/ cohabiting status, ethnicity, and physically active work) did not change the result in a major way.

4.2. Physiological and physical health effects

Contemporary research into physiological and physical health correlates of stress began in the 1920s and 1930s with the work of Cannon (1929, 1931) and Selye (1936). Since then much has been published in this area (e.g., Kawakami & Haratani, 1999; Landsbergis et al., 1995; Meijman et al., 1995). A large body of data has been accumulated concerning physiological responses in people exposed to stressors in laboratories. Adrenaline and cortisol have become known as stress hormones because, in men, levels of both hormones consistently rise in response to stress in laboratory based investigations. If chronically repeated, elevation of adrenaline and cortisol is likely to have long-term consequences for health, especially cardiovascular health, partly via the effects of the hormones on blood pressure and serum cholesterol levels (Pollard, 1997). Research on people conducting their everyday lives, both in and out of work, is necessary to establish whether the same responses are shown on a day to day basis. Such research requires new methodologies and careful data collection. So far, it has been shown that adrenaline and blood pressure do seem to vary in expected ways. Other responses in everyday life, including those of cholesterol, cortisol and the immune system, are less well characterised (Cox, Griffiths & Rial-González, 2000).

As already discussed throughout this report, a growing body of robust evidence, deriving from many rigorous cross-sectional and longitudinal studies, indicates a link between the psychosocial working environment and impacts on workers' physical health. Increasing evidence indicates that many of the most commonly experienced physical effects due to work-related stress and psychosocial risks relate to four physiological systems: namely, hypertension, heart disease, wound-healing, musculoskeletal disorders, gastro-intestinal disorders, and impaired immuno-competence (Cox, Griffiths & Rial-González, 2000). Several studies have examined the link between two psychosocial constructs (namely effort-reward imbalance and job demands and control) and their associated impact on a variety of physical outcomes. A considerable variety of different pathologies, both psychological and physical, have been associated with the experience of stress through work (Holt, 1982). Those disorders usually cited as being stress-related include: bronchitis, coronary heart disease, mental illness, thyroid disorders, skin diseases, certain types of rheumatoid arthritis, obesity, tuberculosis, headaches and migraine, peptic ulcers and ulcerative colitis, and diabetes (Bosma et al., 1997; Cox, 1978; Kristensen, 1996; Kroes, 1976; Selye, 1976; Stansfeld et al., 1995, 1999).

Niedhammer, Tek, Starke and Siegrist (2004) examined longitudinal data collected through the GAZEL cohort; both cross-sectional and prospective analyses were conducted to examine the status of workers' health and their health trends overtime. The GAZEL cohort was established in 1989 to collect data regarding workers' health and working conditions, and originally included 20264 workers for a French electricity and gas company. In 1995 the yearly collected data began to include questions on psychosocial aspects of the working environment. The current study examined data collected data in 1998 (n= 10 175; 71 % men) and a comparison between the data collected in 1998 to 1999 (n= 6286, 71% men). The cross-sectional analysis revealed both effort-reward imbalance and over-commitment were significantly associated with self-reported health for both men and women. When effort and reward were examined as

independent variables, reward was found to be a significant risk factor for both men and women, whilst effort was found to be a significant risk factor only for men. The prospective analysis demonstrated that effort reward imbalance was found to be a significant predictor of poor self-rated health for both genders; however, effort was found not to predict poor-self rated health, whilst reward did. For men only over-commitment was found to be a predictor of poor self-rated health.

The Whitehall study examining a British sample of civil servants (n= 10308) found a similar link between psychosocial risks and detrimental impacts on worker's self-rated health. Specifically, a strong association was observed between high job demands and increased risk of poor physical functioning. Specifically, high job demands were found to be related to 30% increased risk in men and 50% increased risk in women for poor physical functioning in relation to low job demands (Stansfeld, Head & Marmot, 2000). An earlier study conducted by Stansfeld and colleagues (1998), examining the same aforementioned sample of British civil servants, found negative aspects of work (namely high demands and effort-reward imbalance) and low social support were strong independent predictors of poor health functioning. The strength of the longitudinal nature of these studies has direct implications in inferring causal relationships between the variables. However, it should be borne in mind that these studies look at one particular occupational sector and national context.

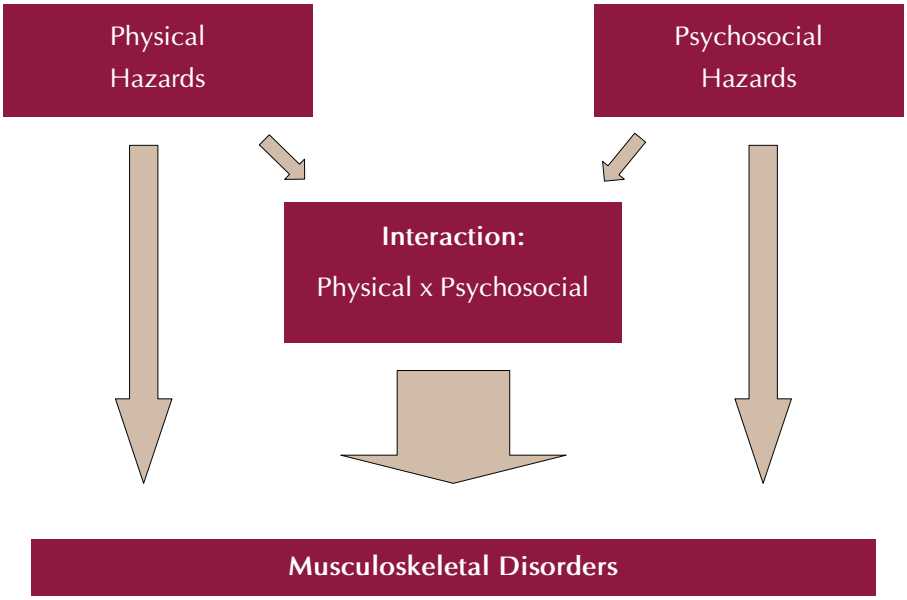
It should be noted that, as the previous discussed studies highlight, many psychosocial factors may have differential impacts on both men and women. Niedhammer and colleagues (2004) highlight the importance of future research conducting separate analysis for men and women in the field of psychosocial factors at work. In so doing this evidence will contribute to a more comprehensive and holistic understanding of psychosocial risks and their impact for the worker and for women and men independently.

4.2.1. Musculoskeletal disorders

Musculoskeletal disorders (MSDs) are the most commonly reported cause of occupational illness by European workers (Eurofound, 2007; EU-OSHA, 2004; Kumar 2001). MSDs make up nearly half of all new cases of work-related disease in the UK (Cherry et al., 2000) The aetiology of musculoskeletal pain is underpinned by two mechanisms (Bongers et al., 1993; Cox & Griffiths, 1996; Deeney & O'Sullivan, 2009; MacDonald et al., 2001; Randall et al., 2002): (a) biomechanical (physical) risk factors; and (b) psychosocial risk factors (De Beeck & Hermans, 2000; Randall, Griffiths, Cox & Welsh, 2002; Warren, 2001). The biomechanical pathway operates through an intimate association between certain physical characteristics of work and mechanical load; whilst psychosocial factors are related to elements of work design and management (Randall et al., 2002).

The biomechanical factors contributing to the development and maintenance of MSDs have, over recent years, been extensively investigated (Buckle, 1997); and their role in the development and maintenance of musculoskeletal pain has been widely established (Warren, 2001). However, evidence indicates that interventions that exclusively target the physical aspects of work design have not been demonstrated to be completely successful in reducing workers' report of musculoskeletal pain (Bigos et al., 1991; Kourinka & Forcier, 1995). In contrast, research examining aetiological psychosocial factors in the development and maintenance of musculoskeletal pain has, until recently, received less scientific investigation (Bongers et al., 2006; Buckle, 1997). Current research has demonstrated that psychosocial and biomechanical risk factors have independent or interactive effects on MSDs development (Warren, 2001; see Figure 3).

Figure 3: Causal paths for work-related MSDs



Source: Adapted from Leka et al. (2008)

On the basis of the above, increasing attention is being placed on the interactive effects of physical and psychosocial hazards in the aetiology of work-related MSDs. The European Agency for Safety and Health at Work has identified this as a priority for research (EU-OSHA, 2004). A review of the literature in relation to lower back pain highlighted the interactive role of psychosocial factors (specifically the role of low social support, low job satisfaction, poor work organisation and low job content) and factors related to the physical aspects of work in the development of musculoskeletal pain (De Beeck & Hermans, 2000). The impact of exposure to both physical and psychosocial hazards for MSDs has been found to have a stronger effect than exposure to physical or psychosocial factors separately (Devereux, et al., 2004).

In the UK Whitehall studies it was found that: '… workers who felt they had low levels of control over their jobs were at increased risk of reporting lower back pain' (Sullivan, Kerr & Ibrahim, 1998). The mechanism for the increased risk is a point of work duration and intensification where production demands are excessive, excessive hours are worked, machine guards which impede production removed, safety rules are flouted, or the pace of production is too fast for safe operation. For example, repetitive quick movements involving the same muscles repeatedly can lead to repetitive strain injury (RSI) related conditions. Similarly, telephonists in call centres/phone banks have an increased incidence of both musculoskeletal injuries and stress (Sznelwar et al., 1999). This risk may be exacerbated if workers are paid by piecework payment systems. For example, an Australian study of clothing manufacturing workers identified that those paid solely on a piecework payment system had more frequent chronic disabilities (73%), compared with those paid on an hourly basis with production bonus (35.3%), and those paid solely on a wage basis (34%) (Mayhew & Quinlan, 1999).

Devereux, Buckle and Vlachonikolis (2002) conducted a cross-sectional case study survey examining the possible association between self-reported symptoms of back disorders and the interactive effect of physical and psychosocial risks in manual workers, delivery drivers,

technicians, customer services computer operators, and general office workers (n= 638). Based on participants' self-reported assessment of their working conditions, employees were categorised into one of four groups: (a) high physical and psychosocial risks; (b) low physical and psychosocial risks; (c) low physical and high psychosocial risks; or (d) high physical and low psychosocial risks. The highest increase in risk was observed for the high physical and high psychosocial exposure group for the symptoms of back disorders; followed by the high physical and low psychosocial exposure group.

Sim, Lacey and Lewis (2006) examined the prevalence and population impact of work-related upper limb and neck pain. This cross-sectional survey was conducted in North Staffordshire, UK, where there is a common local manual industry (n=5133; response rate 53.5%). Like in previous studies, both physical and psychosocial work characteristics were associated with upper limb and neck pain: namely, repeated lifting of heavy objects, prolonged bending of the neck, working with arms at/above shoulder height, little job control, and little supervisor support. In total, 24% of the variance of musculoskeletal pain was accounted for by physical work characteristics, whilst 12%, respectively, was observed to account for psychosocial factors.

Andersen, Haahr and Frost (2007) examined risk factors for severe regional musculoskeletal symptoms by conducting a prospective cohort study of 5604 workers from industrial and service companies. Self-report data on musculoskeletal symptoms and pain, physical and psychosocial work exposures, and individual and health related factors were collected at baseline (n = 4006) and 24 months later (n= 3276). Results indicate that of the data collected at baseline, only 7.7% of respondents were free of regional pain, indicating an overwhelming prevalence of musculoskeletal pain in the general working population. Additionally, the transition from no or minor pain to more severe pain over the 2 year period was found to have a multifactorial aetiology influenced by physical and psychosocial factors, and factors related to health and beliefs about health in the individual. Physical factors were found to predict increasing pain in specific bodily regions, as compared to diffuse and non-specific regional pain. Specifically, arm pain was predicated by highly repetitive work, low back pain predicated by heavy lifting, and lower limb pain by pulling heavy weights. Psychosocial factors, in contrast to physical work characteristics, were found to be associated with nonspecific effects on regional musculoskeletal pain. For example, low job satisfaction was associated with all outcomes, whereas job control was associated with lob back pain and low social support from colleagues was associated with lower limb pain.

Similar results were observed by Randall and colleagues (2002). This cross-sectional survey found workers' subjective rating of the adequacy of the design and management of their physical and psychosocial working environment to be related to their report of musculoskeletal pain; particularly in relation to five key factors: management practice; status, support and participation; physical work environment; work equipment; and job demands. However, the results of the study indicate that these mechanisms appear to be activated only under certain conditions; specifically, musculoskeletal pain reported in the upper body was found to be associated to both biomechanical and stress-related pathways, whilst pain reported in the lower body was found to be only biomechanically-related.

A prospective cohort study aiming to examine the impact of exposure to mechanical risks and psychosocial factors on workers' self-reported neck and shoulder pain was conducted in 2005 by Östergren and colleagues. Randomly selected participants, residing in a large metropolitan Swedish city aged 45-65 (n=4919), were recruited to participate. Self-reported data was collected at baseline and at a one year follow up period. Results of the current study observed that high mechanical exposure was associated with increased risk of shoulder and neck pain

for both women and men during follow up; whilst an interactive effect of mechanical load and psychosocial factors were observed exclusively in women.

Another study in Sweden (Fjell et al., 2007) explored self-reported musculoskeletal pain and working conditions (physical and psychosocial work conditions, lifestyle, psychosomatic symptoms and sick leave) among employees in the Swedish public sector (public hospitals, educational institutions, home care services for the elderly and domestic/catering services in a Swedish county). A comprehensive questionnaire was completed by a total of 2523 people, of which 87% were women and 13% men. Multiple logistic regression analyses showed that the high level of self-reported musculoskeletal pain was highly associated with strenuous physical and psychosocial work conditions. The physical factor with the highest odds ratio (OR) was working in a forward-bent position. High work demands was the most prominent psychosocial factor and distinctly associated with musculoskeletal pain among men. Physical work strain and other demanding working conditions, which were associated with musculoskeletal pain, were frequent among employees in home care services for the elderly and domestic/catering services. There was a strong association between long-term sick leave and high musculoskeletal pain. Furthermore, there was a strong association between a high level of musculoskeletal pain and the exhibition of psychosomatic symptoms in both women and men.

Norman et al. (2008) investigated musculoskeletal symptoms in the Neck/shoulders and Arm/hand in relation to work exposures at call centre (CC) companies in Sweden. Comparisons were made between internal and external CCs. 1,183 operators from 28 CCs participated in the study. Three out of four operators reported pain or aches in one or more of the requested body regions, with no major difference between internal and external CC operators. Comfort of the work environment, showed the strongest association with symptoms in the Neck/shoulder and Arm/hand, in both types of CCs. Other exposures associated with symptoms in the Neck/shoulder or Arm/hand in either type of CC were: low complexity of work, long total time of customer calls per day, continuous computer work without a break, high psychological demands, low decision latitude, lack of social support from colleagues and supervisor.

In a systematic review focusing on psychosocial factors and MSDs in the construction industry, Sobeih et al. (2006) reviewed eight cross-sectional and two cohort studies. High job stress was the most commonly investigated factor followed by job satisfaction, job control and high quantitative job demands. All studies reported an association between musculoskeletal disorders and at least one psychosocial factor. Many of the associations reported were significant even after adjusting for demographics and physical demands of the job.

Chen, Yu and Wong (2005) explored the impact of occupational stress and other psychosocial factors on musculoskeletal pain among Chinese offshore oil installation workers. The prevalence of musculoskeletal pain over the previous 12 months varied between 7.5% for elbow pain and 32% for low back pain; 56% workers had at least one complaint. Significant associations were found between various psychosocial factors and musculoskeletal pain in different body regions after adjusting for potential confounding factors. Occupational stressors, in particular stress from safety, physical environment, and ergonomics, were important predictors of musculoskeletal pain, as was coping by eating behaviour.

Waters et al. (2007) conducted a cross-sectional study of risk factors for musculoskeletal symptoms in the workplace using data from the General Social Survey in the US. Two outcome measures - self-reported back pain and upper extremity pain – in relation to several individual, psychosocial, and physical factors were analyzed. The study population included US adults, non-institutionalized, English-speaking, aged 18 years or older, and employed at least part time (>or=20 hr/wk). The final sample size was 1484 workers. Variables of physical exposure significantly increased the risk of both low back pain and upper extremity pain. Multiple

injuries and some psychosocial factors were associated with MSDs, and there was an additive effect on risk of MSDs with exposure to both physical exposure and work stress.

Krause et al. (1997) examined associations between psychosocial job factors and the prevalence of non-disabling back and neck pain in professional drivers after physical work load was taken into account in a longitudinal study. In phase 1, a total of 1449 transit vehicle operators completed a medical examination and a questionnaire yielding information on demographic and anthropometric variables, health status, and physical and psychosocial job factors. Company records were used to supplement information on employment history. Physical work load was measured in life-time years and current weekly hours of professional driving. The relation of psychosocial factors with back or neck pain was analyzed by logistic regression models adjusted for past and current physical work load, vehicle type, age, gender, body height, and weight. The main result of this study was that both physical work load and psychosocial factors were simultaneously and independently associated with back or neck pain. Psychosocial factors associated with back or neck pain included extended uninterrupted driving periods, frequency of job problems, high psychosocial demands, high job dissatisfaction, and low supervisory support.

In the second phase of this 7.5 year prospective study in San Francisco, Rugulies and Krause (2005) investigated the demand-control-support model and incidence of low back and neck injury in a cohort of 1221 public transit operators. The two main exposure variables were "job strain" (mismatch of high psychological demands and low decision latitude) and "iso-strain" (job strain plus exposure to low social support at work). Analyses controlled for demographic factors, physical workload, and pain at baseline. For low back injuries, increased hazard rates were found for job strain and iso-strain based on tertiles, with hazard ratios (HR) of 1.30 (0.96-1.75) and 1.41 (0.98-2.01), respectively. Job strain and iso-strain based on median split or analyzed as continuous variables were not associated with low back injuries. For neck injuries, job strain and iso-strain based on median split showed HRs of 1.27 (0.99-1.63) and 1.33 (1.01-1.77), respectively. Job strain and iso-strain based on tertiles had HRs of 1.52 (1.13-2.05) and 1.73 (1.21-2.45), respectively. When analyzed as continuous variables, a one-point increase on the job strain and iso-strain scales led to an 8% (0.98-1.19) and 14% (1.02-1.27) increased hazard of neck injuries, respectively. This study also shows the importance of the psychosocial work environment in the etiology of musculoskeletal injuries among transit operators

Using this longitudinal dataset linked to administrative workers' compensation databases (n=1179), Rugulies and Krause (2008) further investigated the effect of effort-reward imbalance on the incidence of compensated low back and neck injuries. HRs for first low back and first neck injury were calculated with multivariate Cox regression models. They found a one standard deviation increase in effort-reward imbalance was associated with compensated low back (HR 1.13, 1.02 to 1.26) and neck injuries (HR 1.14, 1.02 to 1.27) after adjusting for gender, age, height, weight, years of professional driving, weekly driving hours, vehicle type, ergonomic problems, pain at baseline and job strain. The associations between effort-reward imbalance and low back injury were stronger for more severe injuries (HR 1.23, 1.03 to 1.46) than for less severe injuries (HR 1.11, 0.96 to 1.28). For neck injuries, stronger relationships were found for less severe injuries (HR 1.15, 1.02 to 1.29) than for more severe injuries (HR 1.10, 0.86 to 1.41). The findings show that effort-reward imbalance is associated with low back and neck injuries independently of individual worker characteristics, physical workload, ergonomic problems, baseline pain and job strain.

Andersen et al. (2002) found that being female increased the risk of neck/shoulder injury by 1.8 times (1.2-2.8). Gender differences in self-reported musculoskeletal pain and disorders have been highlighted in various documents and studies (Hooftman et al., 2004). Östergren and

colleagues (2005) suggest that gender should be considered a key factor in examining MS disorders and developing interventions.

Understanding the multifaceted nature of the aetiological development of MSDs, considering both physical and psychosocial factors is important when developing strategies to effectively prevent and manage work-related MSDs (De Beeck & Hermans, 2000; Östergren et al., 2005). Moreover, there is evidence to suggest that interventions with a concentrated focus on work organisation issues have the potential to reduce work-related stress and, in turn, possibly neck and upper limb symptoms (Bongers et al., 2006).

4.2.2. Heart disease

Heart disease is the leading cause of death and disability in most countries. The rates of coronary heart disease have been observed to vary markedly across occupations, more than can be accounted for by conventional risk factors, suggesting that elements of work or working conditions might be of aetiological importance (Hemingway & Marmot, 1999). The aetiology of coronary heart disease (CHD) may include: smoking, high blood pressure, high cholesterol, serum triglycerides, atherosclerosis, diabetes mellitus, a diet rich in saturated fats, type A behaviour, stressful life events, lack of social support, shift work and a sedentary lifestyle (Knutsson,1989). In Sweden it has been shown that the output of sympathetic nervous system, 'stress hormones', increase in nearly all stress exposures and these have a fundamental part to play in the stress-CHD pathway (Nurminen & Karjalainen, 2001). Hamer et al. (in press) in a study to explore the mechanisms for psychosocial stress as a risk factor for coronary heart disease used a sample of 514 healthy men and women (mean age = 62.9 +/- 5.7 years), without history or objective signs of CHD, drawn from the Whitehall II epidemiological cohort. They found that salivary cortisol responses to mental stress are associated with coronary artery calcification in healthy men and women and that heightened hypothalamic pituitary adrenal activity is a risk factor for CHD.

A few substantive studies have been conducted which also indicate a more direct pathway between job strain and heart disease. This pathway may include: increased autonomic nervous system activity (e.g. increased heart rate), raised blood pressure with increased risk of hypertension, increased catecholamines and cortisol, decreased fibrinolytic activity and predisposition to thrombosis, and increased mass of the left ventricle. (e.g., Bassett et al., 1998; Nurminen & Karjalainen, 2001; Raikkonen et al., 1996; Schnall et al., 1998). Raikkonen et al. (1996) have also demonstrated that chronic stress was positively associated with plasminogen activator inhibitor-1 antigen. Deficient fibrinolysis due to an increase in plasminogen activator inhibitor-1 antigen is likely to be involved with thrombosis (Juhan-Vague & Alessi, 1993).

Since the earliest studies, the incidence of CHD has been inversely linked with occupational status, although lifestyle factors have been shown to explain much of the variation between socio-economic groups (Townsend & Davidson, 1982). Similarly the first Whitehall study identified an inverse social gradient in fatal CHD among UK civil servants (Marmot et al., 1997). While this social gradient remained twenty years after the first Whitehall study, coronary risk factors only accounted for less than half of the social gradient. In the second Whitehall UK study of 7372 British civil servants, it was identified that much of the inverse social gradient in CHD incidence can be attributed to differences in psychosocial work environment (Marmot et al., 1997). Similarly, while occupational 'class' differences in lifestyle risk factors have decreased in some parts of the world, the substantial Helsinki heart study of 1,806 men found that CHD risks persisted (Tenkanen et al., 1997). Psychosocial factors at work have been indicated as causative variables. Nevertheless, the stress pathway and the life-style factor pathway may also be closely related, as smoking, hypertension, and high body mass index are often related to long-term stress and attempts to cope with it (Tenkanen et al., 1997). Because

coronary risk factors account for, at most, 50% of CHD, a number of recent studies have concentrated on identifying other factors along the stress-CHD pathway (Marmot et al., 1997).

Everson-Rose and Lewis (2005) in a review of relevant literature on (a) negative emotional states, including depression, anger and hostility, and anxiety; (b) chronic and acute psychosocial stressors; and (c) social ties, social support, and social conflict, found each of these psychosocial domains to be significantly associated with increased risk of cardiovascular morbidity and mortality. A growing body of evidence from a diversity of disciplines supports the hypothesis that psychosocial factors are related to both morbidity and mortality due to cardiovascular diseases (Everson-Rose & Lewis, 2005; Landsbergis et al., 2001). Several reviews have been conducted examining the association between psychosocial factors at work and cardiovascular disease; most demonstrating a positive association (Belkic et al., 2000, 2004; Bunker et al., 2003; Eller et al., 2009; Kristensen, Kronitzer & Alfedsson, 1998; Schnall, Landsbergis & Baker, 1994; Tennant, 2000).

A systematic review of exclusively examining prospective cohort studies in relation to psychosocial factors in the aetiology and prognosis of CHD found a significant relationship between job strain and CHD (Hemingway & Marmot, 1999). In an update of this review, Kuper, Marmot and Hemingway (2002), assessed the relative strength of the epidemiological evidence for causal links between psychosocial factors and CHD incidence among healthy populations, and prognosis among CHD patients. They found that the proportion of etiologic studies reporting a strong or moderate association was: 6/18 for Type behaviour and hostility, 15/22 for depression, 4/8 for anxiety, 10/13 for psychosocial work characteristics and 6/9 for social support. For prognostic studies the proportions were: 2/15 for type A behaviour and hostility, 18/34 for depression, 8/18 for anxiety, 2/4 for psychosocial work characteristics and 14/21 for social support, thus leading to the conclusion that based on available prospective epidemiological data, there is evidence for an association between depression, social support and psychosocial work characteristics and CHD aetiology and prognosis.

Chandola and colleagues (2008) examined longitudinal data collected through the Whitehall study. The primary aim of this study was to examine the biological and behavioural mechanisms linking coronary heart disease with work-related stress. The results of the study demonstrated that chronic work stress was strongly associated with CHD and this relationship was demonstrated to be strong among participants under the age of 50. The observed relationship between stress and CHD was found to be mediated through indirect effects of health behaviours (low physical activity and poor diet in particular) and the direct effects of neuroendocrine stress pathways. These two mediating factors were found to account for an overwhelming 32% of variance of the relationship between cumulative stress and CHD. Nabi et al. (2008) also using data from the Whitehall II study reported that psychological factors predicted incident CHD.

Similar results were observed by Kivimaki and colleagues (2002) in Finland in a longitudinal study which examined the relationship between work-related stress and cardiovascular mortality of workers in a metal industry. A total of 812 workers (545 men and 267 women) free from cardiovascular diseases at baseline were followed over approximately 25.6 years. Results of the study indicated that workers reporting job strain were 2.2 times more likely to experience cardiovascular mortality, as compared to their colleagues that did not report job strain. Additionally, workers reporting a reward-effort imbalance were 2.4 times at risk of cardiovascular mortality, as compared to the colleagues that did not report this imbalance.

Kornitzer et al. (2006) carried out the Job Stress, Absenteeism and Coronary Heart Disease in Europe (JACE) study to investigate the relationship of the demands/control/strain model with hard coronary events. This large epidemiological, prospective, multicenter study used six

cohorts (Brussels, Ghent, Lille, Barcelona, Göteborg and Malmö) between 1993 and 1996 from four European countries (Belgium, France, Spain and Sweden) consisting of 21,111 middle-aged male subjects. During a mean follow-up of 40 months 185 acute coronary events or coronary deaths were observed. Age-adjusted hazard ratios (HRs) for developing an acute coronary event were 1.46 (1.08-1.97) for high against low psychological demands and 1.53 (1.0-2.35) for strained (high demands plus low control) against relaxed (low demands plus high control) groups. After adjustment for standard cardiovascular risk factors the HR for developing a coronary event for those above or equal to the median against those below the median of psychological demands was 1.46 (95% CI 1.08-1.97) whereas the HR for strained against relaxed groups is 1.46 (95% CI 0.96-2.25). Sensitivity analyses confirmed the robustness of the results. The results led to the conclusion that the job strain model was an independent predictor of acute coronary events, with the psychological demands scale emerging as the important component.

In the largest country comparison study in this area, Rosengren and colleagues from the INTERHEART study (2004) examined the association of psychosocial risk factors with risk of acute myocardial infarction in 24767 participants from 52 countries. A case-control design was used with 11119 patients with a first myocardial infarction and 13648 age-matched (up to 5 years older or younger) and sex-matched controls from 262 centres in Asia, Europe, the Middle East, Africa, Australia, and North and South America. Data for demographic factors, education, income, and cardiovascular risk factors were obtained by standardised approaches. Psychosocial stress was assessed by four simple questions about stress at work and at home, financial stress, and major life events in the past year. Additional questions assessed locus of control and presence of depression. Findings indicated that people with myocardial infarction (cases) reported higher prevalence of all four stress factors. Of those participants still working, 23.0% (n=1249) experienced several periods of work stress compared with 17 9% (1324) of controls, and 10 0% (540) experienced permanent work stress during the previous year versus 5 0% (372) of controls. Odds ratios were 1.38 (1.19–1.61) for several periods of work stress and 2.14 (1.73–2.64) for permanent stress at work, adjusted for age, sex, geographic region, and smoking.

A detailed discussion of the relationship between psychosocial risks and heart disease has already been provided in section 3. A brief summary is also provided below.

It is clear that research has consistently identified a link between low control, effort reward imbalance, increased stress and CHD. In the Whitehall II study, the odds ratios for low job control were 2.38 for self-reports, and 1.56 when externally assessed (Bosma et al., 1998); while the odds ratios for effort reward imbalance was 1.3 (Kuper et al., 2002a). In a Swedish study, job strain was also associated with excess risk of a first myocardial infarction, with an odds ratio associated with blue-collar status after adjustment for demographic factors of 1.4 (Theorell et al., 1998). Earlier research by Siegrist et al. (1990) on a cohort of blue-collar workers identified that work pressure had an odds ratio of 3.4, and job insecurity of 3.4, and independently predicted IHD. Conversely, increase in job control over time decreases the risk of coronary heart disease (Bosma et al., 1997).

As part of the Belgian Job Stress project (1994-1999), the independent role of perceived job stress on short-term incidence of clinical manifest coronary events in a large occupational group (n= 14337) comprising exclusively of middle-aged men was examined. This study did not find a statistically strong association between job strain and job demands in the development of coronary heart disease; however, a coronary heart disease incidence was substantially associated with social support (Bacquer et al., 2005). The use of exclusively a male population limits the generalisability of these findings to women. However, a prospective study conducted with 49259 middle-aged Swedish women (Kuper, Adami, Theorell &

Weiderpass, 2006) examined psychosocial determinants of CHD. Job strain and social support were weakly associated to CHD, in contrast to pervious findings conducted in predominantly male samples.

Ostry et al. (2003) recommended the combined use of the two models of psychosocial stress at work on health. Peter et al. (2002) used data from the Stockholm Heart Epidemiology (SHEEP) case-control study (n= 951 male and female myocardial infarction cases and 1147 referents) to examine associations between two the alternative models of job stress derived from the effort-reward imbalance and the job strain model. Multivariate analysis showed moderately increased odds ratios for either model. Yet, with respect to the effort-reward imbalance model gender specific effects were found: in men the extrinsic component contributed to risk estimation, whereas this was the case with the intrinsic component in women. Controlling each job stress model for the other in order to test the independent effect of either approach did not show systematically increased odds ratios. An improved estimation of acute myocardial infarction risk resulted from combining information from the two models by defining groups characterised by simultaneous exposure to effort-reward imbalance and job strain (men: odds ratio 2.02, 1.34 to 3.07); women odds ratio 2.19, 1.11 to 4.28).

Only part of the CHD-stress risk shows up in workers' compensation claims. For example, US white-collar workers are frequently compensated for work-related illnesses of the cerebrovascular and circulatory systems (Leigh & Miller, 1998). However, reliance on workers' compensation system data may skew interpretations as some groups of workers may be better covered than are others. For example, workers' compensation is awarded automatically to US police officers and fire fighters who have a heart attack because these jobs are regarded as inherently stressful (Johnson et al., 1996; Karasek & Theorell, 1990; Nurminen & Karjalainen, 2001).

The evidence on the relationship between work-related psychosocial factors and the development of ischemic heart disease (IHD) has been increasing. One the first studies to test the relationship between job strain and the incidence of ischaemic heart disease (IHD) prospectively, began in 1986 as part of the World Health Organization-initiated MONICA II study. It started with a clinical examination of 659 men, all employed and without known IHD, together with a questionnaire-based evaluation of living conditions and psychosocial factors at work, including items identified in the job strain model (high demands – low control). All participants were followed until the end of 1999 with regard to hospitalization and death as a result of IHD. Self-reported job strain was found to be significantly associated with IHD independently of standard coronary risk factors, however only high demands contributed significantly to this result. The incidence of IHD was also found to be highest among employers and managers. The study concluded that high psychological demands at work are a risk factor for IHD (Netterstrøm, Kristensen & Sjøl, 2006).

Following a systematic review, Eller et al. (2009) reported that the literature indicates moderate evidence that high psychological demands, lack of social support, and iso-strain are risk factors for IHD among men. Studies performed during recent years have not shown evidence for lack of control as a risk factor for IHD. Several studies have shown that job strain is a risk factor, but in the more recent ones, these associations can be fully explained by the association between demands and disease risk. Some studies supported the relationship between IHD and effort-reward imbalance, injustice, job insecurity, or long working hours, but more evidence is needed to confirm the causal relationship. Studies involving women are too few to draw any conclusion concerning women, work stress, and IHD.

Newer evidence focusing on samples involving women, suggests that high job strain and job dissatisfaction are important determinants for IHD among Danish predominantly female public

service workers Bonde et al. (2009). In another Danish study, Allesøe et al (2010) investigated the effect of work pressure and job influence on the development of IHD in women (n=12,116) participating in the Danish Nurse Cohort Study. During follow-up (over 15 years), 580 participants were hospitalised with IHD. The findings suggested that younger nurses (<51 years old at baseline) who reported work pressure to be 'too high' had a 1.4-fold (1.04-1.81) increased risk of incident IHD compared with nurses who reported work pressure to be suitable. More evidence is needed to further explore the mechanisms on the link between high demands and increased IHD risk.

4.2.3 Metabolic syndrome and diabetes

Metabolic syndrome (MetS) is considered to be caused primarily by visceral fat accumulation and has been linked to increased risk of cardiovascular disease (Saito et al., 2009), depression (Dunbar et al., 2008; Koponen et al., 2008) and diabetes (Räikkönen, Matthews & Kuller, 2007). Using the different clinical criteria available for defining the syndrome (World Health Organization, National Cholesterol Education Program Adult Treatment Panel III, and International Diabetes Foundation), Räikkönen, Matthews & Kuller, (2007) evaluated whether psychosocial factors that are related to cardiovascular disease and type 2 diabetes predict prospectively the risk for the metabolic syndrome over a 15 year follow up period. Results suggested that psychosocial factors predict the risk for developing the metabolic syndrome by multiple definitions. Psychosocial factors may also play a causal role in the chain of events leading to the metabolic syndrome.

There has been emerging interest on the link between stress at work and the metabolic syndrome (and other associated ailments), mainly from data emerging from the Whitehall II study. Chandola, Brunner and Marmot (2006) conducted a study to investigate the association between stress at work (based on the iso-strain model) and the metabolic syndrome using data from the Whitehall II study (n=10308, follow-up 14 years). They found a dose-response relation was found between exposure to work stressors over 14 years and risk of the metabolic syndrome, independent of other relevant risk factors. Employees with chronic work stress (three or more exposures) were more than twice as likely to have the syndrome than those without work stress (odds ratio adjusted for age and employment grade 2.25, 1.31 to 3.85). These results also provide evidence for the biological plausibility of the link between psychosocial stressors from everyday life and heart disease.

Data from the Whitehall II (n=5232, 6 year follow-up) has also recently been used to examine the association between metabolic syndrome and depressive symptoms (Akbaraly et al., 2009). Results indicated that metabolic syndrome was associated with an increased risk of future depressive symptoms, odds ratio 1.38 (1.02-1.96) after adjustment for potential confounders. Of the five components of MetS, central obesity, high triglyceride levels, and low HDL cholesterol levels predicted depressive symptoms.

Evidence from the Whitehall II study (n=5,895) has also indicated that psychosocial work stress was an independent predictor of type 2 diabetes among women after a 15-year follow-up (Heraclides, et al., 2009). The authors, investigated the effect of psychosocial stress at work on risk of type 2 diabetes, adjusting for conventional risk factors, among a sample of British, white-collar, middle-aged men and women during 1991-2004. Type 2 diabetes was ascertained by an oral glucose tolerance test supplemented by self-reports at baseline and four consecutive waves of data collection including two screening phases. The job strain and iso-strain models were used to assess psychosocial work stress. Results indicated that iso-strain in the workplace was associated with a twofold higher risk of type 2 diabetes in age-adjusted analysis in women but not in men (hazard ratio 1.94, 1.17-3.21).

More evidence from prospective studies using the same work stress models is needed to support the findings of these studies and to further explore the impact of psychosocial risks and stress on, these as well as other possible health outcomes. The next section briefly discusses the evidence presented in this review with the previously published studies on the global burden of diseases estimates of selected occupational risks.

5. Extrapolation of health impact of psychosocial risks: link with previous estimates

5.1. Psychosocial risks and heart disease

Owing to lack of adequacy of exposure information and the applicability of health outcome data to all regions of the globe, occupational contributions to the global burden of cardiovascular disorders were not included in the WHO report on the comparative quantification of health risks even though it was recognised that occupational etiologies existed (Ezzati et al., 2004). In an update on the 'burden of disease' from environmental factors across the major categories of reported diseases and injuries, cardiovascular diseases were reported to be associated with environmental risks such as air pollution, risks in the workplace, exposure to chemicals such as lead and exposure to environmental tobacco smoke in previous studies estimating the impact on the global burden of disease; lead exposure, for example, can increase blood pressure, which in turn increases the risk of cardiovascular disease (Prüss-Üstün & Corvalán, 2006). Exposures to outdoor air pollution accounted for approximately 2% of the global cardiopulmonary disease burden (WHO, 2002; Cohen et al., 2004). It was estimated that approximately 2.5 million people die every year from cardiovascular disease attributable to environmental factors (16% [7—23%]) of the total burden of cardiovascular disease), including work-related stress as well as chemicals, air pollution, and environmental tobacco smoke exposures (Prüss-Üstün & Corvalán, 2006).

However, even though occupational risk factors have been associated with cardiovascular diseases, the evidence is still being debated in studies on burden of disease (Concha-Barrientos, et al., 2004; Prüss-Üstün & Corvalán, 2006) and have not be included in studies of estimates due to lack of global data. In a review of the epidemiologic data and examining the pathways through which psychosocial factors affect pathology, Strike & Steptoe (2004) explored the relationship between coronary artery disease (CAD) and psychosocial factors. They reported that there is evidence to support a causal relationship between chronic stress, socio-economic, depression, and social support and development of CAD. In reviewing the epidemiological evidence linking psychosocial factors and CAD, they found hypothalamic– pituitary–adrenal axis, hypertension and cardiovascular reactivity, endothelial function, inflammatory markers, platelets, coagulation factors, fibrinogen, lipids, glucose metabolism, and lifestyle factors as mediators. This review report, using evidence from large epidemiological studies, longitudinal and cross-sectional studies, proposes that sufficient data may be available to estimate the burden of disease due to psychosocial risks at work.

5.2. Psychosocial hazards and lower back pain

Musculoskeletal diseases included in the WHO report on the comparative quantification of health risks focus mainly on the impact of ergonomic stressors at work on lower back pain (Concha-Barrientos et al., 2004). In the update report, main categories of rheumatoid arthritis, osteoarthritis, low back pain, gout, and a group of "other musculoskeletal diseases" were included (Prüss-Üstün & Corvalán, 2006). Low back pain is associated with exposure to ergonomic stressors at work, and it has been estimated that occupational exposures accounted for 37% of the global burden of disease from low back pain (Concha-Barrientos, et al., 2004; WHO, 2002). The mean attributable fraction was generally higher for men than for women (41% versus 32%), because men were more frequently engaged in occupations that exposed them to risk.

Rheumatoid arthritis and osteoarthritis have both been linked to occupational risks, such as exposure to vibrations, repetitive trauma, knee bending or lifting heavy weights. The incidences of these diseases are higher in occupational groups such as farmers, truck drivers and unskilled workers (Khuder, Peshimam & Agraharam, 2002; Kirkhorn, Greenlee & Reeser, 2003; Lievense et al., 2001; Rossignol et al., 2003). It was estimated that environmental factors account for 17% (7—29%) of the disease burden from rheumatoid arthritis and 20% (13—26%) of that from osteoarthritis. The group of "other musculoskeletal diseases" includes other forms of arthritis, arthropathies, joint disorders, systemic connective tissue disorders, muscle and soft tissue disorders. Evidence indicates that these diseases are also linked to occupational conditions, and it was estimated that 15% (7—23%) of the disease burden for this group of musculoskeletal diseases was attributable to occupational risk factors.

The impact of psychosocial risks has not been included in these global burden of disease reports. This review provides the evidence on the impact of such risks on lower back pain and other MSDs, through which quantification of their health impact may be possible through further work.

5.3. Psychosocial hazards and noise

Comparative quantification of occupational noise on health (hearing loss) accounted for more than four million DALYs, all of them produced by the disability associated with hearing loss (YLD). Worldwide, the burden attributed to occupational noise was estimated to be 16%. In addition to causing irreversible hearing loss, high noise levels in the workplace was reported to cause elevated blood pressure, sleeping difficulties, annoyance and stress. Research findings indicate that occupational noise has multiple consequences, both for the individual and for society, and particularly for those suffering hearing loss at young ages. Most occupational noise exposure can be minimized by the use of engineering controls to reduce the generation of noise at its source, within complete hearing loss prevention programmes that include noise assessment, audiometric monitoring of workers' hearing, appropriate use of hearing protectors and worker education (Concha-Barrientos, et al., 2004).

This review suggests that health effects of noise may often reflect psychological reactions to the noise–stress in addition to the objective exposure levels, which have been previously quantified (Concha-Barrientos et al., 2004). Since only limited evidence of psychological effect of exposure of noise is available (e.g. Ahasan et al., 1999; Barreto et al., 1997; Glass & Singer, 1972) more research is needed before the psychological impact of exposure to noise can be estimated.

Overall this report has provided comprehensive evidence from longitudinal, prospective, review and cross sectional studies on the impact of psychosocial hazards on a number of health outcomes. Extrapolation of the health impact of psychosocial hazards may not be possible on a global basis, due to the lack of data. However, cross sectional studies have been conducted in different countries and such data support the available evidence base from developed countries. In addition, the nature of psychosocial hazards (being many different ones and affecting health either through the experience of work-related stress or through their interaction with physical hazards at the work environment) makes it difficult to extrapolate their impact in a comprehensive manner for each health outcome. However, the data presented in this report has shown evidence that this is possible in certain cases, such as that of CHD and MSDs. It is therefore recommended that further work is devoted in this area.

6. Conclusions

In sum, there is substantial scientific evidence to indicate that there is a clear relationship between psychosocial risks and consequences to individuals' physical, mental and social health; highlighting them as a key public health concern and with clear implication for society-at-large (Black, 2008). Longitudinal studies and systematic reviews have indicated that stress at work is associated with heart disease, depression, and musculoskeletal disorders and there is consistent evidence that high job demands, low control, and effort-reward imbalance are risk factors for mental and physical health problems thereby leading to further strain on public spending for increased costs on healthcare.

Extrapolation of the health impact of psychosocial risks may not be possible on a global basis, due to the lack of data. However, cross sectional studies have been conducted in different countries and such data support the available evidence base from developed countries.

There has been, in recent years, a growing movement to develop measures and programmes to effectively manage and prevent these psychosocial risks (Eurofound, 2007; ILO, 2004; WHO, 2003). Commonly three levels of interventions have been used to address them in the workplace: primary, secondary and tertiary level interventions (Murphy & Sauter, 2004). Primary-level interventions, also commonly referred to as 'organisational-level' interventions (Burke, 1993) are concerned with taking action to modify or eliminate sources of stress (i.e., psychosocial risks) inherent in the workplace and work environment, thus reducing their negative impact on the individual (Cooper & Cartwright, 1997). Secondary-level interventions refer to initiatives aimed at modifying an individual's response to psychosocial risks; specifically concerned with the prompt detection and management of minor illness or psychological distress (Sutherland & Cartwright, 2000). Finally, tertiary level interventions are concerned with minimizing the effects of stress-related problems once they have occurred through the management and treatment of symptoms of occupational disease or illness (Cooper & Cartwright, 1997; Hurrell & Murphy, 1996; LaMontagne et al., 2007).

Conceptually (see Leka et al., 2008) the new area of psychosocial risk management demands organisations to be ready for change; the important drivers or forces of change often being closely related (e.g. rationality, economic usefulness, orientation towards values and norms, compliance with laws and regulations, etc.). On this basis, several change strategies are conceivable, whereby a comprehensive plan to prevent and/or to manage psychosocial risks needs to consider the broader context (economic situation, culture, industrial relations, labour market, etc.) within which organisations operate.

Further work to extrapolate the impact of psychosocial risks on different health outcomes will motivate not only policy makers but also employers to continue their efforts to address these challenges of the modern work environment and to improve the health of employees around the world.

References

Adelmann, P.K. (1987). Occupational complexity, control, and personal income: Their relation to psychological well-being in men and women. *Journal of Applied Psychology, 72,* 529–537.

Ahasan M.R., Mohiuddin G., Vayrynen S., Ironkannas H., & Quddus R. (1999). Workrelated problems in metal handling tasks in Bangladesh: Obstacles to the development of safety and health measures. *Ergonomics, 42(2),* 385-396.

Akbaraly, T.N., Kivimäki, M., Brunner, E.J., Chandola, T., Marmot, M.G., Singh-Manoux, A., & Ferrie, J.E. (2009). Association between metabolic syndrome and depressive symptoms in middle-aged adults: Results from the Whitehall II study. *Diabetes Care, 32(3),* 499-504.

Akerstedt, T. (1985). Adjustment of the physiological circadian rhythms and the sleep-wake cycle to shiftwork. In S. Folkard & T. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling*. Oxford: John Wiley & Sons.

Akerstedt, T. (1988). Sleepiness as a consequence of shift work. *Sleep, 11(1),* 17-34.

Akerstedt, T. (1995). Work hours, sleepiness and the underlying mechanisms. *Journal of Sleep Research, 4(2*), 15-22.

Akerstedt, T., & Landstrom, U. (1998). Work place countermeasures of night shift fatigue. *International Journal Of Industrial Ergonomics, 21(3-4),* 167-178.

Akerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., & Kecklund, G. (2002). Sleep disturbances, work stress and work hours: A cross-sectional study. *Journal of Psychosomatic Research, 53(3),* 741-8.

Akerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., & Kecklund, G. (2002). Work organisation and unintentional sleep: Results from the WOLF study. *Occupational & Environmental Medicine, 59,* 595-600.

Allen, T.D., Herst, D.E.L., Bruck, C.S., & Sutton, M. (2000). Consequences associated with work-to-family conflict: A review and agenda for future research. *Journal of Occupational Health Psychology, 5(2),* 278-308.

Allesøe, K., Hundrup, Y.A., Thomsen, J.F., & Osler, M. (2010). Psychosocial work environment and risk of ischaemic heart disease in women: The Danish Nurse Cohort Study. *Occupational & Environmental Medicine, 67(5),* 318-322.

Althouse, R., & Hurrell, J.J. (1977). An analysis of job stress in coal mining. Washington, D.C.: U.S. Government Printing Office.

Amick, B., Kawachi, I., Coakley, E., Lerner, D., Levine, S., & Colditz, G. (1998). Relationship of job strain and iso-strain to health status in a cohort of women in the United States'. *Scandinavian Journal of Work Environment & Health, 24(1),* 54-61.

Andersen, I., Burr, H., Kristensen, T.S., Gamborg, M., Osler, M., Prescott, E., & Diderichsen, F. (2004). Do factors in the psychosocial work environment mediate the effect of socioeconomic position on the risk of myocardial infarction? Study from the Copenhagen Centre for Prospective Population Studies. *Occupational & Environmental Medicine, 61(11),* 886-892.

Andersen, J.H., Haahr, J., & Frost, P. (2007). Risk factors for more severe regional musculoskeletal symptoms. *Arthritis & Rheumatism, 56(4),* 1355-1364.

Andersen, J.H., Kaergaard, A., Frost, P., Thomsen, J.F., Bonde, P., Fallentin, N., Borg, V., & Mikkelsen S. (2002). Physical, psychosocial, and individual risk factors for neck/shoulder pain with pressure tenderness in the muscles among workers performing monotonous, repetitive work. *Spine, 27(6),* 660-667.

Aronsson, G. (1989). Dimensions of control as related to work organization, stress and health. *International Journal of Health Services, 19(3),* 459-468.

Aronsson, G. (1999a). Contingent workers and health and safety. *Work, Employment & Society, 13(3),* 439-459.

Aronsson, G. (1999b). Influence of worklife on public health. *Scandinavian Journal of Work & Environmental Health, 25(6),* 597-604.

Aronsson, G., & Goransson, S. (1999). Permanent employment but not in a preferred occupation: Psychological and medical aspects, research implications. *Journal of Occupational Health Psychology, 4(2).* 152-163.

Artazcoz, L., Benach, J., Borrell, C., & Cortès, I. (2004). Unemployment and mental health: Understanding the interactions among gender, family roles, and social class. *American Journal of Public Health, 94(1),* 82-88.

Auer, P., & Fortuny, M. (2000). Ageing of the labour force in OECD Countries: Economic and social consequences. Geneva: International Labour Office.

Australian Council of Trade Unions –ACTU (2000). Stop Stress at Work- A Guide for Workers. Melbourne: ACTU OHS Unit.

Australian Council of Trade Unions –ACTU (1998). Stress at Work, a Report on the 1997 ACTU National Survey on Stress at Work. Melbourne: ACTU Occupational Health and Safety Unit.

Bacquer, D., Pelfrene, E., Clays, E., Mak, R., Moreau, M., de Smet, P., Kornitzer, M., & de Backer G. (2006). Perceived job stress and incidence of coronary events: 3-year follow up of the Belgian job stress project cohort. *American Journal of Epidemiology, 161,* 434-441.

Baglioni, A.J., Cooper, C.L., & Hingley, P. (1990). Job stress, mental health and job satisfaction among U.K. senior nurses. *Stress Medicine, 6,* 9–20.

Barling, J., Dekker, I., Loughlin, C., Kelloway, E., Fullagar, C., & Johnson, D. (1996). Prediction and replication of the organizational and personal consequences of workplace sexual harassment. *Journal of Managerial Psychology, 11,* 4-25.

Barreto, S.M., Swerdlow, A.J., Smith, P.G., & Higgins, C.D. (1997). Risk of death from motor-vehicle injury in Brazilian steelworkers: A nested case-control study. *International Journal of Epidemiology, 26(4),* 814-821.

Bassett, J., Spillane, R., & Hocking, B. (1998). Cortisol excretion and illness reporting: A psycho-physiological study of business executives at home and at work. *Journal of Occupational Health & Safety, 14(2),* 135-141.

Bauer, G.F., Huber, C.A., Jenny, G.J., Müller, F., & Hämmig, O. (2009). Socioeconomic status, working conditions and self-rated health in Switzerland: Explaining the gradient in men and women. *International Journal of Public Health, 54(1),* 23-30.

Beale, D., Clarke, D., Cox, T., Leather, P., & Lawrence, C. (1999). System memory in violent incidents: Evidence from patterns of reoccurrence. *Journal of Occupational Health Psychology, 4(3),* 233-244.

Beehr, T.A., & Newman, J.E. (1978). Job stress, employee health and organisational effectiveness: A facet analysis, model and literature review. *Personnel Psychology, 31,* 665-699.

Béjean, S., & Sultan-Taïeb, H. (2005). Modelling the Economic Burden of Diseases Imputable to Stress at Work. *The European Journal of Health Economics, 6(1),* 16-23.

Belkic, K.L., Landsbergis, P.A., Schnall, P.L., & Baker, D. (2004). Is job strain a major source of cardiovascular disease risk? *Scandinavian Journal of Work Environment & Health, 30 (2),* 85-128.

Belkic, K., Landsbergis, P., Schnall, P., Baker, D., Theorell, T., Siegrist, J., Peter, R., & Karasek, R. (2000). Psychosocial factors: Review of the empirical data among men. *Occupational Medicine, 15*, 24–46.

Benach, J., & Mutaner, C. (2007). Precarious employment and health: Developing a research agenda. *Journal of Epidemiology & Community Health, 61,* 276–277.

Benach, J., Amable, M., Muntaner, C., & Benavides, F.G. (2002). The consequences of flexible work for health: Are we looking in the right place? *British Medical Journal, 56(6),* 405-406.

Benavides, F.G., Benach, J., Diez-Roux, A.V., & Roman, C. (2000). How do types of employment relate to health indicators? Findings from the second European survey on working conditions. *Journal of Epidemiology & Community Health, 54(7),* 494-501.

Berg, A.M., Hem, E., Lau, B, Haseth, K., & Ekeberg, O. (2005). Stress in the Norwegian police service. *Occupational Medicine, 55,* 113–120.

Bhalla, S., Jones, B., & Flynn, D. M. (1991). Role stress among Canadian white-collar workers. *Work & Stress, 5,* 289-299.

Biersner, R.J., Gunderson, E.K., Ryman, D.H., & Rahe, R.H. (1971). Correlations of physical fitness, perceived health status, and dispenssary visits with performance in stressful training. USN Medical Neuropsychioatric Research Unit. Technical report no: 71-30. US Navy, Washington DC.

Bigos, S.J., Battie, M.C., Spengler, D.M., Fisher, L.D., Fordyce, W.E., Hansson, T.H., Nachemson, A.L., & Wortley, M.D. (1991). A prospective study of work perceptions and psychosocial factors affecting the report of back injury. *Spine, 16,* 1-6.

Black, C. (2008). Review of the health of Britain's working age population: Working for a healthier tomorrow. London: TSO.

Blackmore, E.R., Stansfeld, S.A., Weller, I., Munce, S., Zagorski, B.M., & Stewart, D.E. (2007). Major depressive episodes and work stress: Results from a national population survey. *American Journal of Public Health, 97,* 2088–2093.

Blanchard, M. (1993). Managing for wellness. *Executive Excellence*, 8–9.

Bøggild, H., & Knutsson, A. (1999). Shift work, risk factors and cardiovascular disease. *Scandinavian Journal of Work Environment & Health, 25(2),* 85-99.

Bøggild, H., Burr, H., Tüchsen, F., & Jeppesen, H.J. (2001). Work environment of Danish shift and day workers. *Scandinavian Journal of Work Environment & Health, 27(2),* 97-105.

Bohle, P. (1999). Shiftwork in nursing: Relationships between work/non-work conflict, domestic responsibilities, gender and health - research report. Sydney: National Occupational Health and Safety Commission.

Bonde, J.P. (2008). Psychosocial factors at work and risk of depression: A systematic review of the epidemiological evidence. *Occupational & Environmental Medicine, 65 (7),* 438-445.

Bonde, J.P., Munch-Hansen, T., Agerbo, E., Suadicani, P., Wieclaw, J., & Westergaard-Nielsen, N. (2009). Job strain and ischemic heart disease: A prospective study using a new approach for exposure assessment. *Journal of Occupational Environmental Medicine, 51(6),* 732-738.

Bongers, P.M., De Winter, C.R., Kompier, M.A.J., & Hilderbrandt, M.D. (1993). Psychosocial factors at work and musculoskeletal disease. *Scandinavian Journal of Work Environment & Health, 19,* 297-312.

Bongers, P.M., Ijmker, S., van den Heuvel, S., & Blatter, B.M. (2006). Epidemiology of work related neck and upper limb problems: Psychosocial and personal risk factors (Part I) and effective interventions from a bio behavioural perspective (Part II). *Journal of Occupational Rehabilitation, 16(3),* 29-302.

Borg, V., Kristensen, T.S., & Burr, H. (2000). Work environment and changes in self-rated health: A five year follow-up study. *Stress Medicine, 6,* 37-47.

Borritz, M., Rugulies, R., Bjorner, J.B., Villadsen, E., Mikkelsen, O.A., & Kristensen, T.S. (2006). Burnout among employees in human service work: Design and baseline findings of the PUMA study. *Scandinavian Journal of Public Health, 34(1),* 49-58.

Bosma, H., Marmot, M., Hemingway, H., Nicholson, A., Brunner, E., & Stansfeld, S. (1997). Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. *British Medical Journal, 314*, 558-565.

Bosma, H., Peter, R., Siegrist, J., & Marmot, M. (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health, 88(1),* 68-74.

Bosma, H., Stansfeld, S.A., & Marmot, M.G. (1998). Job control, personal characteristics, and heart disease. *Journal of Occupational Health Psychology, 3(4),* 402-9.

Bradley, G. (1989). *Computers and the Psychological Work Environment*. London: Taylor and Francis.

Breslin, F.C., & Mustard, C. (2003). Factors influencing the impact of unemployment on mental health among young and older adults in a longitudinal, population-based survey. *Scandinavian Journal of Work Environment & Health, 29(1),* 5-14.

Breslow, L., & Buell, P. (1960). Mortality from coronary heart disease and physical activity of work in California. *Journal of Chronic Diseases, 22,* 87-91.

Brook, A. (1973). Mental stress at work. *Practitioner, 210,* 500-506.

Buck, V. (1972). *Working Under Pressure*. London: Staples Press.

Buckle, P. (1997). Upper limb disorders and work: The importance of physical and psychosocial factors. *Journal of Psychosomatic Research, 43,* 17-25.

Bunker, S.J., Colquhoun, D.M., Esler, M.D., Hickie, I.B., Hunt, D., Jelinek, V.M., Oldenburg, B.F., Peach, H.G., Ruth, D., Tennant, C.C., & Tonkin, A.M. (2003). Stress and coronary heart disease: Psychosocial risk factors. National Heart Foundation of Australia position statement update. *Medical Journal of Australia, 178 (6),* 272-276.

Burke, R.J. (1993). Organizational-level interventions to reduce occupational stressors. *Work & Stress, 7(1),* 77-87.

CAL/OSHA (1998). Guidelines for Security and Safety of Health Care and Community Service Workers. Division of Occupational Safety and Health, Department of Industrial Relations, San Francisco. See www.dir.ca.gov/DOSH/dosh_publications/hcworker.html

Calnan, M., Wainwright, D., & Almond, S. (2000). Job strain, effort–reward imbalance and mental distress: A study of occupations in general medical practice. *Work & Stress, 14,* 297–311.

Campo, M.A., Weiser, S., & Koenig, K.L. (2009). Job strain in physical therapists. *Physical Therapy, 89(9),* 946-956.

Cannon, W.B. (1929). *Bodily Changes in Pain, Hunger, Fear and Rage: An Account of Recent Researches in the Function of Emotional Excitement*. New York: Appleton.

Cannon, W.B. (1931). *The Wisdom of the Body.* New York: Norton.

Chandola, T., Britton, A., Brunner, E., Hemingway, H., Malik, M., Kumaria, M., Badrick, E., Kivimaki, M., & Marmot, M. (2008). Work stress and coronary heart disease: What are the mechanisms? *European Heart Journal, 29,* 640-648.

Chandola, T., Brunner, E., & Marmot, M. (2006). Chronic stress at work and the metabolic syndrome: Prospective study. *British Medical Journal, 332(7540),* 521-525.

Chandola, T., Martikainen, P., Bartley, M., Lahelma, E., Marmot, M., Michikazu, S., Nasermoaddeli, A., & Kagamimori, S. (2004). Does conflict between home and work explain the effect of multiple roles on mental health? A comparative study of Finland, Japan, and the UK. *International Journal of Epidemiology, 33(4),* 884-893.

Chappell, D., & Di Martino, V. (2000). *Violence at Work*. Geneva: International Labour Office.

Chen, W.Q., Yu, I.T.S., & Wong, T.W. (2005). Impact of occupational stress and other psychosocial factors on musculoskeletal pain among Chinese offshore oil installation workers. *Occupational & Environmental Medicine, 62,* 251-256.

Cheng, Y., Chen, C.W., Chen, C.J., & Chiang, T.L. (2005). Job insecurity and its association with health among employees in the Taiwanese general population. *Social Science & Medicine, 61(1),* 41-52.

Cherry, N.M., Meyer, J.D., & Holt, D.L. (2000). Surveillance of work-related diseases by occupational physicians in the UK: OPRA 1996-1999. *Occupational Medicine, 50,* 496-503.

Chui, W., Chan, A., Snape, E. & Redman, T. (2001). Age stereotypes and discriminatory attitudes towards older workers: An East-West comparison. *Human Relations, 54(5),* 629-61.

Cincirpini, P. M., Hook, J. D., Mendes de Leon, C. F., & Pritchard, W. S. (1984). A review of cardiovascular, electromyographic, electrodermal and respiratory measures of psychological stress. National Institute for Occupational Safety and Health, contract no: 84-257, Cincinnati, Ohio: NIOSH.

Clausen, T., Christensen, K.B., Lund, T., & Kristiansen, J. (2009). Self-reported noise exposure as a risk factor for long-term sickness absence. *Noise Health, 11(43),* 93-97.

Cobb, S., & Kasl, S. V. (1977). Termination: The consequences of job loss. US Department of Health, Education and Welfare, Cincinnati.

Cohen, A. (1976). The influence of a company hearing conservative program on extra-auditory problems in workers. *Journal of Safety Research, 8,* 146-162.

Cohen, S., & Willis, T. A. (1985) Stress, social support and the buffering hypothesis. *Psychological Bulletin, 98,* 310-357.

Cohen, A.J., Anderson, H.R., Ostro, B., Pandey, K.D., Krzyzanowski, M., Künzli, N., Gutschmidt, K., Pope, C.A. III, Romieu, I., Samet, J.M., & Smith, K.R. (2004). Urban air pollution. In M. Ezzati, A.D. Lopez, A. Rodgers & C.J.L. Murray (Eds.), *Comparative Quantification of Health Risks*. Geneva: World Health Organization.

Colligan, M.J., Smith, M.J., & Hurrell, J.J. (1977). Occupational incidence rates of mental health disorders. *Journal of Human Stress, 3,* 34-39.

Commission for the Social Determinants of Health (2008). Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization.

Concha-Barrientos, M., Imel, N.D., Driscoll, T., Steenland, N.K., Punnett, L., Fingerhut, M.A., Prüss-Üstün, A., Leigh, J., Tak, S.W., Corvalàn, C. (2004). Selected occupational risk factors. In M. Ezzati, A.D. Lopez, A. Rodgers & C.J.L. Murray (Eds.), *Comparative Quantification of Health Risks*. Geneva: World Health Organization.

Cooper, C.L. (1981). *Executive Families under Stress*. Englewood Cliffs, New Jersey: Prentice Hall.

Cooper, C.L., & Cartwright, S. (1994). Healthy mind: Healthy organizations - A proactive approach to occupational stress. *Human Relations, 47,* 455–471.

Cooper, C.L., & Cartwright, S. (1997). An intervention strategy for workplace stress. *Journal of Psychosomatic Research, 43 (1),* 7-16.

Cooper, C.L., Mallinger, M., & Kahn, R. (1978). Identifying sources of occupational stress amongst dentists. *Journal of Occupational Psychology, 51,* 227–234.

Cooper, C.L., Russell, M., & Geroge, W.H. (1998). Coping expectancies, and alcohol abuse: A test of social learning formulations. *Journal of Abnormal Psychology, 97,* 218-230.

Cooper, C.L., & Smith, M. J. (1986). *Job Stress and Blue Collar Work*. Chichester: Wiley & Sons.

Corey, D.M., & Wolf, G.D. (1992). An integrated approach to reducing stress injuries. In J.C. Quick, L.R. Murphy & J.J. Hurrell (Eds.), *Stress and Well-being at Work*: *Assessments and Interventions for Occupational Mental Health*. Washington DC: American Psychological Association.

Cox, T. (1978). *Stress*. London: Macmillan.

Cox, T. (1985a). The nature and measurement of stress. *Ergonomics, 28,* 1155-1163.

Cox, T. (1985b). Repetitive work: Occupational stress and health. In C.L. Cooper & M. J. Smith (Eds.), *Job Stress and Blue Collar Work*. Chichester: Wiley & Sons.

Cox, T. (1993). Stress research and stress management: Putting theory to work. HSE Contract Research Report No 61/1993). Sudbury: HSE Books.

Cox, T., & Cox, S. (1993). Psychosocial and Organizational Hazards: Monitoring and Control. Occasional Series in Occupational Health, No.5. Copenhagen, Denmark: World Health Organization (Europe).

Cox, T., Ferguson, E., & Farnsworth, W.F. (1993). Nurses' knowledge of HIV and AIDS and their perceptions of the associated risk of infection at work. Paper to: VI European Congress on Work and Organizational Psychology, Alicante.

Cox, T., & Gotts, G. (1987). The General Well-Being Questionnaire Manual. Nottingham, UK: University of Nottingham, Department of Psychology.

Cox, T., & Griffiths, A. (1996). Psychosocial hazards, work-related stress and upper limb disorders: A model. Proceedings of 1st International Congress of Applied Ergonomics, 21-24 May, Istanbul, Turkey.

Cox, T., & Griffiths, A. (2005). The nature and measurement of work-related stress: theory and practice. In J.R. Wilson & N. Corlett (Eds.), *Evaluation of Human Work* (3rd ed.). London: CRS Press.

Cox, T., Griffiths, A., & Leka, S. (2005). Work organization and work-related stress. In K. Gardiner & J.M. Harrington (Eds.), *Occupational Hygiene* (3rd ed.). Oxford: Blackwell Publishing.

Cox, T., Griffiths, A., & Rial-Gonzalez, E. (2000). Research on work related stress. Luxembourg: Office for Official Publications of the European Communities.

Cox, T., & Howarth, I. (1990). Organizational health, culture and helping. *Work & Stress, 4,* 107-110.

Cox, T., & Kuk, G. (1991). Healthiness of schools as organizations: Teacher stress and health. Paper to: International Congress, Stress, Anxiety & Emotional Disorders, University of Minho, Braga, Portugal.

Cox, T., & Leather, P. (1994). The prevention of violence at work: Application of a cognitive behavioural theory. In C.L. Cooper & I. Robertson (Eds.), *International Review of Industrial & Organizational Psychology*, Chichester: Wiley & Sons.

Cox, T., & Leiter, M. (1992). The health of healthcare organizations. *Work & Stress, 6,* 219-227.

Croon, D.E., Sluiter, J, Kuijer, P.P., & Frings-Dresen, M. (2005). The effect of office concepts on worker health and performance: A systematic review of the literature. *Ergonomics, 48(2),* 119-134.

Cummings, G., & Estabrooks, C.A. (2003). The effects of hospital restructuring that included layoffs on individual nurses who remained employed: A systematic review of impact. *International Journal of Sociology and Social Policy, 23(8),* 8-53.

D'Souza, R.M., Strazdins, L., Lim, L., Broom, D., & Rodgers, B. (2003). Work and health in contemporary society: Demands, control and insecurity. *Journal of Epidemiology & Community Health, 57,* 849-854.

Danna, K., & Griffin R.W. (1999). Health and well-being in the workplace: A review and synthesis of the literature. *Journal of Management, 25(3),* 357-384.

Davidson, M.J., & Cooper, C.L. (1981). A model of occupational stress. *Journal of Occupational Medicine, 23,* 564-570.

De Beeck, R.O., & Hermans, V. (2000). Research on work-related low back disorders (No. 204). Luxembourg: Office for Official Publications of the European Communities.

Deeney, C., & O'Sullivan, L. (2009). Work related psychosocial risks and musculoskeletal disorders: Potential risk factors, causation and evaluation methods. *Work, 34 (2),* 239-248.

De Jonge, J., Bosma, H., Peter, R. & Siegrist, J. (2000). Job strain, effort-reward imbalance and employee well-being: A large-scale cross-sectional study. *Social Science & Medicine, 50,* 1317-1327.

De Jonge, J., & Kompier, M.A.J. (1997). A critical examination of the demand–control–support model from a work psychological perspective. *International Journal of Stress Management, 4,* 235–258.

De Lange, A.H., Taris, T.W., Kompier, M.A.J., Houtman, I.L.D., & Bongers, P.M. (2004). Work characteristics and psychological well-being: Testing normal, reversed and reciprocal relationships within the 4-wave SMASH study. *Work & Stress, 18,* 149-166.

De Lange, A.H., Taris, T.W., Kompier, M.A.J., Houtman, I.L.D., & Bongers, P.M. (2003). The very best of the Millennium: Longitudinal research and the Demand-Control-(Support) model. *Journal of Occupational Health Psychology, 8(4),* 282-305.

Demerouti, E., Bakker, A.B., & Bulters, A. (2004). The loss spiral of work pressure, work-home interference and exhaustion: Reciprocal relations in a three-wave study. *Journal of Vocational Behaviour, 64,* 131–149.

Devereux, J.J., Buckle, P.W., & Vlachonikolis, I.G. (1999). Interactions between physical and psychosocial risk factors at work increase the risk of back disorders: An epidemiological approach. *Occupational & Environmental Medicine, 56,* 343-353.

Devereux, J., Rydstedt, L., Kelly, V., Weston, P., & Buckle, P. (2004). The role of stress and psychological factors in the development of musculoskeletal disorders: The stress and MSD study. Report No. 273: HSE.

Devereux, J.J., Vlachonikolis, I.G., & Buckle, P.W. (2002). Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. *Occupational & Environmental Medicine, 59(4),* 269-277.

Dewa, C.S., Lin, E., Kooehoorn, M., & Goldner, E. (2007). Association of chronic work stress, psychiatric disorders, and chronic physical conditions with disability among workers. *Psychiatry Services, 58(5),* 652-658.

Dollard, M.F. Skinner, N., Tuckey, M.R., & Bailey, T. (2007). National surveillance of psychosocial risk factors in the workplace: An international overview. *Work & Stress, 21,* 1-29.

Donaldson, J., & Gowler, D. (1975). Perogatives, participation and managerial stress. In D. Gowler & K. Legge (Eds.), *Managerial Stress*. London: Gower Press.

Dooley, D., Catalano, R. & Wilson, G. (1994). Depression and unemployment: Panel findings from the epidemiologic catchment area study. *American Journal of Community Psychology, 22,* 745–765.

Dunbar, J.A., Reddy, P., Davis-Lameloise, N., Philpot, B., Laatikainen, T., Kilkkinen, A., Bunker, S.J., Best, J.D., Vartiainen, E., Kai, L.S., & Janus, E.D. (2008). Depression: An important comorbidity with metabolic syndrome in a general population. *Diabetes Care, 31(12),* 2368-2373.

Eby, L.T., Casper, W.J., Lockwood, A., Bordeaux, C., & Brinley, A. (2005). Work and family research in IO/OB: Content analysis and review of the literature (1980-2002). *Journal of Vocational Behaviour, 66,* 124-197.

Einarsen, S., Raknes, B.I. & Matthiesen, S.M. (1994). Bullying and harassment at work and their relationships to work environment quality - an exploratory study. *The European Work and Organizational Psychologist, 4,* 381-401.

Eller, N.H., Netterstrøm, B., Gyntelberg, F., Kristensen, T.S., Nielsen, F., Steptoe, A., & Theorell, T. (2009). Work-related psychosocial factors and the development of ischemic heart disease: A systematic review. *Cardiology Review, 17(2),* 83-97.

Elo, A., Leppänen, A., Lindström, K., & Ropponen, T. (1992). OSQ, Occupational Stress Questionnaire - Users instructions. Helsinki: Finnish Institute of Occupational Health.

Elovainio, M., Ferrie, J.E., Singh-Manoux, A., Gimeno, D., De Vogli, R., Shipley, M.J., Vahtera, J., Brunner, E.J., Marmot, M.G., & Kivimäki, M. (2009). Cumulative exposure to high-strain and active jobs as predictors of cognitive function: The Whitehall II study. *Occupational & Environmental Medicine, 66(1),* 32-37.

Emslie, C., Hunt, K., & McIntyre, S. (1999). Problematizing gender, work and health: The relationship conditions and minor morbidity in full-time bank employees. *Social Science & Medicine, 48,* 33-48.

Ertel, M., Pech, E., & Ullsperger, P. (2001). Working hours and health in flexible work arrangements. In C. Weikert, E. Torkelson & J. Pryce (Eds.), *Occupational Health Psychology: Europe 2001*. Nottingham: I-WHO Publications, ISBN: 0-9539936-12.

EU-OSHA (2002). How to tackle psychosocial issues and reduce work-related stress. Luxembourg: Office for Official Publications of the European Communities.

EU-OSHA (2004). Report on the priorities for occupational safety and health research in EU25. Luxembourg: Office for Official Publications of the European Communities.

EU-OSHA (2007). Expert forecast on emerging psychosocial risks related to occupational safety and health. Luxembourg: Office for Official Publications of the European Communities.

EU-OSHA (2009). OSH in figures: Stress at work - facts and figures. Luxembourg: Office for Official Publications of the European Communities.

EuroFound (2007). The Fourth Working Conditions Survey. Dublin: Office for Official Publications of the European Communities.

Eurostat (1999). Work-related health problems and accidental injuries (ad hoc module of the 1999 Labour Force Survey): Eurostat Metadata in SDDS format: Eurostat.

Eurostat (2006). Eurostat Metadata in SDDS format: Eurostat.

Everson-Rose, S.A. & Lewis, T.T. (2005). Psychosocial factors and cardiovascular diseases. *Annual Review of Public Health,* 26, 469-500.

Ezzati, M., Lopez, A.D., Rodgers, A., Murray, C.J.L. (Eds.) (2004). *Comparative Quantification of Health Risks.* Geneva: World Health Organization.

Fell, D.B., Kephart, G., Curtis, L.J., Bower, K., Muhajarine, N., Reid, R., & Roos, L. (2007). The relationship between work hours and utilization of general practitioners in four Canadian provinces. *Health Services Research, 42(4),* 1483-98.

Felstead, A., & Jewson, N. (2000). *In Work, at Home: Towards an Understanding of Homeworking*. London: Routledge.

Ferrie, J.E., Shipley, M.J., Marmot, M., Stansfeld, S.A., & Smith, G.D. (1995). Health effects of anticipation of job change and non-employment: Longitudinal data from the Whitehall II study. *British Medical Journal, 311,* 1264-1269.

Ferrie, J.E., Shipley, M.J., Stansfeld, S.A., & Marmot, M.G. (2002). Effects of chronic job insecurity and change in job security on self reported health, minor psychiatric morbidity, physiological measures, and health related behaviours in British civil servants: The Whitehall II study. *Journal of Epidemiology & Community Health, 56,* 450-454.

Ferrie, J.E., Shipley, M.J., Stansfeld, S.A., Smith, G.D., & Marmot, M. (2003). Future uncertainty and socioeconomic inequalities in health: The Whitehall II study. *Social Science & Medicine, 57(4),* 637-46.

Fielden S.L., & Peckar C.J. (1999). Work stress and hospital doctors: A comparative study. *Stress Medicine, 15(3),* 137-141.

Figley, C.R. (1985). *Trauma and Its Wake: The Study of Treatment of Post Traumatic Stress Disorder*. New York: Brunner/Mazel.

Fischer, F.M., Oliveira, D.C., Nagai, R., Teixeira, L.R., Júnior, M.L., Latorrec, M.R.D.O., & Cooper, S.P. (2005). Job control, job demands, social support at work and health among adolescent workers. *Revista de Salúde, 39(2),* 245-253.

Fjell, Y., Osterberg, M., Alexanderson, K., Karlqvist, L., & Bildt, C. (2007). Appraised leadership styles, psychosocial work factors, and musculoskeletal pain among public employees. *International Archives of Occupational & Environmental Health, 81(1),* 19-30.

Flannery, R. (1996). Violence in the workplace, 1970-1995: A review of the literature. *Aggression & Violent Behaviour, 1,* 57-68.

Floderus, B., Hagman, M., Aronsson, G., Marklund, S., & Wikman, A. (2009). Work status, work hours and health in women with and without children. *Occupational & Environmental Medicine, 66,* 704-710.

Frankenhauser, M. (1975). Sympatheticadreno-medullary activity, behaviour and the psychosocial environment. In P. H. Venables & M. Christie (Eds.), *Research in Psychophysiology*. Chichester: Wiley & Sons.

Frankenhauser, M., & Gardell, B. (1975). Underload and overload in working life: A multidisciplinary approach. Reports from the Department of Psychology, no: 460, University of Stockholm, Stockholm.

French, J.R.P., & Caplan, R. D. (1970). Psychosocial factors in coronary heart disease. *Industrial Medicine, 39,* 383-397.

French, J. R. P., & Caplan, R. D. (1972). Organizational stress and individual strain. In A. Marrow (Ed.) *The Failure of Success*. New York: AMACOM.

French, J. R. P., Caplan, R. D., & van Harrison, R. (1982). *The Mechanisms of Job Stress and Strain*. New York: Wiley & Sons.

French, J. R. P., Rogers, W., & Cobb, S. (1974). A model of person-environment fit. In G.W. Coehlo, D.A. Hamburg & J.E. Adams (Eds.), *Coping and Adaptation*. New York: Basic Books.

Frone, M.R. (2000). Work-family conflict and employee psychiatric disorders: The national comorbidity survey. *Journal of Applied Psychology, 85(6),* 888-895.

Frone, M.R., Russell, M., & Barnes, G.M. (1996). Work-family conflict, gender, and health-related outcomes: A study of employed parents in two community samples. *Journal of Occupational Health Psychology, 1,* 57-69.

Frone, M.R., Russell, M., & Cooper, M.L. (1992). Antecedents and outcomes of work-family conflict: Testing a model of the work-family interface. *Journal of Applied Psychology, 77,* 65-78.

Frone, M.R., Russell, M., & Cooper, M.L. (1995). Job stressors, job involvement and employee health: A test of identity theory. *Journal of Occupational & Organizational Psychology, 68,* 1–11.

Gadalla, T.M. (2009). Determinants, correlates and mediators of psychological distress: A longitudinal study. *Social Science & Medicine, 68(12),* 2199-2205.

Gael, S. (1988). *The Job Analysis Handbook for Business, Industry and Government*. New York: Wiley & Sons.

Ganster, D.C. (1989). Worker control and well-being: A review of research in the workplace. In S.L. Sauter, J.J. Hurrell, Jr. & C.L. Cooper (Eds.), *Job control and worker health: 3–24*. New York: Wiley.

Ganster, D.C., Fusilier, M.R., & Mayes, B.T. (1986). Role of social support in the experience of stress at work. *Journal of Applied Psychology, 71,* 102–110.

Ganster, D.C., & Schaubroeck, J. (1991). Work stress and employee health. *Journal of Management, 17,* 235–271.

Gershon, R.M.M., Barocas, B., Canton, A.N., Li, X., & Vlahov, D. (2009). Stress in police officers: Mental, physical, and behavioural outcomes associated with perceived work. *Criminal Justice & Behaviour, 36,* 275.

Glass, D.C., & Singer, J.E. (1972). *Urban Stress: Experiments on Noise and Social Stressors*. New York: Academic Press.

Glowinkowski, S.P., & Cooper, C.L. (1986). Managers and professionals in business/industrial settings: The research evidence. *Journal of Organizational Behavior Management, 8,* 177–193.

Gobel, M., Springer, J., & Scherff, J. (1998). Stress and strain of short haul bus drivers: Psychophysiology as a design oriented method for analysis. *Ergonomics, 41(5),* 563-580.

Goldberg, D. (1972). *The Detection of Psychiatric Illness by Questionnaire*. London: Oxford University Press.

Glass, D.C., & McKnight, J.D. (1998). Perceived control, depressive symptomatology, and professional burnout: A review of the evidence. *Psychology & Health, 11(1),* 23-48.

Griffiths, A. (1997). Ageing, health and productivity: A challenge for the new millennium. *Work & Stress, 11,* 197-214.

Griffiths, A. (2007). Healthy work for older workers: Work design and management factors. In W. Loretto, S. Vickerstaff & P. White (Eds.), *The Future for Older Workers: New Perspective*. Policy Press, Bristol.

Grosch, J.W., Caruso, C.C., Rosa, R.R., & Sauter, S.L. (2006). Long hours of work in the U.S.: Associations with demographic and organizational characteristics, psychosocial working conditions and health. *American Journal of Industrial Medicine, 49(11),* 943-52.

Grzywacz, J.G., & Bass, B.L. (2003). Work, family, and mental health: Testing different models of work–family fit. *Journal of Marriage & Family, 65,* 248-261.

Guglielmi, R.S., & Tatrow, K. (1998). Occupational stress, burnout, and health in teachers: A methodological and theoretical analysis. *Review of Educational Research, 68(1),* 61-99.

Gurr, K., Straker, L., & Moore, P. (1998). Cultural hazards in the transfer of ergonomics technology. *International Journal of Industrial Ergonomics, 22,* 397-404.

Guthrie, R., & Quinlan, M. (2005). The occupational safety and health rights and workers' compensation entitlements of illegal immigrants: An emerging challenge. *Policy & Practice in Safety & Health, 3(2),* 69-89.

Halbesleben, J.R.B., & Demerouti, E. (2005). The construct validity of an alternative measure of burnout: Investigating the English translation of the Oldenburg Burnout Inventory. *Work & Stress, 19 (3),* 208-220.

Hall, E.M. (1991). Gender, work control and stress: A theoretical discussion and an empirical test. In J.V. Johnson & G. Johansson (Eds.), *The Psychosocial Work Environment: Work Organization, Democratization and Health*. New York: Baywood Publishing.

Hamer, M., O'Donnell, K., Lahiri, A., & Steptoe, A. (2010). Salivary cortisol responses to mental stress are associated with coronary artery calcification in healthy men and women. *European Heart Journal, 31(4),* 424-429.

Hammer, B., Helland, T., Øystein, P.O., Kjell, N., Torvatn, H., & Mahmut, B. (2004). Expanding the psychosocial work environment: Workplace norms and work-family conflict as correlates of stress and health. *Journal of Occupational Health Psychology, 9(1),* 83-97.

Hannigan, B., Edwards, B., & Burnard P. (2004). Stress and stress management in clinical psychology: Findings from a systematic review. *Journal of Mental Health, 13(3),* 235-245.

Harrington, J.M. (1978). *Shift Work and Health: A critical review of the literature*.
London: HMSO.

Harrington, J.M. (2001). Health effects of shift work and extended hours of work. *Occupational & Environmental Medicine,58*, 68-72.

Harris, M.M., Heller, T., & Braddock, D. (1988). Sex differences in psychological well-being during a facility closure. *Journal of Management, 14*, 391–402.

Head, J., Stansfeld, S.A., & Siegrist, J. (2004). The psychosocial work environment and alcohol dependence: A prospective study. *Occupational & Environmental Medicine, 61,* 219-224.

Health and Safety Executive-HSE (2000). *The Effects of New Ways of Working on Employee Stress Levels*. London: HSE.

Hemingway, H., & Marmot, M. (1999). Evidence based cardiology: Psychosocial factors in the aetiology and prognosis of coronary heart disease: Systematic review of prospective cohort studies. *Clinical Review, 318,* 1460-1467.

Heraclides, A., Chandola, T., Witte, D.R., Brunner, E.J. (2009). Psychosocial stress at work doubles the risk of type 2 diabetes in middle-aged women: Evidence from the Whitehall II study. *Diabetes Care, 32(12),* 2230-2235.

Hillert, A. (2008). [Abstract] Burnout - a new disease? *Versicherungsmedizin, 60(4),* 163-169.

Hingley, P., & Cooper, C.L. (1986). *Stress and the Nurse Manager*. Chichester: Wiley & Son.

Hoel, H., Sparks, K., & Cooper, C. (2001). The Cost of Violence/Stress At Work and the Benefits of a Violence/Stress-Free Working Environment. Report commissioned by the International Labour Organization, University of Manchester.

Holt, R.R. (1982). Occupational stress. In L. Goldberger & S. Breznitz (Eds.) *Handbook of Stress: Theoretical and Clinical Aspects*. New York: Free Press.

Hooftman, W.E., van Poppel, M.N.N., van der Beek, A.J., Bongers, P.M., & van Mechelen, W. (2004). *Scandinavian Journal of Work Environment & Health, 30,* 261-278.

Hu, Q., & Schaufeli, W. (2010). Impact of past and future job insecurity on Chinese family business workers' mental health. Paper presented at the 4th International Conference on Psychosocial Factors at Work: The Changing World of Work. 14-17 June 2010, Amsterdam. ICOH Scientific Committee 'Work Organisation & Psychosocial Factors'.

House, J.S., & Wells, J.A. (1978). Occupational stress, social support and health. In A. McLean, G. Black, & M. Colligan (Eds.), *Reducing Occupational Stress: Proceedings of a conference*. DWEH (NIOSH) Publication no: 78-140, 8-29.

Hugo, G., Luszcz, M., Carson, M., Hinsliff, J., Edwards, P., Barton, C., & King, P. (2009). State of Ageing in South Australia: A summary of a report to the South Australian office for the ageing. Adelaide: Department for Families and Communities Government of South Australia.

Hurrell, J.J.Jr., & Murphy, L.R. (1996). Occupational stress interventions. *American Journal of Industrial Medicine, 29,* 338-341.

Iavicoli, S., Deitinger, P., Grandi, C., Lupoli, M., Pera, A., & Rondinone, B. (2004). Fact-finding survey on the perception of work-related stress in EU candidate countries. In S. Iavicoli, P. Deitinger, C. Grandi, M. Lupoli, A. Pera & M. Petyx (Eds.), *Stress at Work in Enlarging Europe*. Rome: ISPESL.

Ibrahim, S.A., Scott, F.E., Cole, D.C., Shannon, H.S., & Eyles, J. (2001). Job strain and self-reported health among working women and men: An analysis of the 1994/5 Canadian National Population Health Survey. *Women Health, 33(1-2),* 105-124.

Ibrahim, S., Smith, P., & Muntaner, C. (2009). A multi-group cross-lagged analyses of work stressors and health using Canadian National sample. *Social Science & Medicine, 68(1),* 49-59.

Ilmarinen, J. (1999). *Ageing worker in the European Union: Status and promotion of work ability, employability and employment*. Finnish Institute of Occupational Health: Helsinki, Finland.

Ilmarinen, J. (2006). The ageing workforce - challenges for occupational health. *Occupational Medicine, 56(6),* 361-364.

ILO (1986). Psychosocial factors at work: Recognition and control (Vol. 56). Geneva: International Labour Office.

ILO (2000). Mental health in the workplace. Geneva: International Labour Organization.

ILO (2004). Global strategy on occupational safety and health. Geneva: International Labour Organization.

Ingersoll, G.L., Cook, J.A., Fogel, S., Applegate, M., & Frank, B. (1999). The effect of patient-focused redesign on midlevel nurse managers' role responsibilities and work environment. *Journal of Nursing Administration, 29(5),* 21-27.

Inoue, A., Kawakami, N., Haratani, T., Kobayashi, F., Ishizaki, M., Hayashi, T., Fujita, O., Aizawa, Y., Miyazaki, S., Hiro, H., Masumoto, T., Hashimoto, S., & Araki, S. (2010). Job stressors and long-term sick leave due to depressive disorders among Japanese male employees: Findings from the Japan Work Stress and Health Cohort Study. *Journal of Epidemiology & Community Health, 64(3),* 229-235.

Ivancevich, J.M., & Matteson, M.T. (1980). *Stress and Work*. Glenview, Illinois: Scott Foresman.

Jackson, S.E., & Schuler, R.S. (1985). A meta-analysis and conceptual critique of research on role ambiguity and role conflict in work settings. *Organizational Behavior & Human Decision Processes, 36,* 16–78.

Jamal, M. (1990). Relationship of job stress and type-a behavior to employees' job satisfaction, organizational commitment, psychosomatic health problems, and turnover motivation. *Human Relations, 43,* 727–738.

Jansen, N.W., Kant, I., Kristensen, T.S., & Nijhuis, F.J. (2003). Antecedents and consequences of work-family conflict: A prospective cohort study. *Journal of Occupational & Environmental Medicine, 45(5),* 479-491.

Janus (1997). Psychological stress at work can threaten physical health. *Health & Safety at Work, 25,* 16.

Joensuu, M., Väänänen, A., Koskinen, A., Kivimäki, M., Virtanen, M., & Vahtera, J. (in press). Psychosocial work environment and hospital admissions due to mental disorders: A 15-year prospective study of industrial employees. *Journal of Affective Disorders*.

Johansson, G., & Aronsson, G. (1984). Stress reactions in computerized administrative work. *Journal of Occupational Behaviour, 5,* 159-181.

Johnson, J.V., & Hall, E.M. (1996). Dialectic between conceptual and causal enquiry in psychosocial work-environment research. *Journal of Occupational Health Psychology, 1 (4),* 362-374.

Johnson, L.C. (1981). Biological rhythms, sleep and shift work. *Advances in Sleep Research (Vol 7).* New York: Spectrum.

Johnson, J., Steward, W., Hall, E., Fredlund, P., & Theorell, T. (1996). Long-term psychosocial work environment and cardiovascular mortality among Swedish men. *American Journal of Public Health, 86,* 324-331.

Jones, J.R., Hodgson, J.T., Clegg, T.A., & Elliot R.C. (1998). *Self-reported Work-related Illness in 1995: Results from a household survey*. Sudbury: HSE Books.

Jones, D.M. (1983). Noise. In G.R.J. Hockey (Ed.), *Stress and Fatigue in Human Performance*. Chichester: Wiley & Sons.

Jones, D.M. (1999). The cognitive psychology of auditory distraction: The 1997 BPS Broadbent Lecture. *British Journal of Psychology, 90 (2),* 167-187.

Juhan-Vague, I., & Alessi, M. (1993). Plasminogen activator inhibitor 1 and atherothrombosis. *Journal of Thrombosis & Haemostasis, 70,* 138-143.

Kahn, R.L. (1973). Conflict, ambiguity and overload: three elements in job stress. *Occupational Mental Health, 31,* 2-9.

Kahn, R.L., & Byosiere, S. (1990). Stress in organizations. In M. Dunnette (Ed.), *Handbook of Industrial and Organizational Psychology*. Chicago: Rand McNally.

Kahn, R.L., Wolfe, D.M., Quinn, R.P., Snoek, J.D., & Rosenthal, R.A. (1964). *Organizational Stress: Studies in Role Conflict and Ambiguity*. New York: Wiley & Sons.

Karasek, R.A. (1979). Job demands, job decision latitude and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24,* 285-308.

Karasek, R., Baker, D., Marxer, F., Ahlbom, A., & Theorell, T. (1981). Job decision latitude, job demands, and cardiovascular disease: A prospective study of Swedish men. *American Journal of Public Health, 71,* 694–705.

Karasek, R.A., Gordon, G., & Pietroskovsky, C. (1985). Job content instrument: Questionnaire and user's guide. Los Angeles, CA/Lowell, MA: University of Southern California/University of Massachusetts.

Karasek, R.A., Schwartz, J., & Theorell, T. (1982). Job characteristics, occupation, and coronary heart disease. Cincinnati, OH: National Institute for Occupational Safety and Health.

Karasek, R.A. & Theorell, T. (1990). *Healthy Work, Stress, Productivity and the Reconstruction of Working Life*. New York: Basic Books.

Kasl, S.V. (1992). Surveillance of psychological disorders in the workplace. In G.P. Keita & S.L. Sauter (Eds.), *Work and Well-Being: An Agenda for the 1990s*. Washington DC: American Psychological Association.

Kasl, S.V. (1996). The influence of the work environment on cardiovascular health: A historical, conceptual, and methodological perspective. *Journal of Occupational Health Psychology, 1,* 42–56.

Kauppinen, K., & Kandolin, I. (1998). Gender and working in the European Union. Dublin: European Foundation for the Improvement of Living and Working Conditions.

Kawakami, N., & Haratani, T. (1999). Epidemiology of job stress and health in Japan: Review of current evidence and future direction. *Industrial Health, 37(2),* 174-186.

Kawakami, N., Araki, S., Takatsuka, N., Shimizu, H., & Ishibashi, H. (1999). Overtime, psychosocial working conditions, and occurrence of non-insulin dependent diabetes mellitus in Japanese men. *Journal of Epidemiology & Community Health, 53(6),* 359-63.

Kegeles, S.M., Coates, T., Christopher, A., & Lazarus, J. (1989). Perceptions of Aids: The continuing saga of Aids-related stigma. *Aids, 3 (1),* 253-258.

Kelloway, E.K., & Barling, J. (1991). Job characteristics, role stress and mental health. *Journal of Occupational Psychology, 64,* 291-304.

Khuder, S.A., Peshimam, A.Z., & Agraharam, S. (2002). Environmental risk factors for rheumatoid arthritis. *Reviews on Environmental Health, 17(4),* 307-315.

Kieselbach, T., Armgarth, E., Bagnara, S., Elo, A., Jefferys, S., Joling, C., Kuhn, K., Nielsen, K., Popma, P., Rogovsky, N., Sahler, B., Thomson, G., Triomphe, C.E., & Widerszal-Bazyl, M. (2009). *Health in Restructuring: Innovative Approaches and Policy Recommendations*. Mering: Rainer Hampp Verlag.

King, P.M. (1995). The psychosocial work environment: Implications for workplace safety and health. *Professional Safety, 40,* 36–39.

Kinnunen, U., & Mauno, S. (1998), Antecedents and outcomes of work-family conflict among employed women and men in Finland. *Human Relations, 51,* 157-77.

Kirkhorn, S., Greenlee, R.T., & Reeser, J.C. (2003). The epidemiology of agriculture-related osteoarthritis and its impact on occupational disability. *WMJ: State Medical Society of Wisconsin, 102(7),* 38—44.

Kivimäki, M., Head, J., Ferrie, J.E., Shipley, M.J., Vahtera, J., & Marmot, M.G. (2003). Sickness absence as a global measure of health: Evidence from mortality in the Whitehall II prospective cohort study. *British Medical Journal, 327(7411),* 364-368.

Kivimäki, M., Leino-Arjas, P., Luukkonen, R., Riihimäki, H., Vahtera, J., & Kirjonen, J. (2002). Work stress and risk of cardiovascular mortality: Pospective cohort study of industrial employees. *British Medical Journal, 325(7369),* 857.

Kivimäki, M., & Vahtera, J. (2008). Reducing sickness absence in occupational settings. *Occupational & Environmental Medicine, 65*, 219-220.

Kivimäki, M., Vahtera, J., Elovainio, M., Virtanen, M.,& Siegrist, J. (2007). Effort-reward imbalance, procedural injustice and relational injustice as psychosocial predictors of health: Complementary or redundant models? *Occupational & Environmental Medicine, 64 (10),* 659-665.

Kivimäki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Väänänen, A., & Vahtera J. (2006). Work stress in the aetiology of coronary heart disease – a meta-analysis. *Scandinavian Journal of Work Environment & Health, 32(6),* 431-442.

Knutsson, A. (1989). Shiftwork and coronary heart disease. *Scandinavian Journal of Social Medicine, Supplement, 44,* 1-36.

Knutsson, A., Akerstedt, T., & Jonsson, B. (1988). Prevalence of risk factors for coronary artery disease among day and shift workers. *Scandinavian Journal of Work Environment & Health, 14,* 317-321.

Kogi, K. (1997). Ergonomics and technology transfer into small and medium-sized enterprises. *Ergonomics, 40,* 1118-1129.

Kompier, M.A.J. (2006). New systems of work organization and workers' health. *Scandinavian Journal of Work Environment & Health, 32(6, special issue),* 421-430.

Kompier, M.A.J., & Marcelissen, F.H.G. (1990). *Handbook of Work Stress: A Systematic Approach for Organizational Practice*. Amsterdam: NIA.

Koningsveld, E.A.P., Zwinkels, W.S. Mossink, J.C.M., Thie, X.M., & Abspoel, M. (2003). Societal costs of working conditions (in Dutch). The Hague: Ministry of Social Affairs and Employment (no 324).

Kornitzer, M., deSmet, P., Sans, S., Dramaix, M., Boulenguez, C., DeBacker, G., Ferrario, M., Houtman, I., Isacsson, S-O., Ostergren, P-O., Peres, I., Pelfrene, E., Romon, M., Rosengren, A., Cesana, G., & Wilhelmsen, L. (2006). Job stress and major coronary events: Results from the job stress, absenteeism and coronary heart disease in Europe study. *European Journal of Cardiovascular Prevention & Rehabilitation, 13(5),* 695-704.

Koponen, H., Jokelainen, J., Keinänen-Kiukaanniemi, S., Kumpusalo, E., & Vanhala, M. (2008). Metabolic syndrome predisposes to depressive symptoms: A population-based 7-year follow-up study. *Journal of Clinical Psychiatry, 69(2),* 178-182.

Kopp, M.S., Stauder, A., Purebl, G., Janszky, I., & Skrabski, A. Work stress and mental health in a changing society. *European Journal of Public Health, 18(3),* 238-244.

Kortum, E. (2007). Work-related stress and psychosocial risks: Trends in developing and newly industrialized countries. *The Global Occupational Health Network Newsletter, special issue (July),* 3-6.

Koukoulaki, T. (2004). Stress prevention in Europe: Trade union activities. In S. Iavicoli (Ed.), *Stress at Work in Enlarging Europe*. Rome: National Institute for Occupational Safety and Prevention (ISPESL).

Kourinka, I., & Forcier, L. (1995). *Work Related Musculoskeletal Disorders (WMSDs): A Reference Book for Prevention*. London: Taylor & Francis.

Kouvonen, A., Kivimaki, M., Cox, S.J., Cox, T., & Vahtera, J. (2005). Relationship between work stress and body mass index among 45,810 female and male employees. *Psychosomatic Medicine, 67(4),* 577-583.

Kouvonen, A., Kivimaki, M., Elovainio, M., Pentti, J., Linna, A., Virtanen, M., & Vahtera, J. (2006). Effort-reward imbalance and sedentary lifestyle: An observational study in a large occupational cohort. *Occupational & Environmental Medicine, 63(6),* 422-427.

Krause, N., Lynch, J., Kaplan, G.A., Cohen, R.D., Goldberg, D.E., & Salonen, J.T. (1997). Predictors of disability retirement. *Scandinavian Journal of Work Environment & Health, 23,* 403-413.

Kristensen, T.S. (1996). Job stress and cardiovascular disease: A theoretic critical review. *Journal of Occupational Health Psychology, 1(3),* 246-260.

Kristensen, T.S., Borritz, M., Villadsen, E., & Christensen, K.B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work & Stress, 19(3),* 192-207.

Kristensen, T.S., Hannerz, H., Høgh, A., & Borg, V. (2005). The Copenhagen Psychosocial Questionnaire—a tool for the assessment and improvement of the psychosocial work environment. *Scandinavian Journal of Work Environment & Health, 31(6),* 438–449.

Kristensen, T.S., Kronitzer, M., & Alfedsson, L., (1998). Social factors, work, stress and cardiovascular disease prevention. Brussels: European Heart Network.

Kroes, W.H. (1976). *Society's Victim, the Policeman: An Analysis of Job Stress in Policing*. Thomas, Springfield.

Kryter, K.D. (1972). Non auditory effects of environmental noise. *American Journal of Public Health, 62,* 389-398.

Kumar, S. (2001). Theories of musculoskeletal injury causation. *Ergonomics, 42,* 14-47.

Kuoppala, J., Lamminpää, A., Liira, J., & Vainio, H. (2008). Leadership, job well-being, and health effects - A systematic review and a meta-analysis. *Journal of Occupational & Environmental Medicine, 50(8),* 904-915.

Kuper, H., & Marmot, M. (2003). Job strain, job demands, decision latitude, and risk of coronary heart disease within Whitehall II study. *Journal of Epidemiological & Community Health, 57,* 147-153.

Kuper, H., Marmot, M., & Hemingway, H. (2002). Systematic review of prospective cohort studies of psychosocial factors in the etiology and prognosis of coronary heart disease. *Seminars in Vascular Medicine, 2,* 267-314.

Kuper, H., Singh-Manoux, A., Siegrist, J., & Marmot, M. (2002a). When reciprocity fails: Effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. *Occupational & Environmental Medicine, 59 (11),* 777-784.

Kuper, H., Adami, H-O., Therorell, T., & Weiderpass, E. (2006). Psychosocial determinants of coronary heart disease in middle-aged women: A prospective study in Sweden. *American Journal of Epidemiology, 164,* 349-357.

Laaksonen, M., Martikainen, P., Rahkonen, O., & Lahelma, E. (2008). Explanations for gender differences in sickness absence: Evidence from middle-aged municipal employees from Finland. *Occupational & Environmental Medicine, 65,* 325-330.

Lallukka, T., Chandola, T., Roos, E., Cable, N., Sekine, M., Kagamimori, S., Tatsuse, T., Marmot, M., & Lahelma, E. (in press). Work-family conflicts and health behaviors among British, Finnish, and Japanese employees. *International Journal of Behavioural Medicine*.

LaMontagne, A.D., Keegel, T., Louie, A.M.L., Ostry, A., & Landsbergis, P.A. (2007). A systematic review of the job-stress intervention evaluation literature, 1995-2005. *International Journal of Occupational & Environmental Health, 13,* 268-280.

LaMontagne, A.D., Keegel, T., Vallance, D., Ostry, A., & Wolfe, R. (2008). Job strain — Attributable depression in a sample of working Australians: Assessing the contribution to health inequalities. *BMC Public Health, 8,* 181.

Landstrom, U., Holmberg, K., Kjellberg, A., Soderberg, L., Tesarz, M. (1995). Exposure time and its influence on noise annoyance at work. *Journal of Low Frequency Noise & Vibration, 14(4),* 173-180.

Landsbergis, P.A., Cahill, J., & Schnall, P. (1999). The impact of lean production and related new systems of work organization on worker health. *Journal of Occupational Health Psychology, 4(2),* 108-130.

Landsbergis, P.A., Schnall, P.L., Belkic, K.L., Baker, D., Schwartz, J., & Pickering, T.G. (2001). Work stressors and cardiovascular disease. *Work, 17,* 191-208.

Landy, F.J. (1989). *The Psychology of Work Behaviour*. Monterey, California: Brooks/Cole.

Landy, F.J. (1992). Work design and stress. In G.P. Keita & S.L. Sauter (Eds.), *Work and Well-Being: An Agenda for the 1990s*. Washington DC: American Psychological Association.

Leather, P., Brady, C., Lawrence, C., Beale, D. & Cox, T. (Eds.) (1999). *Work-related Violence: Assessment and Intervention*. London: Routledge.

Leather, P., Lawrence, C., Beale, D., Cox, T., & Dickson, R. (1998). Exposure to occupational violence and the buffering effects of intra-organizational support. *Work & Stress, 12(2),* 161-178.

Lehto, A.M., & Sutela, H. (1998). Finnish quality of worklife survey. Helsinki: Statistics Finland, 1998. Labour market, as cited in M. Nurminen & A. Karjalainen (2001). Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. *Scandinavian Journal of Work Environment & Health, 27(3),* 161-213.

Leigh, J., & Miller, T. (1998). Job-related diseases and occupations within a large workers' compensation data set. *American Journal of Industrial Medicine, 33,* 197-211.

Leigh, J. Markowitz, S. Fahs, M. Shin, C., & Landrigan, P. (1997). Occupational injury and illness in the United States: Estimates of costs, morbidity, and mortality. *Archives of Internal Medicine, 157,* 1557-1568.

Leiter, M.P., & Harvie, P.L. (1996). Burnout among mental health workers: A review and a research agenda. *International Journal of Social Psychiatry, 42(2),* 90-101.

Leka, S., & Cox, T., (2008). *The European Framework for Psychosocial Risk Management*. Nottingham: I-WHO publications.

Leka, S., Hassard, J., Jain, A., Makrinov, N., Cox, T., Kortum, E., Ertel, M., Hallsten, L., Iavicoli, S., Lindstrom, K., & Zwetsloot, G. (2008). *Towards the development of a psychosocial risk management framework*. SALTSA report. Nottingham: I-WHO publications.

Leka, S., Griffiths, A., & Cox, T. (2003). *Work Organization and Stress*. Geneva: World Health Organization.

Levi, L. (1981). *Preventing Work Stress*. Reading, Mass: Addision-Wesley.

Levi, L. (1984). Stress in industry: Causes, effects and prevention. Occupational Safety and Health Series no. 51. Geneva: International Labour Organization.

Levi, L. (2002). Spice of life or kiss of death. In Working on Stress, Magazine of the European Agency of Safety and Health at Work No.5. Luxembourg: Office for Official Publications of the European Communities.

Li, J., & Jin, T.Y. (2007). Work stress and health - current research activities and implications in China. WHO Global Occupational Health Network (GOHNET) Newsletter, Special Issue, 25-28.

Li, J., Yang, W., & Cho, S.I. (2006). Gender differences in job strain, effort-reward imbalance, and health functioning among Chinese physicians. *Social Science & Medicine, 62 (5),* 1066-1077.

Lievense, A., Bierma-Zeinstra, S., Verhagen, A., Verhaar, J., & Koes, B. (2001). Influence of work on the development of osteoarthritis of the hip: A systematic review. *Journal of Rheumatology, 28(11),* 2520—2528.

Lin, J.D., Lee, T.N., Yen, C.F., Loh, C.H., Hsu, S.W., Wu, J.L., & Chu, C.M. (2009). Job strain and determinants in staff working in institutions for people with intellectual disabilities in Taiwan: A test of the Job Demand-Control-Support model. *Research in Developmental Disabilities, 30(1),* 146-57.

Lindstrom K., Elo A., Skogstad A., Dallner M., Gamberale F., Hottinen V., Knardahl S., & Orhede E. (2000). User's Guide for the QPS Nordic – General Nordic Questionnaire for Psychological and Social Factors at Work. Copenhagen: Nordic Council of Ministers.

Linn, M.W., Sandifer, R., & Stein, S. (1985). Effects of unemployment on mental and physical health. *American Journal of Public Health, 75,* 502-506.

Lloyd, C., King, R., & Chenoweth, L. (2002). Social work, stress and burnout: A review. *Journal of Mental Health, 11(3),* 255-265.

Lobban R.K., Husted, J., & Farewell, V.T. (1998). A comparison of the effect of job demand, decision latitude, role and supervisory style on self-reported job satisfaction. *Work & Stress, 12(4),* 337-350.

Lu, J.L. (2008). Occupational hazards and illnesses of Filipino women workers in export processing zones. *International Journal of Occupational Safety & Ergonomics, 14(3),* 333-342.

Lu, L., Chen, Y.C., & Hsu, C.H. (1994). Occupational stress and its correlates. IOSH, Taipei. Cited in Lu, L., Tseng, H. & Cooper, C.L. (1999). Managerial stress, job satisfaction and health in Taiwan. *Stress Medicine, 15*, 53-64.

Lund, T., Labriola, M., Christensen, K.B., Bültmann, U., & Villadsen, E. (2006). Physical work environment risk factors for long term sickness absence: Prospective findings among a cohort of 5357 employees in Denmark. *British Medical Journal, 332 (7539),* 449-52.

Lundberg, U., & Forsman, L. (1979). Adrenal medullary and adrenal cortical responses to understimulation and over stimulation: Comparison between type A and type B persons. *Biological Psychology, 9,* 79-89.

Lynch, J., Krause, N., Kaplan, G.A., Salonen, R., & Salonen, J.T. (1997a). Workplace demands, economic reward, and progression of carotid atherosclerosis. *Circulation, 96,* 302–307.

Lynch, J., Krause, N., Kaplan, G.A., Tuomilehto, J., & Salonen, J.T. (1997b). Workplace conditions, socioeconomic status, and the risk of mortality and acute myocardial infarction: The Kuopio Ischemic Heart Disease Risk Factor Study. *American Journal of Public Health, 87,* 617–622.

MacDonald, L.A., Karasek, R.A., Punnett, L., & Scharf, T. (2001). Covariation between workplace physical and psychosocial stressors: Evidence and implications for occupational health research and prevention. *Ergonomics, 44,* 696-718.

Macleod, J., Smith, G.D., Heslop, P., Metcalfe, C., Carroll, D. & Hart, C. (2001). Are the effects of psychosocial exposures attributable to confounding? Evidence from a prospective observational study on psychological stress and mortality. *Journal of Epidemiology & Community Health, 55(12),* 878-884.

Mann, S., & Holdsworth, L. (2003). The psychological impact of teleworking: Stress, emotions and health. *New Technology, Work & Employment, 18(3),* 196-211.

Marchand, A., Demers, A., & Durand, P. (2005). Does work really cause distress? The contribution of occupational structure and work organization to the experience of psychological distress. *Social Science & Medicine, 60,* 1-14.

Margolis, B.L., & Kroes, W.H. (1974). Work and the health of man. In J. O'Toole (Ed.) *Work and the Quality of Life*. Cambridge, Mass: MIT Press.

Margolis, B.L., Kroes, W.H., & Quinn, R.P. (1974). Job stress: an unlisted occupational hazard. *Journal of Occupational Medicine, 16,* 652-661.

Marmot, M., & Wilkinson, R.G. (Eds.) (2006). *Social Determinants of Health*. Oxford: Oxford University Press.

Marmot, M., Bosma, H., Hemingway, H., Brunner, E., & Stansfeld, S. (1997). Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *The Lancet, 350,* 235-239.

Marmot, M., Davey, S.G., Stansfeld, S., Patel, C., North, F., Head, J., White, I., Brunner, E.J., & Feeney, A. (1991). Health inequalities among British civil servants: The Whitehall II Study. *The Lancet, 337,* 1387–1393.

Marmot, M., Feeney, A., Shipley, M., North, F., & Syme, S.L. (1995). Sickness absency as a measure of health status and functioning from the UK Whitehall II study. *Journal of Epidemiology & Community Health, 49,* 124-130.

Maslach, C. (2001). What have we learned about burnout and health? *Psychology & Health, 16(5),* 607-611.

Maslach, C., & Jackson, S.E. (1981). The measurement of experienced burnout. *Journal of Occupational Behaviour, 2,* 99–113.

Maslach, C., Jackson, S.E., & Leiter, M.P. (1996). *Maslach Burnout Inventory manual (3rd ed.).* Palo Alto, CA: Consulting Psychologists Press.

Maslach, C., Schaufeli, W.B., & Leiter, M.P. (2001). Job burnout. *Annual Review of Psychology, 52,* 397-422.

Maurer, T. (2001). Career-relevant learning and development, worker age, and beliefs about self-efficacy for development. *Journal of Management, 27,* 123-140.

Mausner-Dorsch, H., & Eaton, W.E. (2000). Psychosocial work environment and depression: Epidemiologic assessment of the demand-control model. *American Journal of Public Health, 90(11),* 1765-2000.

Mayhew, C. (2003). Occupational violence: A neglected occupational safety and health issue? *Policy & Practice in Health & Safety, 1(1),* 31-58.

Mayhew, C., & Quinlan, M. (1999). The effects of outsourcing on occupational health and safety: A comparative study of factory-based workers and outworkers in the Australian clothing industry. *International Journal of Health Services, 29 (1),* 83-107.

McDonough, P. (2000). Job insecurity and health. *International Journal of Health Services, 30,* 453–476.

McDonough, P., & Amick, B.C. (2001). The social context of health selection: A longitudinal study of health and employment. *Social Science & Medicine, 53,* 135–145.

Meijman, T.F., Van Dormolen, M., Herber, R.F.M., Rongen, H., & Kuiper, S. (1995). Job stress, neuroendocrine activation, and immune status. In S.L. Sauter & L.R. Murphy (Eds.), *Organizational Risk Factors for Job Stress*. Washington, DC: APA.

Melamed S., Yekutieli D., Froom P., Kristal-Boneh E., & Ribak, J. (1999). Adverse work and environmental conditions predict occupational injuries-The Israeli Cardiovascular Occupational Risk Factors Determination in Israel (CORDIS) study. *American Journal of Epidemiology, 150(1),* 18-26.

Melchior, M., Caspi, A., Milne, B.J., Danese, A., Poulton, R., & Moffitt, T.E. (2007). Work stress precipitates depression and anxiety in young, working women and men. *Psychological Medicine, 37(8),* 1119–1129.

Messing, K. (1998). *One Eyed Science: Occupational Health and Women Workers*. Philadelphia: Temple University Press.

Michie, S. (2002). Causes and management of stress at work. *Occupational & Environmental Medicine, 59,* 67-72.

Middeldorp, C.M., Cath, D.C., & Boomsma, D.I. (2006). A twin-family study of the association between employment, burnout and anxious depression. *Journal of Affective Disorders, 90,* 163-169.

Mino, Y., Shigemi, J., Tsuda, T., Yasuda, N., & Bebbington, P. (1999). Perceived job stress and mental health in precision machine workers of Japan: A 2-year cohort study. *Occupational & Environmental Medicine, 56,* 41-45.

Molinie, A.F. (2003). Age and working conditions in the European Union. Dublin: European Foundation for the Improvement of Living and Working Conditions.

Monden, C.W. (2005). Changing social variations in self-assessed health in times of transition? The Baltic States 1994-1999. *European Journal of Public Health, 15(5),* 498-503.

Monk, T. H., & Tepas, D. (1985). Shift Work. In C.L. Cooper & M.J. Smith (Eds.), *Job Stress and Blue Collar Work*. Chichester: Wiley & Sons.

Moorehead, A., Steele, M., Alexander, M., Kerry, S., & Duffin, L. (1997). Changes at Work: The second Australian workplace industrial relations survey. Melbourne: Longman.

Mullarkey, S., Jackson, P.R., Wall, T.D., Wilson, J.R., & Grey-Taylor, S.M. (1997). The impact of technology characteristics and job control on worker mental health. *Journal of Organizational Behaviour, 18,* 471–489.

Muncer, S., Taylor, S., Green, D., & McManus, I. (2001). Nurses' representations of the perceived causes of work-related stress: A network drawing approach, *Work & Stress, 15(1),* 40-52.

Murphy, L.R., & Sauter, S.L. (2004). Work organization interventions: Stage of knowledge and future directions. *Social & Preventive Medicine, 49,* 79-86.

Murphy, G., & Athanasou, J. (1999). The effect of unemployment on mental health. *Journal of Occupational & Organizational Psychology, 72,* 83-99.

Murray, C.J.L., & Lopez, A. (1996). Global Health Statistics: A compendium of incidence, prevalence and mortality estimates for over 2000 conditions. Cambridge: Harvard School of Public Health.

Nabe-Nielsen, K., Tüchsen, F., Christensen, K.B., Garde, A.H., & Diderichsen, F. (2009). Differences between day and non day workers in exposure to physical and psychosocial work factors in the Danish eldercare sector. *Scandinavian Journal of Work Environment & Health, 35(1),* 48-55.

Nabi, H., Singh-Manoux, A., Shipley, M., Gimeno, D., Marmot, M.G., & Kivimaki, M. (2008). Do psychological factors affect inflammation and incident coronary heart disease: The Whitehall II Study. *Arteriosclerosis, Thrombosis & Vascular Biology, 28(7),* 1398-1406.

Neale, M.S., Singer, J., Schwartz, G.E., & Schwartz, J. (1983). Conflicting perspectives on stress reduction in occupational settings: A systems approach to their resolution. Report to NIOSH on P.O. No. 82-1058, Cincinnati, Ohio.

Netterstrøm, B. (1999) Denmark: self-rule on route 166. An intervention study among bus drivers. In M. Kompier & C. Cooper (Eds.) *Preventing Stress, Improving Productivity: European Case Studies in the Workplace*. London: Routledge.

Netterstrøm, B., Kristensen, T.S., & Sjøl, A. (2006). Psychological job demands increase the risk of ischaemic heart disease: A 14-year cohort study of employed Danish men. *European Journal of Cardiovascular Prevention & Rehabilitation, 13(3),* 414-420.

Netterstrøm, B., Conrad, N., Bech, P., Fink, P., Olsen, O., Rugulies, R., & Stansfeld, S. (2008). The relation between work-related psychosocial factors and the development of depression. *Epidemiologic Reviews, 30,* 118-132.

Ng, D.M., & Jeffery, R.W. (2003). Relationships between perceived stress and health behaviors in a sample of working adults. *Health Psychology, 22(6),* 638-642.

Niedhammer, I., Chastang, J.F., & David, S. (2008a). Importance of psychosocial work factors on general health outcomes in the national French SUMER survey. *Occupational Medicine, 58(1),* 15-24.

Niedhammer, I., Chastang, J.F., & David, S. (2008b). The contribution of occupational factors to social inequalities in health: findings from the national French SUMER survey. *Social Science & Medicine, 67(11),* 1870-81.

Niedhammer, I., Goldberg, M., Leclerc, A., Bugel, I., & David, S. (1998). Psychosocial factors at work and subsequent depressive symptoms in the Gazel cohort. *Scandinavian Journal of Work Environment & Health, 24,*197–205.

Niedhammer, I., Tek, M-Y., Starke, D., & Siegrist, J. (2004). Effort-reward imbalance model and self-reported health: Cross-sectional and prospective findings from the GAZEL cohort. *Social Science & Medicine, 58,* 1531-1541.

Nielsen, M.L., Rugulies, R., Smith-Hansen, L., Christensen, K.B., & Kristensen, T.S. (2006). Psychosocial work environment and registered absence from work: Estimating the etiologic fraction. *American Journal of Industrial Medicine, 49(3),* 187-96.

NIOSH (1999). Stress at work. Publication no. 99-101. Cincinnati: National Institute for Occupational Safety and Health.

NIOSH (2002). The changing organization of work and the safety and health of working people: Knowledge gaps and research directions. NIOSH (Vol. 2002-116): DHHS (NIOSH).

Nishiyama, K., & Johnson, J.V. (1997). Karoshi - death from overwork: Occupational health consequences of Japanese production management. *International Journal of Health Services, 27(4),* 625-641.

Norman, K., Floderus, B., Hagman, M., Toomingas, A., & Tornqvist, E.W. (2008). Musculoskeletal symptoms in relation to work exposures at call centre companies in Sweden. *Work, 30(2),* 201-214.

North, F.M., Syme, S.L., Feeney, A., Shipley, M., & Marmot, M. (1996). Psychosocial work environment and sickness absence among British civil servants: The Whitehall II study. *American Journal of Public Health, 86(3),* 332-340.

Nurminen, M., & Karjalainen, A. (2001). Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. *Scandinavian Journal of Work Environment & Health, 27(3),* 161-213.

O'Neill, D.H. (2000). Ergonomics in industrially developing countries: Does its application differ from that in industrially advanced countries? *Applied Ergonomics, 31,* 631-640.

Ortega, A., Høgh, A., Pejtersen, J.H., Feveile, H., & Olsen, O. (2009). Prevalence of workplace bullying and risk groups: A representative population study. *International Archives of Occupational & Environmental Health, 82(3),* 417-426.

Östergen, P-O., Hanson, B.S., Balogh, I., Ektor-Andersen, J., Isacsson, A., Örbaek, P., Winkel, J., & Isacsson, S-O. (2005). Incidence of shoulder and neck pain in a working population: Effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmö shoulder and neck cohort. *Journal of Epidemiological & Community Health, 59,* 721-728.

Östlin, P., Eckermann, E., Mishra, U.S., Nkowane, M., & Wallstam, E. (2006). Gender and health promotion: A multisectoral policy approach. *Health Promotion International, 21,* 21-35.

Ostry, A.S., Kelly, S., Demers, P.A., Mustard, C., & Hertzman, C. (2003). A comparison between the effort-reward imbalance and demand control models. *BMC Public Health, 27,* 3-10.

Oxenstierna, G., Ferrie, J., Hyde, M., Westerlund, H., & Theorell, T. (2005). Dual source support and control at work in relation to poor health. *Scandinavian Journal of Public Health, 33(6),* 455-463.

Parent-Thirion, A., Macías, E., Hurley, J., Vermeylen, Greet G. (2007). Fourth European Working Conditions Survey. European Foundation for the Improvement of Living and Working Conditions. Luxembourg: Office for Official Publications of the European Communities.

Park, S.G., Min, K.B., Chang, S.J., Kim, H.C., & Min, J.Y. (2009). Job stress and depressive symptoms among Korean employees: The effects of culture on work. *International Archives of Occupational & Environmental Health, 82(3),* 397-405.

Parkes, K., & Sparkes, T. (1998). Organizational interventions to reduce work stress: Are they effective? A review of the literature. Sudbury: HSE books.

Patten, S.B., Wang, J.L., Williams, J.V., Lavorato, D.H., Bulloch, A., & Eliasziw, M. (2009). Prospective evaluation of the effect of major depression on working status in a population sample. *Canadian Journal of Psychiatry, 54(12),* 841-855.

Pearse, R. (1977). *What Managers Think About Their Managerial Careers*. New York: AMACOM.

Pejtersen J.H., & Kristensen, T.S. (2009). The development of the psychosocial work environment in Denmark from 1997 to 2005. *Scandinavian Journal of Work Environment & Health, 35(4),* 284-93.

Pejtersen, J., Allermann, L., Kristensen, T.S., & Poulsen, O.M. (2006). Indoor climate, psychosocial work environment and symptoms in open-plan offices. *Indoor Air, 16(5),* 392-401.

Peter, R., & Siegrist, J. (2000). Psychosocial work environment and the risk of coronary heart disease. *International Archives of Occupational & Environmental Health, 73,* 41-45.

Peter, R., Alfredsson, L., Knutsson, A., Siegrist, J., & Westerholm, P. (1999). Does a stressful psychosocial work environment mediate the effects of shift work on cardiovascular risk factors? *Scandinavian Journal of Work Environment & Health, 25,* 376–381.

Peter, R., Siegrist, J., Hallqvist, J., Reuterwall, C., & Theorell, T. (2002). Psychosocial work environment and myocardial infarction: Improving risk estimation by combining two complementary job stress models in the SHEEP Study. *Journal of Epidemiology & Community Health, 56(4),* 294-300.

Peterson, C. (1999). *Stress at Work: A Sociological Perspective*. Amityville: Baywood.

Peterson, U., Demerouti, E., Bergström, G., Samuelsson, M., Asberg, M., & Nygren, A. (2008). Burnout and physical and mental health among Swedish healthcare workers. *Journal of Advanced Nursing, 62(1),* 84-95.

Pikhart, H., Bobak, M., Siegrist, J., Pajak, A., Rywik, S., Kyshegyi, J., Gostautas, A., Skodova, Z., & Marmot, M. (2001). Psychosocial work characteristics and self rated health in four post-communist countries. *Epidemiology & Community Health, 55(9),* 624-630.

Pilkington, A. Mulholland, R. Cowie, H. Graham, M., & Hutchinson, P. (2001). Baseline measures for the evaluation of the work-related stress campaign. Health & Safety Executive research report no. CRR 322. Sudbury: HSE Books.

Pines, A.M., & Aronson, E. (1988). *Career Burnout Causes and Cures*. New York: Free Press.

Pollard T.M. (1997). Physiological consequences of everyday psychosocial stress *Collegium Antropologicum, 21(1),* 17-28.

Porter, L.W. (1990). Commitment patterns in industrial organizations. Paper presented at the Society for Industrial and Organizational psychology, Miami Beach, Florida (April, 1990).

Price, R.H., & Hooijberg, R. (1992). Organizational exit pressures and role stress: Impact on mental health. *Journal of Organizational Behavior, 13,* 641–651.

Prüss-Üstün, A., & Corvalán, C. (2006). Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease. Geneva: World Health Organization.

Quick, J.D., Quick, J.C., & Horn, R.S. (1986). Health consequences of stress. *Journal of Organizational Behavior Management, 8,* 19–36.

Quinlan, M. (2004). Workers' compensation and the challenges posed by changing patterns of work. *Policy & Practice in Safety & Health, 2(1),* 25-52.

Quinlan, M., Mayhew, C., & Bohle, P. (2001). The global expansion of precarious employment, work disorganization, and consequences for occupational health: A review of recent research. *International Journal of Health Services, 31(2),* 335-414.

Radi, S., Ostry, A., & Lamontagne, A.D. (2007). Job stress and other working conditions: Relationships with smoking behaviors in a representative sample of working Australians. *American Journal of Industrial Medicine, 50(8),* 584-596.

Raikkonen, K., Lassila, R., Keltikangas-Jarvinen, L., & Hautanen, A. (1996). Association of chronic stress with plasminogen activator inhibitor-1 in healthy middle-aged men. *Arteriosclerosis, Thrombosis & Vascular Biology,* 363-367.

Räikkönen, K., Matthews, K.A., & Kuller, L.H. (2007). Depressive symptoms and stressful life events predict metabolic syndrome among middle-aged women: A comparison of World Health Organization, Adult Treatment Panel III, and International Diabetes Foundation definitions. *Diabetes Care, 30(4),* 872-877.
Ramirez, A.J., Graham, J., Richards, M.A., Cull, A., & Gregory, W.M. (1996). Mental health of hospital consultants: The effects of stress and satisfaction at work. *The Lancet, 347,* 724-728.

Randall, R., Griffiths, A., Cox, T., & Welsh, C. (2002). The activation of mechanisms linking judgments of work design and management with musculoskeletal pain. *Ergonomics, 45,* 13-31.

Raphael, B. (1991). Psychiatric aspects of preventative intervention with victims of violence. In D. Chappell, P. Grabosky & H. Strang (Eds.), *Australian Violence: Contemporary Perspectives*. Canberra: Australian Institute of Criminology.

Rhoades, L., & Eisenberger, R. (2002). Perceived organizational support: A review of the literature. *Journal of Applied Psychology, 87(4),* 698-714.

Richman, J., Rospenda, K., Nawyn, S., Flatherty, J., Fendrich, M., Drum, M., & Johnson, T. (1999). Sexual harassment and generalised workplace abuse among university employees: Prevalence and mental health correlates. *American Journal of Public Health, 89,* 358-363.

Rick, J., Briner, R., Daniels, K., Perryman, S., & Guppy, A. (2001). A critical review of psychosocial hazard measures. Health & Safety Executive research report no. CRR 356. Sudbury: HSE Books.

Rippon, T. (2000). Aggression and violence in health care professions. *Journal of Advanced Nursing, 31,* 452-460.

Robertson, I.T., & Cooper, C.L. (1983). *Human Behaviour in Organizations*. London: MacDonald and Evans Ltd.

Rodrigueza, E., Frongillob, E.A., & Chandrac, P. (2001). Do social programmes contribute to mental well-being? The long-term impact of unemployment on depression in the United States. *International Journal of Epidemiology, 30,* 163-170.

Rosengren, A., Hawken, S., Ôunpuu, S., Sliwa, K., Zubaid, M., Almahmeed, W.A., Blackett, K.N., Sitthiamorn, C., Sato, H., & Yusuf, S. (2004). Association of psychosocial risk factors with risk of acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the INTERHEART study): Case-control study. *The Lancet, 364,* 953–962.

Rossignol, M., Leclerc, A., Hilliquin, P., Allaert, F.A., Rozenberg, S., Valat, J.P., Avouac, B., Coste, P., Savarieau, B., & Fautrel, B. (2003). Primary osteoarthritis and occupations: A national cross sectional survey of 10 412 symptomatic patients. *Occupational & Environmental Medicine, 60(11),* 882-886.

Rugulies, R., & Krause, N. (2005). Job strain, iso-strain, and the incidence of low back and neck injuries. A 7.5-year prospective study of San Francisco transit operators. *Social Science & Medicine, 61(1),* 27-39.

Rugulies, R., & Krause, N. (2008). Effort-reward imbalance and incidence of low back and neck injuries in San Francisco transit operators. *Occupational & Environmental Medicine, 65 (8),* 525-533.

Rugulies, R., Norborg, M., Sørensen, T.S., Knudsen, L.E., & Burr, H. (2009). Effort-reward imbalance at work and risk of sleep disturbances: Cross-sectional and prospective results from the Danish Work Environment Cohort Study. *Journal of Psychosomatic Research, 66(1),* 75-83.

Rugulies, R., Aust, B., Burr, H., & Bültmann, U. (2008). Job insecurity, chances on the labour market and decline in self-rated health in a representative sample of the Danish workforce. *Journal of Epidemiology & Community Health, 62(3),* 245-50.

Rugulies, R., Bültmann, U., Aust, B., & Burr, H. (2006). Psychosocial work environment and incidence of severe depressive symptoms: Prospective findings from a 5-year follow-up of the Danish work environment cohort study. *American Journal of Epidemiology, 163(10),* 877-87

Russek, H.I., & Zohman, B.L. (1958). Relative significance of heredity, diet and occupational stress in CHD of young adults. American Journal of Medical Sciences, 235, 266-275.

Rutenfranz, J., Haider, M., & Koller, M. (1985) Occupational health measures for night workers and shift workers. In S. Folkard & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling*. Chichester: Wiley & Sons.

Rutenfranz, J., Colquhoun, W.P., Knauth, P., & Ghata, J.N. (1977). Biomedical and psychosocial aspects of shift work: A review. *Scandinavian Journal of Work Environment & Health, 3,* 165-182.

Rydstedt, L.W., Johansson, G., & Evans, G.W. (1998). A longitudinal study of workload, health and well-being among male and female urban bus drivers. *Journal of Occupational & Organizational Psychology, 71*, 35–45.

Saito, I., Iso, H., Kokubo, Y., Inoue, M., & Tsugane, S. (2009). Metabolic syndrome and all-cause and cardiovascular disease mortality: Japan Public Health Center-based Prospective (JPHC) Study. *Circulation Journal, 73(5),* 878-884.

Salavecz, G., Chandola, T., Pikhart, H., Dragano, N., Siegrist, J., Jöckel, K.H., Erbel, R., Pajak, A., Malyutina, S., Kubinova, R., Marmot, M., Bobak, M., & Kopp, M. (2010). Work stress and health in Western European and post-communist countries: An East-West comparison study. *Journal of Epidemiology & Community Health, 64(1),* 57-62.

Sauter, S.L., & Murphy, L.R. (1995). *Organizational Risk Factors for Job Stress*. Washington, DC: APA.

Sauter, S.L., Hurrell, J.J., & Cooper, C.L. (1989). *Job Control & Worker Health*. Chichester: Wiley & sons.

Sauter, S.L., Murphy, L.R., & Hurrell, J.J. (1992). Prevention of work related psychological disorders: A national strategy proposed by the National Institute for Occupational Safety and Health. In G.P. Keita & S.L. Sauter (Eds.), *Work and Well-Being: An Agenda for the 1990s*. Washington, DC: APA.

Sauter, S.L., Hurrell, J.J., Jr., Murphy, L.R., & Levi, L. (1998). Psychosocial and organizational factors. In J.M. Stellman (Ed.) *Encyclopaedia of Occupational Health and Safety (Fourth Ed.)*, 34.2-34.6. Geneva: International Labour Organization.

Sauter, S.L., Brightwell, W.S., Colligan, M.J., Hurrell, J.J., Katz, T.M., LeGrande, D. E., Lessin, N., Lippin, R.A., Lipscomb, J.A., & Murphy, L.R. (2002). The changing organization of work and the safety and health of working people: Knowledge gaps and research directions. NIOSH (Vol. 2002-116): DHHS (NIOSH).

Schaufeli, W.B., & Enzmann, D. (1998). *The Burnout Companion to Study and Practice: A Critical Analysis*. London: Taylor and Francis.

Schaufeli, W.B., & Greenglass, E.R. (2001). Introduction to special issue on burnout and health. *Psychology and Health, 16,* 501-510.

Schaufeli, W.B., & Taris, T.W. (2005). The conceptualization and measurement of burnout: Common ground and worlds apart. *Work & Stress, 19(3),* 256-262.

Schnall, P., Landsbergis, P., & Baker, D. (1994). Job strain and CVD. *Annual Review of Public Health, 15,* 381–411.

Schnall, P., Schwartz, J., Landbergis, P., Warren, K., & Pickering, T., (1998). A longitudinal study of job strain and ambulatory blood pressure: Results from a 3-year follow-up. *Psychosomatic Medicine, 60,* 697-706.

Schnall, P. L., Belkic, K., Landsbergis, P., & Baker, D. (Eds.). (2000). The workplace and cardiovascular disease. *Occupational Medicine: State of the Art Reviews, 15(1),* 1–319.

Schneider, K., Swan, S., & Fitzgerald, L. (1997). Job-related and psychological effects of sexual harassment in the workplace: Empirical evidence from two organisations. *Journal of Applied Psychology, 82*, 401-414.

Schriber, J.B., & Gutek, B.A. (1987). Some time dimensions of work: Measurement of an underlying aspect of organizational culture. *Journal of Applied Psychology, 7,* 624-650.

Schrijvers, C., van de Mheen, D., Stronks, K., & Mackenbach, J. (1998). Socioeconomic inequalities in health in the working population: The contribution of working conditions. *International Journal of Epidemiology, 27,* 1011–1018.

Schultz, A.B., & Edington, D.W. (2007). Employee health and presenteeism: A systematic review. *Journal of Occupational Rehabilitation, 17(3),* 547-579.

Scutella, R. & Wooden, M. (2008). The effects of household joblessness on mental health. *Social Science & Medicine, 67(1),* 88-100.

Selye, H. (1936). A syndrome produced by diverse nocuous agents. *Nature, 138,* 32.

Selye, H. (1976). *Stress in Health and Disease*. Boston: Butterworths.

Shields, M.A., & Price, S.W. (2003). The labour market outcomes and psychological well-being of ethnic minority migrants in Britain. UK, Home Office. Retrieved November 3rd, 2003 from National Coalition of Anti-Deportation Campaigns.

Shields, M. (2006). Stress and depression in the employed population. *Health Reports, 17(4),* 11-29.

Shields, M. (1999). Long working hours and health. *Health Reports, 11(2),* 33-48.

Shields, M. (2002). Shift work and health. *Health Reports, 13(4),* 11-33.

Shirom, A. (2005). Reflections on the study of burnout. *Work & Stress, 19(3),* 263-270.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of Occupational Health Psychology, 1,* 27–41.

Siegrist, J. (2009). Job control and reward: Effects on well being. In S. Cartwright & C.L. Cooper (Eds.), *The Oxford Handbook of Organizational Well-being*. Oxford: Oxford University Press.

Siegrist, J., Peter, R., Georg, W., Cremer, P., & Seidel, D. (1991). Psychosocial and bio-behavioral characteristics of hypertensive men with elevated atherogenic lipids. *Atherosclerosis, 86,* 211–218.

Siegrist, J., Peter, R., Junge, A., Cremer, P., & Siedel, D. (1990). Low status control, high effort at work and ischemic heart disease: Prospective evidence from blue-collar men. *Social Science & Medicine, 31(10),* 1127-1134.

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., & Peter, R. (2004). The measurement of effort-reward imbalance at work: European comparisons. *Social Science & Medicine, 58(8),* 1483-99.

Siegrist, J., & Rödel, A. (2006). Work stress and health risk behaviour. *Scandinavian Journal of Work Environment & Health, 32 (6),* 473-481.

Sim, J., Lacey, R. J., & Lewis, M. (2006). The impact of workplace risk factors on the occurrence of neck and upper limb pain: A general population study. *BMC Public Health online access*.

Simmons, L.A., & Swanberg, J.E. (2009). Psychosocial work environment and depressive symptoms among US workers: Comparing working poor and working non-poor. *Social Psychiatry & Psychiatry Epidemiology, 44(8),* 628-635.

Smith, M.J., Hurrell, J.J., & Murphy, R.K. (1981). Stress and health effects in paced and unpaced work. In G. Salvendy & M.J. Smith (Eds.), *Pacing and Occupational Stress*. London: Taylor and Francis.

Smith, A. (1991). A review of the non auditory effects of noise on health. *Work & Stress, 5,* 49-62.

Smith, M.J. (1985). Machine-paced work and stress. In C.L. Cooper & M.J. Smith (Eds.), *Job Stress and Blue Collar Work*. Chichester: Wiley & sons.

Smith, A., Johal, S., Wadsworth, E., Smith, G., & Peters, T. (2000). The scale of occupational stress: The Bristol stress and health at work study. Health & Safety Executive research report no. CRR 265. Sudbury: HSE Books.

Sobeih, T., Salem, S., Genaidy, A., Daraiseh, N., & Shell, R. (2006). Psychosocial factors and musculoskeletal disorders in the construction industry: A systematic review. *Theoretical Issues in Ergonomics Science, 7(3),* 329-344.

Sparks, K., Cooper, C., Fried, Y., & Shirom, A. (1997). The effects of hours of work on health: A meta-analytic review. *Journal of Occupational & Organizational Psychology, 70,* 391-408.

Sparks, K., Faragher, B., & Cooper, C.L. (2001). Well-being and occupational health in the 21st century workplace. *Journal of Occupational & Organizational Psychology, 74,* 489-509.

Spielberger, C., & Vagg, R (1991). Professional manual for the job stress survey. Tampa, Fl: Center for Research in Behavioural Medicine & Health Psychology, University of Southern Florida.

Spurgeon, A., & Harrington, J.M. (1989). Work performance and health of junior hospital doctors - a review of the literature. *Work & Stress, 3,* 117-128.

Spurgeon, A., Harrington, J.M., & Cooper, C.L. (1997). Health and safety problems associated with long working hours: A review of the current position. *Occupational & Environmental Medicine, 54(6),* 367-375.

Stainbrook, G.L., & Green, L.W. (1983). Role of psychosocial stress in cardiovascular disease. Houston Heart Bulletin, 3, 1-8.

Standing, H., & Nicolini, D. (1997). Review of work-related violence. Health & Safety Executive Contract Research Report 143/1997. Sudbury: HSE Books.

Stansfeld, S., & Candy, B. (2006). Psychosocial work environment and mental health - a meta-analytic review. *Scandinavian Journal of Work Environment & Health, 32, (6),* 443-462.

Stansfeld, S., Head, J., & Marmot, M. (2000). Work related factors and ill health: The Whitehall II study. Health & Safety Executive research report no. CRR 266. Sudbury: HSE Books.

Stansfeld, S.A., Bosma, H., Hemingway, H., & Marmot, M.G. (1998). Psychosocial work characteristics and social support as predictors of SF-36 health functioning: The Whitehall II study. *Psychosomatic Medicine, 60,* 247–255.

Stansfeld, S.A., Fuhrer, R., Shipley, M.J., & Marmot, M. G. (1999). Work characteristics predict psychiatric disorder: Prospective results from the Whitehall II study. *Occupational & Environmental Medicine, 56,* 302–307.

Stansfeld, S.A., North, F.M., White, I., & Marmot, M.G. (1995). Work characteristics and psychiatric disorder in civil servants in London. *Journal of Epidemiology & Community Health, 49,* 48-53.

Stansfeld, S.A., Rael, E.G., Head, J., Shipley, M., & Marmot, M. (1997). Social support and psychiatric sickness absence: A prospective study of British civil servants. *Psychological Medicine, 27(1),* 35-48.

Stewart, R. (1976). *Contrasts in Management*. New York: McGraw-Hill.

Strike P.C., & Steptoe, A. (2004). Psychosocial factors in the development of coronary artery disease. *Progress in Cardiovascular Disease, 46(4),* 337-347.

Sullivan, T., Kerr, M., & Ibrahim, S (1998). Workplace stress: Taking it to heart. *Occupational Health & Safety Canada, 14(6),* 24-25.

Sundin, L., Bildt, C., Lisspers, J., Hochwälder, J., & Setterlind, S. (2006). Organisational factors, individual characteristics and social support: What determines the level of social support? *Work, 27(1),* 45-55.

Sutherland, V.J., & Cooper, C.L. (2000). *Strategic Stress Management: An Organizational Approach*. New York: Palgrave.
Suzuki, S., Ohida, T., Kaneita, Y., Yokoyama, E., Miyake, T., Harano, S., Yagi, Y., Ibuka, E., Kaneko, A., Tsutsumi, T., & Uchiyama, M. (2004). Mental health status, shift work, and occupational accidents among hospital nurses in Japan. *Journal of Occupational Health, 46,* 448-454.

Sverke, M., Hellgren, J., & Näswall, K. (2002). No security: A meta-analysis and review of job insecurity and its consequences. *Journal of Occupational Health Psychology, 7(3),* 242-264.

Syme, S.L. (1997). Community participation, empowerment, and health: Development of a wellness guide for California. Wellness Lecture Series, California Wellness Foundation & University of California.

Szabo, S., Maull, E.A., & Pirie, J. (1983). Occupational stress: Understanding, recognition and prevention. *Experientia, 39,* 1057-1180.

Sznelwar, L., Mascia, F., Zilbovicius, M., & Arbix, G. (1999). Ergonomics and work organization: The relationship between tayloristic design and workers' health in banks and credit cards companies. *International Journal of Occupational & Safety Ergonomics, 5 (2),* 291-301.

Tabanelli, M.C., Depolo, M., Cooke, R.M.T., Sarchielli, G., Bonfiglioli, R., Mattioli, S., & Violante, F.S. (2008). Available instruments for measurement of psychosocial factors in the work environment. *Journal International Archives of Occupational & Environmental Health, 82(1),* 1-12.

Tenkanen, L., Sjoblom, T., Kalimo, R., Alikoski, T., & Harma, M., (1997). Shift work, occupation and coronary heart disease over 6 years of follow-up in the Helsinki heart study. *Scandinavian Journal of Work Environment & Health, 23,* 257-265.

Tennant, C. (2000). Work stress and coronary heart disease. *Journal of Cardiovascular Risk, 7(4),* 273-276.

Tennant, C. (2001). Work-related stress and depressive disorders. *Journal of Psychosomatic Research, 51,* 697–704.

Terry, D.J., & Jimmieson, N.L (1999). Work control and employee well-being: A decade review. In C.L. Cooper & I. Robertson (Eds.), *International Review of Industrial and Organizational Psychology (Vol. 14).* Chichester: American Ethnological Press.

Theorell, T. (1998). Measuring psychosocial factors in working life. Working Life Research and Development News, Newsletter no 5. Stockholm: National Institute for Working Life.

Theorell, T., & Hasselhorn, H.M. (2005). On cross-sectional questionnaire studies of relationships between psychosocial conditions at work and health—are they reliable? *International Archives of Occupational & Environmental Health, 78,* 517–522.

Theorell, T., Oxenstierna, G., Westerlund, H., Ferrie, J., Hagberg, J., & Alfredsson, L. (2003). Downsizing of staff is associated with lowered medically certified sick leave in female employees. *Occupational & Environmental Medicine, 60(9),* E9 (electronic paper).

Theorell, T., Tsutsumi, A., Hallquist, J., Reuterwall, C., Hogstedt, C., Fredlund, P. Emlund, N., Johnson, J., & the SHEEP study group (1998). Decision latitude, job strain, and myocardial infarction: A study of working men in Stockholm. *American Journal of Public Health, 88(3),* 382-388.

Thomas, C., Hertzman, C., & Power, C. (2009). Night work, long working hours, psychosocial work stress and cortisol secretion in mid-life: Evidence from a British birth cohort. *Occupational & Environmental Medicine, 66(12),* 824-31.

Townsend, P., & Davidson, N. (1982). *Inequalities in Health: The Black Report*. Middlesex: Penguin.

Tsutsumi, A., & Kawakami, N. (2004). A review of empirical studies on the model of effort–reward imbalance at work: Reducing occupational stress by implementing a new theory. *Social Science & Medicine, 59(11),* 2335-2359.

Tsutsumi, A., Kayaba, K., Yoshimura, M., Sawada, M., Ishikawa, S., Sakai, K., Gotoh, T., Nago, N., & the Jichi Medical School Cohort Study Group (2003). Association between job characteristics and health behaviours in Japanese rural workers. *International Journal of Behavioural Medicine, 10(2),* 125–142.

Umehara, K., Ohya, Y., Kawakami, N., Tsutsumi, A., & Fujimura, M. (2007). Association of work-related factors with psychosocial job stressors and psychosomatic symptoms among Japanese paediatricians. *Journal of Occupational Health, 49(6),* 467-81.

Vahtera, J., Kivimäki, M., & Pentti, J. (1997). Effect of organisational downsizing on health of employees. *The Lancet, 350,* 1124–1128.

Vahtera, J., Pentti, J., & Kivimäki, M. (2004). Sickness absence as a predictor of mortality among male and female employees. *Journal of Epidemiology & Community Health, 58(4),* 321–326.

van den Berg, T.I.J., Elders, L.A.M., de Zwart, B.C.H., & Burdorf, A. (2009). The effects of work-related and individual factors on the Work Ability Index: A systematic review. *Occupational & Environmental Medicine, 66,* 211-220.

van der Doef, M. P., & Maes, S. (1999). The job demand control (-support) model and psychological well-being: A review of 20 years of empirical research. *Work & Stress, 13,* 87–114.

van der Hulst, M. (2003). Long work-hours and health. *Scandinavian Journal of Work Environment & Health, 29(3),* 171-188.

van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. B. (2005). Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies. *Social Science & Medicine, 60(5),* 1117-1131.

van Waarden, F., den Hertog, J., Vinke, H., & Wilthagen, T. (1997). Prospects for safe and sound jobs: The impact of future trends on costs and benefits of occupational health and safety. Dutch Ministry of Social Affairs and Employment and The Netherlands School for Social and Economic Policy Research.

Vecchio, R.P. (1995). It's not easy being green: Jealousy and envy in the workplace. *Research in Personnel & Human Resources Management, 13*, 201–244.

Vermeulen, M., & Mustard, C. (2000). Gender differences in job strain, social support at work, and psychological distress. *Journal of Occupational Health Psychology, 5(4),* 428-440.

Virtanen, M., Ferrie, J.E., Gimeno, D., Vahtera, J., Elovainio, M., Singh-Manoux, A., Marmot, M.G., & Kivimäki, M. (2009). Long working hours and sleep disturbances: The Whitehall II prospective cohort study. *Sleep, 32(6),* 737-45.

Virtanen, M., Kivimäki, M., Joensuu, M., Virtanen, P., Elovainio, M., & Vahtera, J. (2005). Temporary employment and health: A review. *International Journal of Epidemiology, 34,* 610-622.

Virtanen, M., Vahtera, J., Pentti, J., Honkonen, T., Elovainio, M., & Kivimäki, M. (2007). Job strain and psychologic distress influence on sickness absence among Finnish employees. *American Journal of Preventative Medicine, 33(3),* 182-187.

Virtanen, P., Vahtera, J., Kivimäki, M., Pentti, J., & Ferrie, J. (2002). Employment security and health. *Journal of Epidemiology & Community Health, 56*, 569-574.

Visser, M.R.M., Smets, E.M.A, Oort, F.J., & de Haes, C.J.M. (2003). Stress, satisfaction and burnout among Dutch medical specialists, *Canadian Medical Association Journal, 168(3),* 271-275.

Viswesvaran C., Sanchez, J.I., & Fisher, J. (1999). The role of social support in the process of work stress: A meta-analysis. *Journal of Vocational Behaviour, 54(2),* 314-334.

Wallhagen, M.I., Strawbridge, W.J., Cohen, R.D., & Kaplan G.A. (1997). An increasing prevalence of hearing impairment and associated risk factors over three decades of the Alameda County Study. *American Journal of Public Health, 87(3),* 440- 442.

Wang, J. (2005). Work stress as a risk factor for major depressive episode(s). *Psychological Medicine, 35,* 865-871.

Wang, J., Lesage, A., Schmitz, N., & Drapeau, A. (2008). The relationship between work stress and mental disorders in men and women: Findings from a population-based study. *Journal of Epidemiology & Community Health, 62(1),* 42-47.

Wang, J., Schmitz, N., Dewa, C., & Stansfeld, S. (2009). Changes in perceived job strain and the risk of major depression: results from a population-based longitudinal study. *American Journal of Epidemiology, 169(9),* 1085-1091.

Wardell, W.I., Hyman, M., & Bahnson, C.B. (1964). Stress and coronary heart disease in three field studies. *Journal of Chronic Diseases, 17,* 73-84.

Warr, P.B. (1992). Job features and excessive stress. In R. Jenkins & N. Coney (Eds.), *Prevention of Mental Ill Health at Work*. London: HMSO.

Warren, N. (2001). Work stress and musculoskeletal disorder etiology: The relative roles of psychosocial and physical risk factors. *Work, 17,* 221-234.

Waters, T.R., Dick, R.B., Davis-Barkley, J., & Krieg, E.F. (2007). A cross-sectional study of risk factors for musculoskeletal symptoms in the workplace using data from the General Social Survey (GSS). *Journal of Occupational & Environmental Medicine, 49(2),* 172-184.

Weber, A., & Jaekel-Reinhard, A. (2000). Burnout syndrome: A disease of modern societies? *Occupational Medicine, 50,* 512-517.

Wemme, K.M., & Rosvall, M. (2005). Work related and non-work related stress in relation to low leisure time physical activity in a Swedish population. *Journal of Epidemiology & Community Health, 59(5),* 377–379.

Westerlund, H., Theorell, T., & Alfredsson, L. (2004). Organizational instability and cardiovascular risk factors in white-collar employees: An analysis of correlates of structural instability of workplace organization on risk factors for coronary heart disease in a sample of 3,904 white collar employees in the Stockholm region. *European Journal of Public Health, 14(1),* 37-42.

WHO (2002). World Health Report 2002 - Reducing risks, promoting healthy life. Geneva: World Health Organization.

WHO (2003). Authored by S. Leka, A. Griffiths, & T. Cox, Work Organization and Stress. Protecting Workers' Health Series, No. 3. Geneva: World Health Organization.

WHO (2005). Mental health: Facing the challenges, building solutions. Copenhagen: World Health Organization.

WHO (2007a). Authored by I. Houtman, A., K. Jettinghoff, & L. Cedillo, Raising awareness of stress at work in developing countries : A modern hazard in a traditional working environment: advice to employers and worker representatives. Protecting Workers' Health Series, No. 6. Geneva: World Health Organization.

WHO (2007b). International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD 10). Geneva: World Health Organization.

Wieclaw, J., Agerbo, E., Mortenesen, P.B., Burr, H., Tuchsen, F., & Bonde, J.P. (2008). Psychosocial working conditions and the risk of depression and anxiety disorders in the Danish workforce. *BMC Public Health online access*.

Wilkins, K., & Beaudet, M.P. (1998). Work stress and health. *Health Reports, 10(3),* 47-62.

Yang, H., Schnall, P.L., Jauregui, M., Su, T.C., & Baker, D. (2006). Work hours and self-reported hypertension among working people in California. *Hypertension, 48 (4),* 744-750.

Yeh, W-Y., Cheng, Y., & Chen, C.J. (2009). Social patterns of pay systems and their associations with psychosocial job characteristics and burnout among paid employees in Taiwan. *Social Science & Medicine, 68(8),* 1407-1415.

Ylipää, V., Arnetz, B.B., & Preber, H. (1999). Predictors of good general health, well being and musculosceletal disorders in Swedish dental hygienists. *Acta Odontologica Scandinavica, 57(5),* 277-282.

Yu, S., Gu, G., Zhou, W., & Wang, S. (2008). Psychosocial work environment and well-being: A cross-sectional study at a thermal power plant in China. *Journal of Occupational Health, 50(2),* 155-162.

Zahm, S.H. (2000). Women at work. In M.B. Goldman & M.C. Hatch (Eds.), *Women and Health*. San Diego, CA: Academic Press.

Health Impact of Psychosocial Hazards at Work: An Overview

The working environment and the nature of work itself are both important influences on health. In recent decades significant changes, closely linked to the organisation and management of work, have taken place in the world of work. These have resulted in emerging risks and new challenges in the field of occupational health and safety. Psychosocial risks at the workplace have been identified as significant emerging risks. Linked to psychosocial risks, issues such as work-related stress and workplace violence are widely recognised as major challenges to occupational health and safety.

Overall this report provides comprehensive evidence on the impact of psychosocial hazards on a number of health outcomes. Extrapolation of the health impact of psychosocial risks may not be possible on a global basis, due to the lack of data. However, cross sectional studies have been conducted in different countries and such data support the available evidence base from developed countries. In addition, the nature of psychosocial hazards (being many different ones and affecting health either through the experience of work-related stress or through their interaction with physical hazards at the work environment) makes it difficult to extrapolate their impact in a comprehensive manner for each health outcome. However, the data presented in this report has shown evidence that this is possible in certain cases, such as that of heart diseases and musculoskeletal disorders. It is therefore recommended that further work is devoted in this area and that this report is used as a first step in this process.

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