From the Department of Public Health Science
Division of Intervention and Implementation Research
Karolinska Institutet, Stockholm, Sweden

HEALTHY WORKPLACES

Factors of importance for employee health and organizational production

Malin Lohela Karlsson

Karolinska Institutet

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ABSTRACT

The overall aim of the thesis was to investigate one aspect of healthy workplaces; namely, how psychosocial work factors affect employees' general health and organizational production.

The aim of Study I was to identify psychosocial factors at work that promote positive changes in employee health and factors that prevent negative changes in employee health. Specifically, we wanted to see if certain changes in the work environment would have a positive or negative impact on changes in the general health of the employee. The results showed that if employees' perception of leadership and social climate improved, their health would also improve. A decrease in employees' perception of leadership, organizational commitment and experiencing job strain were related to a decrease in their health.

The aim of Study II was to investigate whether there is a relationship between psychosocial work environment factors and production loss, and if a potential relationship is mediated by employee health. Organizational commitment, social climate, job demands, job control and role compatibility were directly or indirectly related to production loss through employee health.

The aim of Study III was to further develop a work capacity index including both qualitative and quantitative aspects of the ability to perform at work by including factors in the psychosocial work environment. A further aim was to evaluate the effects of a workplace intervention by estimating the change in the work capacity index. The results showed that the intervention had an effect in terms of more employees who were healthy and healthier employees, measured as improvement in the work capacity index, among the companies that worked actively with the intervention. The company that put less effort into the method did not have the same positive effect as the others did.

Improvements in employee health and decreased production loss are related to improvements in psychosocial work factors. A good work environment contributes to improved employee health, which in turn affects organizational production. Creating a healthy workplace is not achieved by a single intervention. Instead, it is a process that needs to be maintained and constantly preserved. This focus must be part of the organizational culture, structure and climate. The results of the research done here, as well as of previous research, suggest that a healthy workplace is not only of value to companies, but also to the people who work for those companies.

Keywords: healthy organizations, healthy workplaces, psychosocial work factors, health-related quality of life, employee health, production loss, workplace health promotion, intervention study, longitudinal design

SAMMANFATTNING

Det övergripande syftet med avhandlingen var att undersöka en aspekt av friska arbetsplatser; hur psykosociala arbetsmiljöfaktorer är relaterat till anställdas hälsa samt organisationers produktion.

Syftet med den första studien var att identifiera de faktorer i den psykosociala arbetsmiljön som bidar till förbättrad hälsa hos de anställda samt de som förhindrar en försämrad hälsa hos de anställda. Framförallt var syftet att undersöka om förändringar i olika arbetsmiljöfaktorer var relaterade till positiva eller negativa förändringar i de anställdas hälsa. Resultatet visade att de anställda som upplevde en förbättring av ledarskapet på arbetsplatsen samt ett förbättrat socialt klimat hade en ökad chans för bättre hälsa. De som upplevde en försämring av ledarskapet, minskat engagemang i organisationen och hade skattat spänt arbete vid båda mättillfällena hade ökad risk för sämre hälsa.

I den andra delstudien var syftet att undersöka om det fanns ett samband mellan psykosociala arbetsmiljöfaktorer och produktionsbortfall, samt om detta samband medierades av anställdas hälsa. De anställdas engagemang i organisationen, samt upplevelser av det sociala klimatet, arbetets krav och kontroll samt rollförenlighet var direkt eller indirekt relaterade till produktionsbortfall via deras hälsa.

Syftet med den tredje delstudien var att vidareutvecklades ett befintligt arbetskraftindex, vilket inkluderar både kvalitativa och kvantitativa aspekter på förmågan att arbeta, till att även innefatta faktorer i den psykosociala arbetsmiljön. Denna modell användes sedan i syfte att utvärdera en arbetsplats intervention genom att mäta förändringarna i arbetskraftindexet. Resultatet visade att interventionen hade en positiv effekt på de anställda hos de företag som arbetade aktivt med metoden. Fler anställda blev friska, dvs ökade sin arbetsförmåga, samt de anställda som tidigare uppskattats som friska ökade sin arbetsförmåga ytterligare. Det företag som inte la ner lika mycket tid på interventionen fick inte samma positiva effekt som de andra företagen.

Förbättringar i anställdas hälsa och ett minskat produktionsbortfall har ett samband med förbättringar i den psykosociala arbetsmiljön. En bra arbetsmiljö och ett högt engagemang i organsiationen bidrar till förbättrad hälsa, vilket i sin tur leder till ett minskat produktionsbortfall. För att skapa en frisk arbetsplats behövs upprepade interventioner och kontinuitet. Detta bör vara en del av den kultur, struktur och det klimat som finns på arbetsplatsen. Resultaten i denna avhandling visar på att en frisk arbetsplats inte bara är av värde för företagen, utan även för de som arbetar där.

Nyckelord: Friska organisationer, friska arbetsplatser, psykosociala arbetsmiljöfaktorer, hälsorelaterad livskvalitet, anställdas hälsa, produktionsbortfall, hälsopromotion på arbetsplatsen, interventions studie, longitudinell design

Det är visserligen berömvärt att hjälpa de
sjuka att bli friska, men lika berömvärt är
att hjälpa de friska att bevara sin hälsa.

Hippokrates (400 f Kr)

LIST OF PUBLICATIONS

I. Lohela M, Björklund C, Hagberg J, Vingård E, Jensen I. Does a change in psychosocial work factors lead to a change in employee health? *Journal of Occupational and Environmental Medicine.* 2009;51:195-203.

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III. Lohela Karlsson M. Evaluation of a change in employees' work ability. *Submitted 2009.*

CONTENTS

LIST OF ABBREVIATIONS

AHA	Swedish abbreviation for Work and Health in Process and Engineering Industries (*Arbete och Hälsa*)
DEA	Data Envelopment Analysis
EQ-5D	EuroQol questionnaire for measuring HRQL
EU	European Union
HRM	Human resource management
HRQL	Health-related quality of life
OHS	Occupational health services
PATH	Practices for the Achievement of Total Health
QPS	Questionnaire for Psychological and Social factors at work
SF-12	Short Form 12; Questionnaire for measuring HRQL
TTO	Time trade-off
WHO	World Health Organization
WHP	Workplace health promotion

1 INTRODUCTION

The changing nature of work, with reorganization, increased work load, technical development and insecure employment, is suggested to cause deteriorating health among employees. People fall ill, decrease their work performance and motivation, become more dissatisfied, or change jobs. These are not only consequences that affect the employees; they also affect the companies as well as society. Today, we know that people are both affected by their work environment [1-4] and affect the work environment themselves [5]. Earlier focus was on the physical work environment, but since 1978 the concept of work environment has changed to also include psychosocial work factors. According to the Swedish law of work environment, companies should develop the work environment to fit people's physical and psychological conditions [6]. The purpose of work environment improvements is not only to reduce risks, but to create an environment that contributes to employees' well-being, job satisfaction and development, as well as organizational productivity.

For decades, productivity and efficiency improvements have been the goal when changes have been made in organizations and to working conditions. Already in the late 1890s Scientific Management was introduced, a task-oriented optimization of work that implied less control for workers and a standard method for performing a job. Wages were used as motivational incentives to increase performance [7]. Then in the 1920s Human Relations arose, based on the Hawthorne studies. In contrast to Scientific Management, Human Relations took into consideration the social part of work in an attempt to improve company effectiveness [8]. More recently developed theories discuss healthy workplaces, workplaces that contribute to employee health as well as organizational effectiveness. The framework of healthy organizations (organizational health) involves evaluating how individuals and organizational factors interact to determine individual well-being and organizational performance [9].

The problem of poor working conditions and how to improve employee health is not only a topic related to Swedish conditions. Research within this field is done around the world and large international organizations, such as WHO, have pointed out the importance of improving the work environment for workers' health. The European Union (EU) has taken action for a common strategy on health and safety at work to prevent ill-health and promote health at workplaces [10], and has also established the European Network for Workplace Health Promotion [11]. The aim of the network is to identify examples of good practice of workplace health promotion. In doing this, the EU highlights the importance for member countries to work with these issues. If companies can support their employees in staying healthy and motivated, it is possible that they will increase company productivity through an increase in individual performance. In a study, O'Donnell [12] suggested that this could be done by investing in health-promotion programs on both organizational and individual levels. But do we know that companies can actually increase their production by investing in their employees? Which psychosocial work factors contribute to an improvement in employee health? Are psychosocial work factors and employee health related to organizational production? An attempt to answer these questions is made in this thesis.

2 THEORETICAL BACKGROUND

2.1 HEALTHY WORKPLACES

The ideas behind healthy organizations, also called healthy workplaces or occupational health, go back to the beginning of the twentieth century. Early researchers such as Argyris, McGregor, Schein, Mayo and Maslow have used different perspectives to look into how organizations can contribute to healthy, motivated and effective employees. A summary can be read in Jaffe [13], for example. Scientific management [7] is based on the assumption that people are driven by extrinsic rewards such as salary, promotion and status. Recent theories suggest that organizations that target people's needs can benefit from increased commitment and productivity [14]. A company that is economically successful will be able to attract people into its organization, organize and direct their efforts toward production, as well as create profit. If employees' full ability and potential are tapped into and nurtured, organizational effectiveness will improve [14, 15].

2.1.1 Definition of a healthy workplace

A general definition of a healthy organization is one that contributes to a healthy workforce and has financial success [9, 15]. Most research has focused on organizational effectiveness, measured as reaching profit, production, service and continuity goals. However, Jaffe [13] extended organizational effectiveness with another dimension: how organizations treat their employees and how effectiveness, health and well-being are connected. These aspects are included in his definition of healthy organizations. Thus, a healthy organization is not only economically successful but also contributes to healthy, motivated and satisfied employees [13]. It gives the employees well-designed and meaningful jobs, as well as opportunities for career and work-life enhancement [16]. It includes the structure of the organization and how reorganization can contribute to health and effectiveness [9]. Further, it also includes the work environment, leadership, culture and climate. The adherers to the theory of healthy organizations believe that it is possible to combine employee health with profits, whereas others believe that if resources are devoted to improving employee health then fewer resources will be available to contribute to company profit [17]. A healthy workplace is one with resources that can help employees handle job and life stressors [18]. Kelloway and Day [18] suggest that such a workplace has potential positive consequences not only on the individual level, but also on organizational and societal levels. It could affect the individual through psychological, physiological and behavioral indicators of health. The organization would be affected through increased performance, reduced turnover and customer satisfaction, as well as an improved reputation. On a societal level the healthy workplace could have an impact on health-care costs or government programs.

Kelloway and Day [19] also suggest that many organizations are struggling to define a healthy workplace, to assess the healthy and unhealthy aspects of their environment, and find out how to improve the quality of their workplace. In the assessment of a workplace a holistic approach to health must be held, which means that both physical

and psychological aspects of an individual's health should be considered. Also, several indicators of individual and organizational health must be considered, as well as those of society [19]. Questions raised are 1) whether the same characteristics affect employee well-being and organizational outcomes, 2) what the relationships are between employee health and organizational productivity, and 3) whether the factors that affect health and performance in one industry are the same in others [15].

As the concepts of healthy organization and healthy workplace are used interchangeably in the literature, the concept of healthy workplace will be used throughout this thesis.

2.1.2 Models of a healthy workplace

Even though healthy workplaces have been discussed in research, few attempts have been made to develop and empirically test models [16]. One attempt was made by Wilson et al. [16] (Figure 1), who used previous literature to identify the key domains of a healthy workplace.

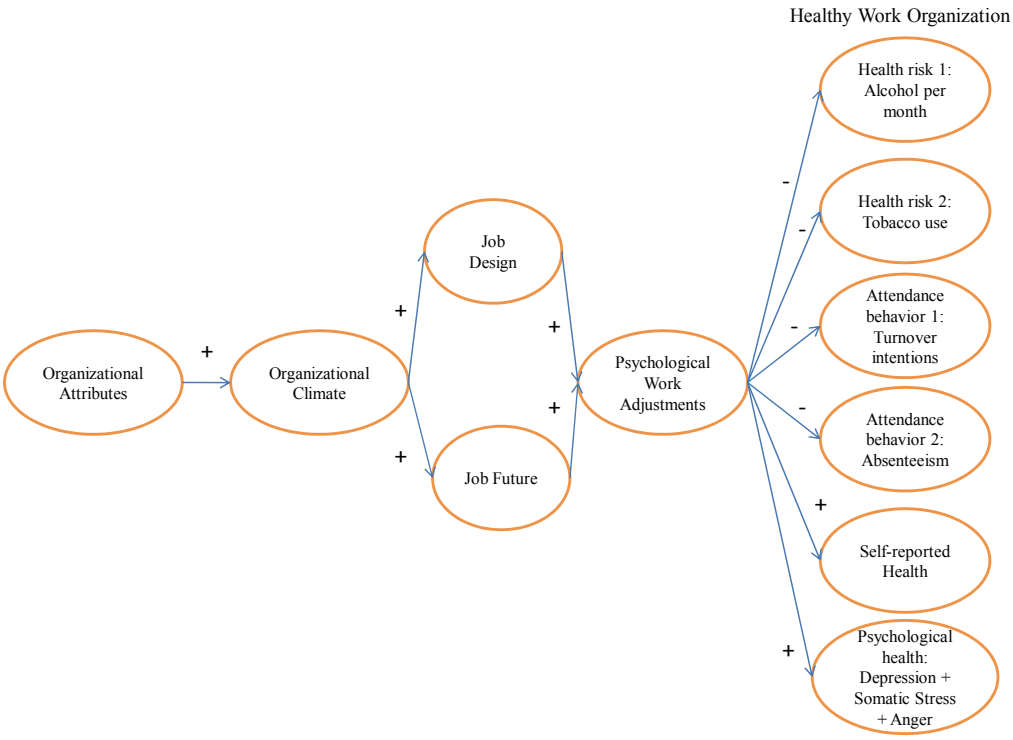

Figure 1. Model of healthy workplace as presented by Wilson et al. [16]

Three domains of work life highlighted in previous research were found: job design, organizational climate and job future. These domains included employees' perception of their work tasks, the social aspects of the work organization, job security and career development. The model also included leadership and organizational culture, employees' attitudes, perceived stress and several health and well-being measures. The

results of the study showed that work characteristics influenced worker attitudes and stress, which in turn affected health and well-being. Attitudes such as job satisfaction and commitment are important for employee performance [20, 21]. However, the model by Wilson et al. [16] only included turnover intentions and absenteeism as dimensions of organizational effectiveness. Neither performance, efficiency nor reduced performance was included.

The PATH (Practices for the Achievement of Total Health) Model was developed based on earlier research, and describes the link between organizational practice, employee well-being and organizational improvements [22]. It suggests that organizational improvements can be a result of a direct effect from workplace practices, or an indirect effect from workplace practices on organizational improvements through employee well-being.

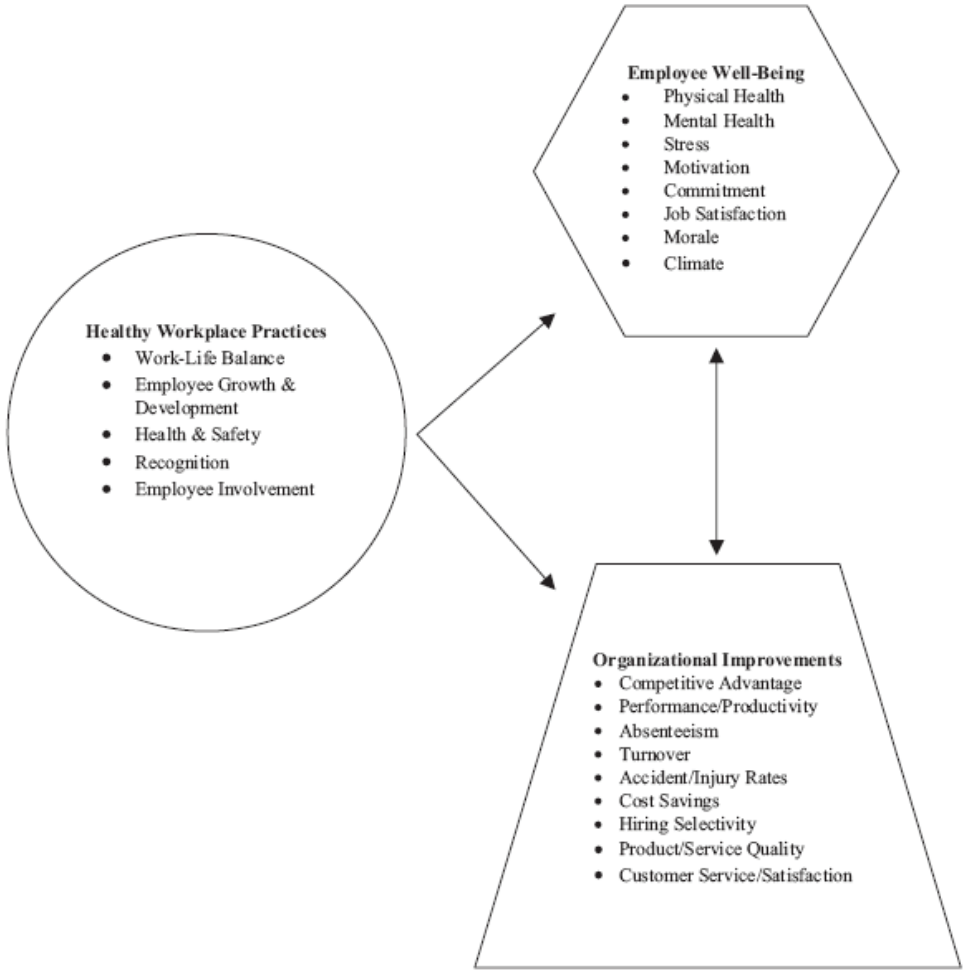

Figure 2. The PATH Model [22]

Creating a healthy workplace is an ongoing process and is achieved through interactions between the work environment and its individuals. The PATH model (Figure 2) is based on healthy workplaces and the assumption that organizations that contribute to employee health will be profitable and competitive on the market. The ability to create a healthy workforce requires an understanding of how health is affected

by the work environment, and how employee health contributes to organizational success [22]. However, this interrelationship has rarely been considered in the literature [22]. Sainford [15] found three studies that examined employee health and organizational health in the same study. In a study by Parker et al. [21], one aim was to perform a meta-analysis of studies investigating the relationship between psychosocial work environment, psychological well-being, motivation and performance. However, no studies were found that investigated the relationship. Lately, more studies have been performed that take into consideration both employee and organizational outcomes. However, more needs to be done to increase the knowledge of how workplace and employee health are related to organizational effectiveness.

To summarize, most research in the area of healthy organizations is done on the relationship between psychosocial work environment, employee attitudes and performance. Other aspects of healthy workplaces, such as the relationship between psychosocial work factors, health and production, need to be further developed. There is especially a need to investigate whether the same factors affect employee health and organizational production, and how psychosocial work factors and employee health are related to production. Criticism has been voiced about the lack of comprehensive and validated measures in the assessment of workplace factors and health outcomes [19]. If more comprehensive and validated questionnaires were used, with a longitudinal design, this could help organizations identify the factors that might be effective in their workplace [19]. These results could then be used in workplace health-promotion strategies to improve employee health as well as organizational effectiveness.

2.2 PSYCHOSOCIAL WORK ENVIRONMENT AND EMPLOYEE HEALTH

Previous research has shown that work environment can affect companies in terms of both decreased employee health and financial measures, and several factors that cause stress and ill health have been identified. These pertain to both an organizational as well as a task level. Stress can cause negative effects both for individuals working in an organization and for the organization itself. Its effect on health can lead to restricted work ability [23], which in turn has an important impact on the productivity of organizations as well as society. In the late 1990s sickness absence rates increased tremendously in Sweden, which to some part can be explained by a worsening of the psychosocial work environment [24]. For example, the Swedish Work Environment Authority reported that organizational and social factors were the second largest reason for work-related illness [25].

Psychosocial work conditions and their effect on employee well-being have received a great deal of attention over the years. The focus has been on different aspects of well-being, such as general health perceptions, physical and mental health, stress, worker attitudes, employee morale and motivation, suggesting that all are important in the understanding of employee well-being [22]. Different measures of well-being are related differently to job and organizational characteristics [26, 27]. A combination of job demand, social support, decision latitude [3, 28-30], and of high effort and low reward [3] have been

seen as risk factors for worker health and are probably the most investigated aspects. However, others aspects such as leadership, social climate and commitment have also been found to be of importance for the well-being of the employee [31-34]. The structures, culture and values in an organization can also contribute to health problems among the employees, and should therefore be taken into consideration [15]. In Sweden with its aging population, there is a need to maintain as well as increase the well-being of workers to enable work ability.

2.3 HEALTH AND PRODUCTION LOSS

Health research focusing on productivity was not common in the 1990s [35], but now several studies have investigated the impact of health on health-care expenditures, productivity loss or both. Most studies have been conducted in the US, which has a different culture and welfare system than Sweden does. From an organizational perspective, health-care costs might be irrelevant for Swedish companies in comparison to companies in the US. On the other hand, much of the research done on health and productivity is of importance for Swedish companies. Health status is suggested as one of the underlying factors in enhancing or maintaining productivity at workplaces [36, 37], as health is a factor that determines how many hours a person can work but also how productive a person can be. Productivity loss is commonly used in studies that evaluate the association between health risks, illnesses and productivity, and is normally measured as absenteeism and/or presenteesim, so-called reduced productivity on the job.

Several studies have shown a relationship between number of health risks and total productivity [38-40]. The more health risks there are, the more production will be reduced [38, 41-43]. Diagnoses [39] and employee well-being [42, 44, 45] are other important components related to production loss.

Sickness absence is often used as an indicator of productivity [37]. Increased productivity means that companies can produce the same amount of goods with fewer labor hours of input and therefore increase profit. A reduction in absenteeism reflects only one part of the gains in workplace productivity. Reduced performance due to health problems while at work has been found to be the largest component of production loss [38, 46, 47]. The cost of presenteeism is not always known to the employees; neither is the impact of presenteeism on employee health. In the long run, working while ill is related to an increased risk of coronary events [48], future ill health [49] and future sickness absence [50, 51].

2.4 PSYCHOSOCIAL WORK ENVIRONMENT AND PRODUCTION

Some of the factors in the work environment that affect employee well-being have also been shown to affect organizational outcomes such as performance and profit [15, 52, 53]. Nevertheless, the existence of a relationship between work factors and performance is undetermined [54]. Some studies have found a relationship [52, 53, 55-59] while others have not [59-61]. In a review from the year 2000 [54] it is suggested that work environment does

influence performance, but this only holds for people with certain characteristics, or jobs with specific characteristics or with combinations of certain characteristics. In another study, an attempt has been made to explain a nonlinear relationship between stressors and performance. However, no optimal level between stressors and performance was found [62]. Since the results are inconclusive, there might not be a direct relationship between these variables. There could instead be an indirect relationship, through employees' well-being, attitudes or motivation. Individuals' psychological climate and relationship to work attitudes, psychological well-being, motivation and performance were investigated in a meta-analysis [21]. The results show that work climate had a stronger relationship with worker attitudes than with performance, and the relationship between climate perceptions and performance was found to be mediated by employee attitudes [21].

Investigations of work conditions and performance are more common than those of the relationship between work conditions and production loss, which is measured as sickness absence and/or presenteeism. To date, most studies have concentrated on how health affects employee performance levels, and health has been suggested as the most important factor in explaining production loss [45]. However, few studies have been done within the field. Several psychosocial work factors have been found to be related to sickness absence [63-66] and to presenteeism [67-69]. Company characteristics, stress, job and employee characteristics are all significantly related to productivity loss [45]. However, the pattern of factors associated with sickness absence and presenteeism differs [69]. Absence is commonly seen as a result of poor health. Nevertheless, it can also be a coping strategy when dealing with demands at the workplace [70]. Just as some individual factors can lower productivity and increase organizational costs, unhealthy organizations can produce similar negative effects [71]. Therefore, it is important to take into account organizational factors when investigating factors that could affect presenteeism and absenteeism.

2.5 DOES THE PSYCHOSOCIAL WORK ENVIRONMENT AND EMPLOYEE HEALTH AFFECT ORGANIZATIONAL PRODUCTION?

A systematic literature review was performed to establish the research evidence of the relationship between the psychosocial work environment and employee health and its impact on organizational production [72]. Searches were conducted in Medline, PsycINFO, Web of Science and Econlit to identify original studies in a working population. By production, in this particular study, we were referring to productivity, performance and production loss. Production loss is often measured in terms of impaired performance at work due to health problems. The search included studies in English that have been published in scientific journals. Each database was searched up to 1 September 2009, without using a specific start date and using a combination of search terms (MeSH and keywords) from psychosocial factors at work, factors related to employee health and organizational outcomes. A total of 2,264 studies were identified in the search.

In the second phase, two of the authors scrutinized all the titles and abstracts to identify all relevant studies that fulfilled the inclusion criteria. The inclusion criteria were that the studies had to (a) include an investigation of the relationship of all three factors: psychosocial work factors, employee health, and production; (b) measure production directly or indirectly using production loss, performance or productivity regardless of how they had defined the concepts; (c) use production as the dependent variable; (d) include empirical studies involving working employees; (e) be published in peer-reviewed international scientific journals and (f) be written in English. Exclusion criteria were (a) studies measuring sick leave or presenteeism without analyzing this within the concept of production loss; (b) reviews; (c) editorials and (d) other types of published papers that only included theoretical development.

One hundred fifty-eight published studies of relevance were identified. These studies were then assessed independently by two reviewers. After the full-text reading of the remaining studies, 15 articles met the inclusion criteria and were included. In the final stage, published studies known to the authors were included. This resulted in two additional studies. A total of 17 studies were included in the review. Of these, nine articles examined the outcome of productivity loss or reduced production at work [46, 66, 68, 73-78], seven examined different aspects of performance [59, 61, 79-83], and one investigated organizational productivity [84]. One of the studies [79] investigating performance contained three different populations with separate analyses; these were evaluated separately. Three of the studies had a prospective design [46, 59, 74], and all the others were cross-sectional.

The studies included between 73 and 16,001 employees and contained data from hospital employees, home-care workers, computer users, workers from the construction, manufacturing and service industries, or included several trades in their study. Job demands and job control were the most common estimate of psychosocial work factors and were used in seven of the studies. Six studies were rated as having moderate quality and ten were rated as having weak quality. Two of the studies in Byrne and Hochwarter [79] were rated as moderate and one as weak. Few of the articles investigated the same psychosocial work factors and health outcomes with the different organizational outcomes.

The results revealed that there is limited evidence that psychosocial work factors and health are associated with production loss independent of the study population, and that the ways the different factors relate to production loss differ. There is limited evidence that both the psychosocial work environment and musculoskeletal pain syndromes affect production losses independently among a population with musculoskeletal disorders. The evidence is clearest in relation to the demand/control factors at work (job strain). For a population with non-specific health problems, there was no evidence of how work factors and health affect production loss due to the low number of studies. There is not enough evidence to show the mediating effect of health or other health problems.

Performance was measured in terms of self-rated or supervisor-rated performance. Evidence that both psychosocial work factors and health affect self-rated performance is limited. However, there are too few studies that have investigated this relationship to be able to draw any conclusions on the existing evidence of specific relationships, although there are a few studies with moderate and weak quality that point in the same direction. These studies indicate that there is limited evidence that emotional exhaustion does not mediate the relationship between social support and supervisor-rated performance; limited evidence that mental health does mediate the relationship between social support and self-rated performance; and limited evidence of mental health as a mediating factor between social support and objective performance. There is also limited evidence to indicate that support moderates the relationship between pain and self-rated performance.

It was not possible to draw any conclusions regarding evidence of a relationship between psychosocial work factors, health and productivity due to the limited number of studies.

Overall, this review was not able to demonstrate more than limited evidence of the impact of psychosocial work factors and employee health on organizational production, mainly due to the low number of published longitudinal studies. The current evidence points to demand/control at work and musculoskeletal pain as independent predictors of production loss. More high-quality, longitudinal studies are therefore needed. Only then will it be possible to draw strong evidence-based conclusions concerning a relationship between specific factors in the psychosocial work environment, employee health and organizational outcomes.

2.6 DEFINITION OF PSYCHOSOCIAL WORK FACTORS

The psychosocial work environment is the result of an interaction between the work organization and the individual. It is "those factors that are determined by work content, its organization and the social relationships at the workplace" [85]. It is also mentioned as the non-physical aspects of a workplace and includes, besides the organization and social relationships, management [86]. It has also been expressed as "the sociostructural range of opportunities that is available to an individual person to meet his or her needs of well-being, productivity, and positive self-experience" [87]. This concept incorporates how the individual is affected by the direct environment, but also how the individual affects the working environment him or herself. Several different concepts are used to describe factors related to the psychosocial work environment. In this thesis, psychosocial work factors are used as a concept. This concept is related to psychosocial work environment, but differs by also including organizational commitment.

2.7 DEFINITION OF HEALTH

Health is a concept with several dimensions that has been measured and defined in different ways. One of the most commonly used definitions of health is the one by

WHO: “a state of complete physical, mental and societal well-being, and not merely the absence of disease or infirmity” [88]. However, this definition has received a great deal of criticism as it is regarded as difficult to achieve. In a review of health and health promotion, Medin and Alexandersson [89] identified three main concepts of health: i) health as the absence of illness, ii) health as a resource and a strength, and iii) health as the state of being in balance. According to Nordenfelt, health is associated with the concept of ability and unhealthy/or disease with the concept of disability. A healthy person is considered to be someone who is able (to perform), while an unhealthy person is unable (to perform). However, the ability must be judged in relation to the different goals [90]. Thus, health exists in various degrees and therefore one cannot be described as being healthy or not healthy [91].

From a work perspective, Nordenfelt’s view of health as something that can exist in various degrees might be relevant. A person in good psychological health but with decreased physical function might be able to perform in the same manner as a person with good physical function, depending on the goals. This describes health from two different dimensions [92, 93]. First, there is the clinical judgment of health: ill or healthy. Second, there is the self-assessed health: good or bad health perception. This is described in Figure 3 below.

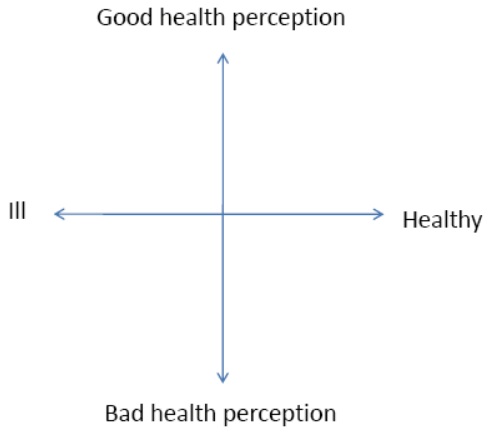

Figure 3. Health can have different dimensions. Health and illness describe the physical part of health, while health perception is the self-rated health [92, 93].

A combination of these dimensions expresses four different states of health in which the individual could, for example, be healthy and have a good health perception, or be healthy from a physical perspective but have a bad health perception. People often change between these health states over years, as health is not static. Workplace health promotion is one strategy that could be used in order to improve people’s health.

2.7.1 Health-related quality of life

Health-related quality of life (HRQL) is one of the most common measures of health used in studies, and has been found to be an independent predictor of mortality [94] and morbidity [95]. It is considered an inexpensive and convenient way to identify risk groups and risk factors [95], and is often used in workplace surveys. General health has been suggested to be the core of health [95] and captures several dimensions of health.

2.7.2 Work ability

Work ability has three main dimensions described in the literature: physical, psychological and social. The physical dimension describes work ability from a physical perspective; that people have the physical ability to work. The psychological dimension includes mental health, while the social dimension takes into consideration both social factors at the workplace and the home environment. An individual's ability to work is not only a result of his or her capacity, but also of the work itself. Work ability can therefore be seen as a result of the interaction between individual capabilities and the demands at the workplace [96]. In this aspect work ability is a measure of workers' ability to perform, which is a result of their work environment, attitude and health. This concept is closely related to Nordenfelt's definition of health.

2.8 DEFINITION OF ORGANIZATIONAL PRODUCTION

2.8.1 Production loss

Production loss, or productivity loss, is a measure of the reduction in employees' performance due to illness. Work productivity can be reduced due to health problems, causing a decrease in employees' performance, so-called presenteeism. Presenteeism refers to people who go to work despite illness [97, 98]. The existence of presenteeism is often due to individual reasons, but could also be the result of the culture of the organization or the organization of work [99]. A decrease in production could also be a result of people being unable to attend work due to health problems; this phenomenon is known as sick leave.

2.9 WORKPLACE HEALTH PROMOTION

Workplace health promotion (WHP) is a process that enables people to increase their control over factors that affect health [100], and could conduce decreases in sickness absence and increase productivity [101]. This demands participation from employees to succeed, but also demands that employees are allowed to participate and take control. The focus is on the promotion of health, but could in some cases also incorporate the prevention of risk factors for health. As WHP is a process, it is not done in a fast and easy manner [101]. There are several changes that can be performed within WHP such as organizational, leadership and work environment changes. This process must be part of the organization on all levels to be able to affect the health of the employees. In this type of measure, both the employers and the employees are responsible for the project's success. Health is affected by the surroundings and by people's conditions and their

actions. Thus, WHP must incorporate both the individual and his or her environment in order to be successful [13, 37, 71, 101].

WHP became common in the 1970s, when companies grew aware of interventions as effective means to promote employee well-being and healthy lifestyles and to reduce stress, sickness absence and health-related costs [102]. However, one of the most important instances in the development of WHP, as it is described today as activities to promote health and to some extent prevent ill health at workplaces, was the First International Conference on Health Promotion held by WHO in 1986. Participation and equality were highlighted as prerequisites for creating health in the Ottawa Charter for Health Promotion [100], which was formulated at this conference.

WHP has long focused on individual factors and on how to improve employee health without considering the organizational impact on employee health and organizational effectiveness [13]. Nevertheless, WHP can be seen as a part of a healthy workplace. To be successful, it should be performed on an organizational as well as an individual level [71, 103]. The goal of health promotion from an organizational perspective is to increase productivity and organizational commitment, as well as decrease absenteeism and turnover [71]. If properly designed, implemented and evaluated, health-promotion programs could be used as a business strategy [104]. However, investing in human capital is not always self-evident to employers, while investments in physical capital such as machines and buildings to improve capacity seldom are questioned. Investments in education to improve employees' effectiveness are a common activity for employers. If a person who has received competence development falls ill, this investment will not benefit the company in the same way as if the worker stays healthy. Investments in human capital are more often seen as a potential for companies to improve productivity. Improved psychosocial work environment and improved health have a positive impact on company effectiveness, demonstrated in several studies. A healthy worker has the ability to perform well, which in turn will affect company productivity [37]. If companies provide health-promotion activities, employees will not need to spend time or money to receive health benefits, which could be perceived as a gain for them. The employer will benefit by attracting and retaining better workers [36]. The health of an employee, i.e. the health capital, can be seen as general, which means that employees take this with them when they leave the company. This could make companies unwilling to pay for health-promotion programs. But health capital can also be seen as complementary for performance levels, and not only as general. From this perspective, a company may be more willing to invest in health promotion even though the investment will probably be lower than the requested level from a societal perspective [37].

A model of health promotion (Figure 4) was presented by O'Donnell [12], describing the relationship between health promotion, work organization, employee health, motivation and organizational productivity.

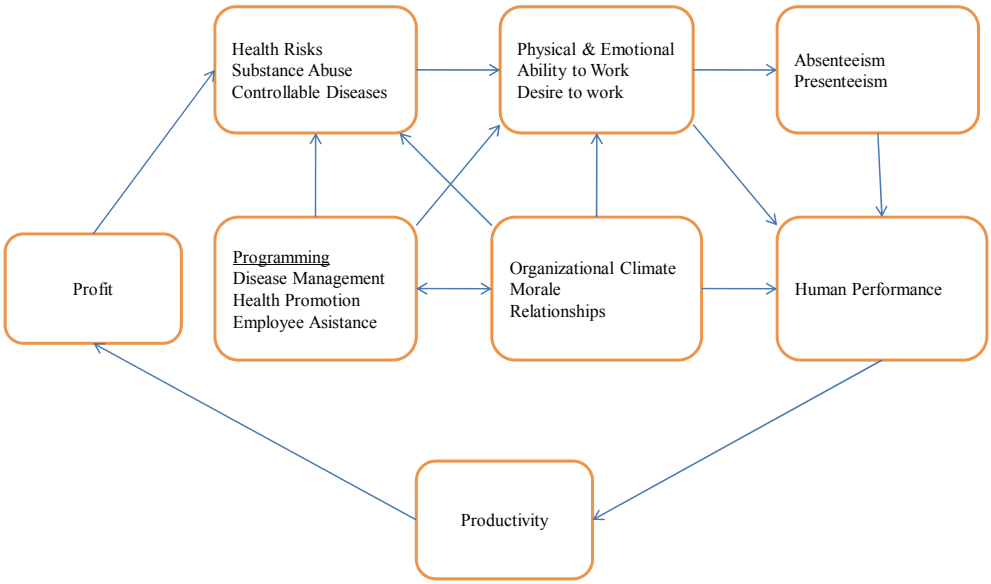

Figure 4. Mechanisms linking health, productivity and profit [12].

The basic idea is that people who are physically and emotionally able to work, and have a desire to work, have a higher performance than those who are lacking in these qualities. Higher levels of performance will lead to an increase in productivity, which in turn can yield higher profits for the company. Organizational climate and morale affect health, the ability to work, worker attitudes and their performance. Health-promotion programs play a central role in this model. These programs can improve organizational climate and reduce health risks. This in turn is related to the ability to work, as well as to absenteeism and presenteeism. O'Donnell's model highlights the complexity of WHP and the link to employee as well as organizational outcomes.

To gain deeper knowledge of healthy workplaces, several steps are needed. First, those factors that can contribute to an improvement in employees' health through using more comprehensive questionnaires and a longitudinal design need to be identified. Second, there is a need to identify the factors that affect organizational production, and investigate whether they have a direct or indirect effect on production. Finally, the existing research evidence of how work organization is related to employee well-being and organizational effectiveness must be identified. Healthy workplaces are created by improving employee health and organizational effectiveness, and it is important to evaluate the effects of a workplace health-promotion intervention to determine whether an improvement has been made.

3 AIMS

3.1 OVERALL AIM

The overall aim of the thesis was to investigate one aspect of healthy workplaces; namely, how psychosocial work factors affect employees' general health and organizational production.

3.2 SPECIFIC AIM

3.2.1 Study I

The aim of the study was to identify psychosocial factors at work that promote positive changes in employee health and factors that prevent negative changes in employee health. Specifically, we wanted to see if certain changes in the work environment would have a positive or negative impact on changes in the general health of the employee. Our hypotheses were:

H_A: A negative change in psychosocial work factors leads to a negative change in health.

H_B: A positive change in psychosocial work factors leads to a positive change in health.

3.2.2 Study II

The aim of this study was to investigate whether there is a relationship between psychosocial work environment factors and production loss, and if a potential relationship is mediated by employee health. We especially addressed the following questions:

1. Is there a relationship between employees' perception of psychosocial work factors at baseline and future production loss?
2. Does a change in the psychosocial work factors contribute to a change in production loss?
3. Does employee health mediate the relationship between psychosocial work factors and production loss?

3.2.3 Study III

The aim of this study was to further develop a work capacity index including both qualitative and quantitative aspects of the ability to perform at work by including factors in the psychosocial work environment. A further aim was to evaluate the effects of a workplace intervention by estimating the change in the work capacity index. The study addressed the following questions:

1. Are there any differences among the employees at different companies that are reflected in the work capacity index, i.e. an estimate of work ability?
2. Will a workplace intervention increase employees' ability to work, measured in terms of this work capacity index?

4 MATERIAL AND METHOD

4.1 THE AHA STUDY

Between 2000 and 2003 a large intervention study called the AHA study (abbreviation in Swedish for Work and Health in process and engineering industries) was conducted at four large companies in Sweden. This intervention included more than 4,200 employees. Companies 1 and 2 were paper mills, Company 3 a steelwork and Company 4 a truck manufacturer. The aim of the study was to reinforce and sustain a lasting state of health throughout working life by developing a model for the industry that renders a healthy workplace. This was to be achieved by implementing a model in which measures relating to health/ill health were included as a natural component in the organization of work throughout the company.

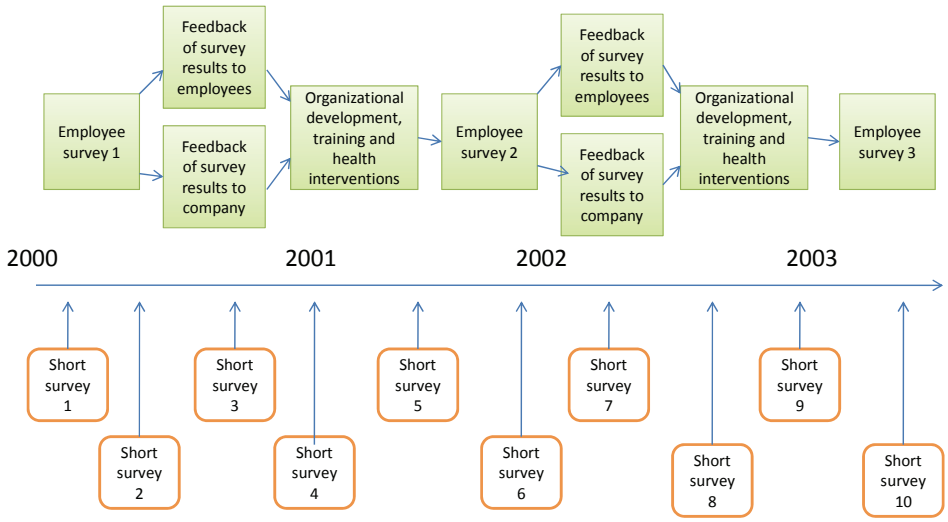

Figure 5. Flow-chart describing data collection and intervention in the AHA study

4.1.1 Design

The study is a multi-center study with a single subject method with repeated measurements [105]. All employees were invited to participate. Company A started the intervention during the first quarter of 2000, Company B in the second quarter, Company C in the third quarter and Company D in the fourth quarter. Two kinds of questionnaires were sent to the participants during the study period (Figure 5). A comprehensive questionnaire was distributed three times starting in the year 2000. The second assessment was completed after 18 months and the last one after 36 months. The response rates of the different measurements were 68 %, 65 % and 77 %. The comprehensive questionnaire included questions related to different psychosocial work factors, employee health, lifestyle, sick leave and presenteeism. The other questionnaire was a short one, administrated ten times during the 3½-year follow-up. The responses

to the questionnaires were anonymous for the employers, and were forwarded to the research team only. Participation was encouraged but voluntary, and written informed consent was obtained from each of the employees. Register data on sick leave were collected from the companies' payroll throughout the study period.

All participants were screened through the questionnaires. Feedback on the results was given to them individually based on the information obtained from the questionnaire. Employees with a health risk were offered an intervention through the occupational health services (OHS). A group intervention was also part of the method. It was based on active participation from both employees and management, and contained results on an aggregated level about workers' health, lifestyle and the psychosocial work environment. The feedback on the results was presented at work group level in conjunction with the performed assessment, and was done according to the survey feedback method. A more detailed description of the AHA study is presented elsewhere [106, 107].

A total of 4,238 employees received the questionnaire at the baseline measurement. Loss to follow-up was analyzed for the second comprehensive measurement, since this had the lowest response rate of the three measurements. This revealed that women (difference 4.7%), employees older than 50 years (difference 9%), and white-collar workers (difference 13.4%) were somewhat overrepresented among the respondents [108].

4.2 SAMPLE

4.2.1 Sample Study I

The study population consisted of 1,212 employees from all four companies (28.6% of the whole study population). All employees who completed the first and last comprehensive measurements, as well as the corresponding short questionnaires at the point in time of the comprehensive questionnaire, were included (n=1740). Employees who scored full health on both occasions were excluded from the analysis as there was no room for improvement (n=528).

The study population consisted of 85.6% men and 80.0 % blue-collar workers, with a mean age of 44.12 years (sd 9.8). Of the employees, 91.2 % had a high school degree or lower (Table 1).

4.2.2 Sample Study II

All employees who had responded to the first and second comprehensive measurements were included in this study; thus the study population consisted of 2,095 employees (49.4% of the total study population). The responses from the individuals were used in the analysis to estimate the relationship between psychosocial work factors and future production loss, for both sick leave and presenteeism. To estimate the change in future presenteeism, the questions about presenteeism from the second and third measurements were used. Of those who had responded to the first two

measurements, 1,899 employees (44.8% of the total population) had also answered the question about presenteeism at the last measurement. Data were available on 2,015 employees to be able to estimate a change in sick leave. Of the respondents in the study population 87 % were men and 23 % were white-collar workers, and the mean age was 43 years (sd 10.4) (Table 1).

4.2.3 Sample Study III

To evaluate a change in employees' work ability, data from the two paper mills and a steelwork were used. The study population consisted of all the employees who responded to all three comprehensive measurements, with no missing values in the included items. Of the population 15 % were women, with a mean age of 45 years (sd 9.3) (Table 1). A total of 1,040 persons (24.5% of the study population) were included. Employees at Company D were excluded from this study due to a lack of data in one of the included variables.

Table 1. Descriptive data on the AHA study population at baseline and the different samples used in Studies I, II and III. All are presented as percentwise distribution within the population.

		AHA baseline population	Study I	Study II	Study III
	n (% of the total population)	2894 (68.3)	1212 (28.6)	2095 (49.4)	1040 (24.5)
		%	%	%	%
Sex	Women	12.8	14.4	12.9	15.0
	Men	87.2	85.6	87.1	85.0
Educational level	Compulsory school	31.5	35.6	32.1	36.1
	High school	58.6	55.6	57.8	53.9
	University	8.3	8.1	8.5	8.8
	Postgraduate	1.6	0.7	1.5	1.3
Type of employment	Blue collar	78.4	80.0	77.3	75.3
	White collar	21.6	20.0	22.7	24.7
Age	18-34	29.6	19.1	25.2	15.4
	35-44	26.6	28.4	27.4	25.4
	45-54	28.7	36.6	32.2	41.1
	55-64	15.1	15.9	15.2	18.0
Mean age (sd)		41.93 (10.94)	44.12 (9.81)	42.85 (10.43)	45.55 (9.33)

4.3 MEASURES

4.3.1 Psychosocial work factors

In an attempt to assess psychological and social factors of significance in the workplace, a comprehensive and validated questionnaire called the QPS Nordic was developed by the Nordic Council of Ministers [109]. This questionnaire includes factors pertaining to the social and organizational level, task level and individual level (Table 2). All the included factors are related to employee health and well-being and are used to gather information about how employees perceive their work. The questionnaire contains several questions concerning the different factors, each with a five-point Likert scale ranging from "very seldom or never" to "very often or always", "very little or not at all" to "very much", or "completely disagree" to "completely agree".

Table 2. Content areas of the QPS Nordic questionnaire [110]

Social and organizational level	Task level	Individual level
Social interactions	Job demands	Commitment to organization
Leadership	Control at work	Mastery of work
Communication	Role expectations	Preference for challenge
Organizational culture and climate	Predictability at work	Predictability, individual
Group work		Work motives
		Work centrality
		Interactions between work and private life

Leadership is an overall index that, in this thesis, was constructed from the indices fair leadership, empowering leadership and social support from manager.

Several of these factors are included in the concept psychosocial work factors, which is used in this thesis.

4.3.2 Health-related quality of life

Different scales or instruments are used to capture HRQL, and some are more common than others. The short form 36 (SF-36) [111], its shorter version the SF-12 [112], and the Euroqol EQ-5D [113, 114] are all instruments that capture several dimensions of health and include a general health measure. In this thesis both the EQ-5D and SF-12 are used. The EQ-5D [113, 114] is a validated questionnaire used to measure HRQL. It consists of five items that ask people to rate their state of health. The five dimensions are mobility, self-care, usual activities, pain/discomfort and mood. The responses are no problems, some problems and severe problems. The SF-12 [112] is a validated and widely used measure of health, and contains 12 questions that cover both physical and mental health. In a study comparing the SF-12 and EQ-5D, neither instrument was found to be

better than the other when it came to practical viability, coverage or discrimination [115]. However, people were more likely to report full health on the EQ-5D than on similar items on the SF-12 [115].

4.3.3 Dependent variables

4.3.3.1 Study I

In this study employee health was measured with the EQ-5D [113, 114]. The items are weighted using the time trade-off (TTO) method [116] to yield a value between 0 and 1, where 1 means having full health and 0 is the worst possible health. The variable was divided into positive change in health, negative change in health, and no change in health. A positive change in health was estimated as in increase in health between the first and last comprehensive measurements. A negative change in health was estimated as a decrease in health between the same measurements, while no change in health indicated that there was no difference in health between the two measurements.

4.3.3.2 Study II

In this study the relationship between psychosocial work factors and production loss, as well as whether a potential relationship was mediated by employee health, was investigated. Two different measures were used as indicators of production loss: sick leave and presenteeism. Information on sick leave was collected from company registers from 2000 to 2003. Total sick leave the past 12 months for each individual at the time of the second and third measurements was used. The variable was divided into a binary variable with a cut-off <7 days or ≥7 days. Information on presenteeism was collected from the comprehensive questionnaires at the second and third measurements. The question answered by the employees was: *"How many times during the past 12 months have you been at work even though you, according to your health state, should have stayed at home?"*. The response options were *0 times, 1 time, 2-5 times* and *5 times or more*. This was also recoded to a binary variable with the cut-off *1 time or less* and *2 times or more*.

4.3.3.3 Study III

In this paper the efficiency of the AHA intervention was evaluated in regard to presenteeism, sick leave and total hours worked. Information on presenteeism and sick leave was collected in the same manner as in Study II. Total hours worked were collected from company registers, and contained information on total hours worked the past 12 months at the time of the second and third measurements.

4.3.4 Independent variables

4.3.4.1 Study I

Psychosocial work factors were collected using the QPS Nordic [117, 118]. Every item is part of an index, which creates an overall measure of different psychosocial work

factors. The indices are summed up to give a value between 0 and 100, where a higher value indicates a better perception of the work factor. Thirteen indices were included in this study: quantitative job demands, qualitative job demands, work pace, work decision, leadership, social climate, innovative climate, commitment to the organization, role compatibility, role ambiguity, social support from colleagues, mastery of work and job strain. The responses were collected at the comprehensive first and second measurements.

4.3.4.2 Study II

In this study several psychosocial work factors collected using the QPS Nordic were included as independent variables. The included indices were work demands, work control, leadership, social climate, innovative climate, commitment to the organization, role compatibility, role ambiguity, social support from colleagues and mastery of work. These were collected at the first and second measurements. Employee health was used as a mediating variable, measured using the SF-12 [112] at both the first and second measurements.

4.3.4.3 Study III

This study is based on two previous studies, and is an extension of a previously developed work capacity index consisting of employee health (EQ-5D) and total time available for work as input/independent variables. The purpose was to extend this index to also include psychosocial work factors. The included psychosocial work factors were chosen based on the results from Study II in this thesis. Role compatibility, work demands, work control, commitment to the organization and social climate were included as psychosocial work factors. The work factors were collected using the QPS Nordic at the first and second measurements. Employee health and total time available for work were also used as input variables. Employee health was measured using the EQ-5D. To capture a measure of the total time possible for employees to work, we included total hours available to work during the past 12 months. To eliminate any restrictions in the model due to number of work hours, the assumption was that it is possible to use the whole day (24 hours) for different kinds of activities.

4.4 STATISTICAL ANALYSIS

4.4.1 Study I

The statistical analysis was performed on individual level and in several steps. In the first step, uncertainty coefficient statistics were used to test the relationship between employee health and psychosocial work factors. Significant variables were then included in further analyses. In the next step a modified Poisson regression [119] was performed to find the factors in the psychosocial work environment that were of importance for a change in employee health. Two different regressions were performed, one with negative change in health as the dependent variable and one with positive change in health as the dependent variable. The independent variables were divided

into three categories: positive change, negative change and no change. A change was considered to be larger than six points on the scale from 0 to 100. The change in the variables was calculated as the difference between the scores at baseline and the scores at the 36-month follow-up. The independent variable job strain was treated as having or not having job strain at the different time points. The psychosocial work factors and the covariates were included in the regression. The final model was chosen based on the goodness of fit values AIC and BIC [120]. The analyses were performed using SPSS 16.0.

4.4.2 Study II

To explore which factors were correlated with production loss, simple cross-tabulations with Kendall's tau-b test were performed for each psychosocial work factor and measure of production loss. All analyses were performed on individual level. Non-significant variables were excluded from further analyses. A stepwise forward logistic regression was conducted for sick leave and presenteeism, separately. The final variables were included in a multivariate logistic regression. To test for mediation, the analyses were performed according to the recommendations in Baron and Kenny [121]. The psychosocial work factors were tested for their relation to production loss. In the next step, psychosocial work factors were tested with health as the dependent variable. In the third step a logistic regression was performed on production loss, which included the different psychosocial work factors as well as employee health. In the last step, the results from the first regression were compared with those from the final regression. The same procedure was used to evaluate the relationship in future production loss and in a change of future production loss. All analyses were performed using SPSS 17.0.

4.4.3 Study III

Data Envelopment Analysis (DEA) [122, 123] was used to evaluate changes in employees' work ability as a result of the AHA intervention. First, a work capacity index was created for all employees at the participating companies at baseline. This was established using an output-based approach [124]. The change in work ability was evaluated using the Malmquist Productivity index [125, 126]. The resulting change was divided into two: a change as a result of more employees obtaining full work ability, and a change as a result of increased work ability by those who had full work ability at baseline. Mann-Whitney U tests were performed to compare the results between the companies and between different demographic and work-related characteristics. DEA analysis was performed using OnFront, and Mann-Whitney U statistics using SPSS 17.0.

4.5 ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Committee of Karolinska Institutet (AHA; Dnr 00-012).

4.6 RELATIONSHIP BETWEEN THE STUDIES

The relationships between the three studies are shown in Figure 6. This thesis investigates one aspect of a healthy workplace; namely, how psychosocial work factors contribute to healthy employees, and how work environment and employee health affect organizational production. Study I investigates whether a change in psychosocial work factors contributes to a change in employee health. To further deepen the understanding of the relationship between workplace characteristics, employee health, and organizational production, Study II investigates whether there is a relationship between psychosocial work factors and production loss, and whether a relationship is mediated by employee health. Study III evaluates the AHA intervention and its effectiveness in creating healthy employees and improvement of work ability. The AHA intervention was designed to improve health and organizational productivity through individual- and organizational-level interventions. The result, a work capacity index, was used to evaluate whether the proportion of healthy workers had improved as a result of the method used.

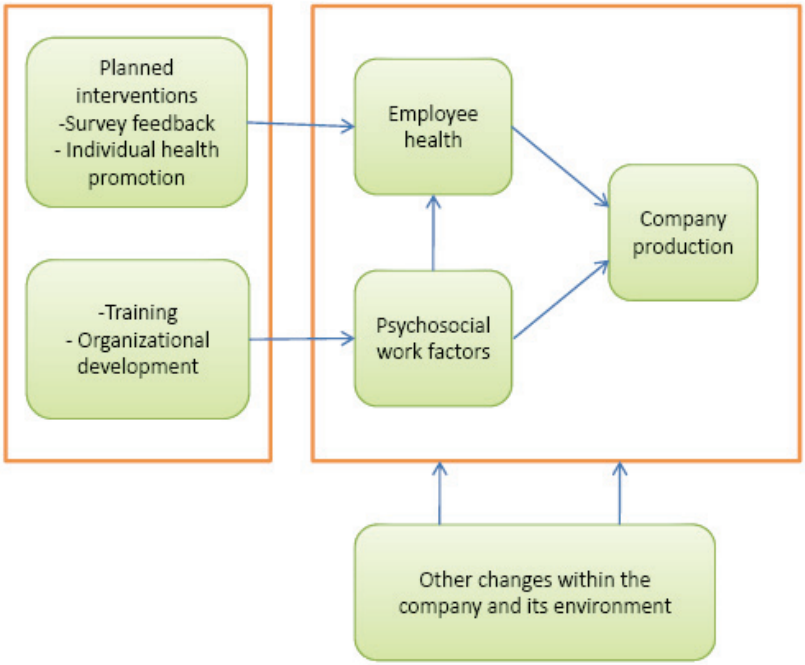

Figure 6. Relationships between the three studies in the thesis

4.7 SUMMARY OF PAPERS

Table 3. Descriptive statistics of the included papers.

	Study I	Study II	Study III
Title	Does a change in psychosocial work factors lead to a change in employee health?	The effects of psychosocial work factors on production loss, and the mediating effect of employee health	Development of a work capacity index to evaluate change in employees' work ability based upon a Data Envelopment Analysis approach
Aim of the study	The aim of the study was to identify psychosocial factors at work that promote positive changes in employee health and factors that prevent negative changes in employee health.	The aim of this study was to investigate whether there is a relationship between psychosocial work environment factors and production loss, and if a potential relationship is mediated by employee health.	The aim of this paper was to further develop a work capacity index including both qualitative and quantitative aspects of the ability to perform at work by including factors in the psychosocial work environment. A further aim was to evaluate the effects of a workplace intervention by estimating the change in the work capacity index.
Sample	The AHA study	The AHA study	The AHA study
No of participants	1,212	2,095	1,040
Data collection	Questionnaire	Questionnaire, Registers	Questionnaires, Registers
Study design	Longitudinal	Longitudinal	Longitudinal
Method of analysis	Modified Poisson regression	Logistic regression	DEA, Mann Whitney U-test
Dependent variables	Employee health	Production loss measured as sick leave and presenteeism	Sick leave, presenteeism, total hours worked

Independent variables	Quantitative job demands, qualitative job demands, work pace, work decision, leadership, social climate, innovative climate, commitment to the organization, role compatibility, role ambiguity, social support from colleagues, mastery of work, and job strain	Job demands, job control, leadership, social climate, innovative climate, commitment to the organization, role compatibility, role ambiguity, social support from colleagues, and mastery of work. Employee health as a mediator.	Job demands, job control, role compatibility, commitment to the organization, social climate, employee health
Covariates or confounders	Age, sex, employment grade, educational level and whether subjects had gone through an occupational health services intervention	Gender, age and type of employment	-
Main results	A negative change in leadership, organizational commitment, and reporting job strain both time periods increased the risk for a negative change in health. A positive change in the social climate and leadership increased the chance for a positive change in health.	Health partly and fully mediates the relationship between several psychosocial work factors and production loss.	Sixty-four percent of the employees obtained full work ability, which indicates room for improvement. Workers at Companies A and B increased their work ability at follow-up, whereas workers at Company C exhibited a decrease in work ability.

5 RESULTS

5.1 STUDY I

The results revealed that a positive/negative change in employees' perception of psychosocial work factors was related to a positive/negative change in their HRQL. Employees who perceived a deterioration in leadership and organizational commitment had an increased risk of a deterioration in health, compared to those who experienced a positive change in the same factors. Employees who reported job strain at both time periods had an increased risk of negative change in health compared to those who did not report job strain at both time periods.

The results also showed that employees who perceived an improvement in social climate and leadership had an increased chance of improved health, compared to those who experienced a deterioration in social climate and leadership. Reporting job strain at both time periods decreased the chance for a positive change in health compared to those who did not have job strain.

5.2 STUDY II

The results showed that improved social climate and higher organizational commitment were related to lower future sick leave. In Step 2, the relationship between changes in psychosocial work factors and a change in sick leave was analyzed. The results showed that if an employee perceived the social climate as improved and/or an increased commitment to the organization, this was significantly related to less sick leave in the future. Health fully mediated the relationship between social climate and sick leave, and partly that between organizational commitment and sick leave. Thus, the social climate affects sick leave through employee health, while organizational commitment has both a direct effect on sick leave and an indirect effect through employee health.

Work demands, work control, role compatibility and social climate were significantly related to presenteeism. All of these except work demands were negatively related to future presenteeism. High work demands were related to an increase in future presenteeism. All factors remained significant after controlling for age, gender and type of employment. In Step 2, the relationship between changes in psychosocial work factors and a change in presenteeism was analyzed. The results showed that improvements in organizational commitment, role compatibility, work control, social climate and leadership were negatively related to future presenteeism. An increase in work demands was related to higher future presenteeism. All of these except leadership were still significant after the covariates were controlled for.

The relationship between social climate, organizational commitment, work control, work demands and role compatibility and presenteeism was fully or partly mediated by health. This means that improvements in employees' perception of social climate or organizational commitments affect employee health, which in turn affects future presenteeism. Improvements in perceived work control and role compatibility affect

future presenteeism directly, as well as indirectly through health. Increased work demands also have both a direct and indirect effect on presenteeism through employee health.

5.3 STUDY III

About 64 % of the population was estimated to have full work ability, indicating that they were healthy employees. Company A had the highest percentage of healthy employees. Overall there were no significant differences in work ability among the employees at the different companies, except at Company C. At this company work ability differed between men and women, blue- and white-collar workers, and managers and co-workers.

The AHA intervention improved the work ability among employees at Companies A and B, with the highest improvement at Company B. Company C had a decrease in employees' work ability. The results showed that even though workers at Companies A and B had full work ability at baseline they further improved their work ability. At Company B, employees with initial reduced work ability reached full work ability.

6 DISCUSSION

Several models of a healthy workplace have been presented in the literature. These models explain how the work organization, work tasks, environment, and employee well-being are related to performance and organizational effectiveness. Questions raised from these models are 1) whether the same characteristics that affect employee well-being also affect organizational outcomes, 2) what the relationships are between employee health and organizational productivity, and 3) whether the factors that affect health and performance in one industry are the same for another industry [15]. In an attempt to answer some of these questions and overcome some of the earlier criticism of previous research that has been raised, the purpose of this thesis was to investigate how psychosocial work factors affect employee health and organizational production.

6.1 HEALTHY WORKPLACES

A healthy workplace is a workplace that contributes to both employee well-being and organizational success. This had been investigated in studies using work characteristics as predictors for health outcomes and organizational outcomes separately. The results from the studies in this thesis suggest that a good work environment contributes to improved health of the employees (Study I), which in turn affects the organizational production (Study II). To be able to maximize health for the employees, it is important to identify how employees' health is affected by the work environment, and how health affects organizational success [22]. Identifying risk factors and promoting factors of health and production is of outmost importance for the improvement of employee and organizational health.

In this thesis, one aspect of healthy workplaces was included. The focus has been on employee health and company production loss, and how these are affected by psychosocial work factors. Other aspects of healthy workplaces have been evaluated in other studies, which have found relationships between workplace characteristics, motivation, worker attitudes and performance [21] and between attitudes and performance indicators [20]. If these factors are improved, it will have positive effects on customer loyalty, profit, productivity, turnover and organizational safety [20].

The idea of the healthy workplace was introduced already at the beginning of the twentieth century. The focus then was on the relations between morale and productivity, the importance of taking part in decision-making and the significance of leadership and leadership styles [8]. Even though this was the beginning of a new way of studying the area, or a new way of theoretical thinking, this research field has grown, and no longer only concerns how the work organization or work environment affects worker attitudes and job satisfaction. Lately, several studies also investigate the medical consequences of a poor psychosocial work environment. The beliefs of the manager and leadership styles as important parts of a healthy workplace have been shown to be significant [33, 127-130]. What appears to be important is how employees perceive their managers. The results in this thesis are in accordance with previous findings. It was

found that an improvement in employees' perception of leadership is related to an improvement in their health, whereas a decrease in employees' perception of leadership increases their risk of negative changes in health (Study I). In our study, we investigated the effect on HRQL. However, how workers perceive their leadership could have other future consequences for employee health. For example, in a recently published study it was found that the experience of good leadership decreased the likelihood of future ischemic heart disease [34]. This further highlights the importance of good leadership.

6.1.1 Creating healthy workers

The aspect in which a change in several psychosocial work factors affected a change in employee health was investigated in Study I. This showed that leadership, social climate, organizational commitment and job strain had different impacts on health. Employees' perception of improved leadership and/or social climate were related to improved health. People who perceived the leadership to be worse than before or were less committed to the organization at the follow-up, had an increased risk of decreased health. For example, perceiving the leadership to be worse over time had an almost 30 percent increased risk of poorer health. A good social climate and good leadership can therefore be viewed as health-promoting factors. Further, if employees perceived job strain for a long time period (three years) this was related to a decreased likelihood of improvements in health, as well as a 30 percent increased likelihood of deterioration in health. Poor ratings on leadership scores and organizational commitment, as well as having high job strain, can be summarized as risk factors for ill health.

In the theoretical framework used in this thesis, it is assumed that employees' organizational commitment predicts employee health. However, it is possible that employee well-being could affect how committed a person is to their work or to the company. Göransson et al. [131] went even further and suggested that well-being is not the only thing that explains employees' attitudes. If workers consider working conditions to be a strong contributing factor to their health, their attitudes could also be affected. This is called work-related health attributions. Göransson et al. [131] found that work-related health attributions were a more important predictor of worker attitudes and withdrawal attentions than mental distress was. Similar findings were also reported in another study [28].

6.1.2 Minimize company production loss

The way people perceive their work, social climate, and leadership has been found to be important for employee health as well as for production loss (Study II), which was in line with the literature review presented by Wilson et al. [16]. However, their model differs from the one presented here. Job design and job future were used as a link between organizational climate and psychological work adjustment, which in turn were associated with different measures of healthy workplaces. The analytical model presented here is more in line with the PATH model [22], which concludes that

organizational improvements could be a result of a direct effect of workplace changes, but also an indirect effect through employee well-being. Psychosocial work factors are assumed to have a direct or indirect effect on company production loss through employee health (Figure 7). To be able to decrease production loss, there is a need to know what factors are of significance.

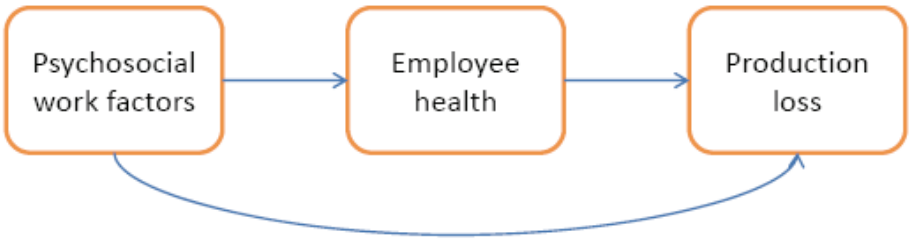

Figure 7. The investigated relationship between psychosocial work factors, employee health and production loss.

When looking at both the short-term and long-term impact of psychosocial work factors on production loss, some factors are more important than others. Improved social climate, organizational commitment, work control and role compatibility decrease the odds of company production loss in the short run. When investigating the effects over time it was found that an increase in social climate, commitment to the organization, work control and role compatibility were related to less future production loss, while increased work demands were related to an increase in future production loss.

More psychosocial work factors were related to presenteeism than to sick leave, when changes over time were investigated. Greater work control and improved role compatibility are factors that were significantly related to decreased presenteeism only, and not to sick leave. Work demands were also related to presenteeism. However, increased work demands increased future presenteeism. The findings on work demands and work control are in accordance with those in a recent systematic review [72]. To be able to minimize production loss it is essential to consider the social climate, role compatibility, work control, organizational commitment and work demands. However, two of the psychosocial work factors were related to both measures of production loss, namely social climate and organizational commitment. The difference between these two factors is that social climate affects company production loss through employee health, whereas organizational commitment impacts company production loss both directly and indirectly through employee health. These factors could be regarded as key factors for production loss.

In this study, production loss was measured in terms of both sick leave and presenteeism. These measures contribute to people's ability to perform at work, but not necessarily in equal parts. People at work produce more than people who stay at home do, even if they are ill or have health problems. However, a sickness-present person

might produce less in terms of quantity and with lower quality than a healthy employee does, which in turn could affect the company result. Independent of their contribution, researchers have agreed on the importance of taking into account both these measures when estimating production loss [132].

Several studies have been able to show a relationship between psychosocial work factors and sick leave [63-66], as well as between different psychosocial work factors and presenteeism [67-69]. Psychosocial work factors have been found to be more strongly associated with presenteeism than with sick leave, while poor health was more strongly associated with sick leave [69]. In Study II, the same tendencies are seen. The explanation rate in the regression analysis of sick leave increased more than for presenteeism, when employee health was controlled for. However, the difference between the explanation rate in the regressions between sick leave and presenteeism was not great. Presenteeism seemed to be more affected by psychosocial work factors compared to sick leave. However, the strength of the existing relationships did not differ much.

Overall, the same factors that affected employees' health also affected production loss. Apart from role compatibility, which had an effect on production loss but not on employee health, leadership is the one factor that differed between the two parts of healthy workplaces, i.e. healthy workers (Study I) and effective organization (Study II). When the effect on presenteeism over time was investigated, leadership was almost significant ($p= 0.075$); an increased perception of leadership decreased the odds of presenteeism. The effect was indirect, meaning that better leadership affects health and decreases presenteeism. The results further reveal that leadership was not related to sick leave, findings that were not supported in another recent study by Nyberg et al. [128]. This may be explained by different ways of measuring leadership, the different study designs, and the variables that were controlled for.

6.1.3 Key factors of a healthy workplace?

Leadership, social climate, work demands, work control, job strain, role compatibility and organizational commitment were found to be key factors of a healthy workplace in the studies included in this thesis. A systematic review [72] supports some of these findings. The review found only a few articles that have investigated how the psychosocial work environment and employees' health are related to production loss, performance or productivity. Work demands and work control were the factors that were mostly investigated in relation to production loss and found relevant. A Finnish study [26] showed that employees' perception of their job and organizational characteristics, as well as their well-being, was associated with company effectiveness. Job satisfaction was positively related to both production and profitability, while support and social climate were related to the level of production and profitability.

It has been suggested that commitment is important for employees' performance, and that employees would be committed if they were awarded for their efforts [14]. The results of Studies I and II demonstrate that high organizational commitment is related to

improved employee health and reduced production loss. Whether an improvement in the work environment would lead to improved commitment was not investigated. It has been suggested by others that workers' commitment could be improved if companies were able to create a healthy workplace [28].

Lindström et al. [26] suggest that the factors of importance for a healthy workplace differ between branches, companies, employments, gender and different ages of workers , and that they are based on the perception of the employees. The way people perceive their work situation is related to what branch they are working in and to the size of the company. People working at small companies perceived better control, supervisor support, work climate and appreciation, compared to workers at larger companies.

The situation at a workplace can be experienced differently by employees. One employee might perceive a situation as a stressor while another does not; all stressors do not affect all individuals in the same way. Earlier experience, different coping strategies and resources may moderate the relationship between stressors and stress, and between stress and strain [18]. Jobs in different branches have shown to be related to employees' well-being. Exhaustion symptoms were more common in accounting and office work, while sickness absence rates were highest in the hotel and restaurant branches [26]. Nevertheless, literature reviews have been able to identify key areas that are important for well-being and their effect on organizational effectiveness. For example, job design, organizational climate, job future [16], functional leadership, a good work environment, individual responsibility and healthy lifestyle are seen as successful characteristics of a healthy workplace [133]. A good psychosocial work environment and organizational commitment were found to be important for a healthy workplace in this thesis. The results of the research done here, as well as previous research, suggest that a healthy workplace is not only of value to companies, but is also of good value to the people who work there.

6.2 WORKPLACE HEALTH PROMOTION

In a meta-analysis [103] of health-promotion programs and their effects, moderate evidence was found regarding health-promotion programs decreasing sickness absence and improving work ability, and having positive effects on mental well-being. A combination of psychosocial and physical work environment interventions was recommended to achieve the best effect. The interventions implemented at the participating companies in the AHA study were directed at both organizational and individual levels with positive effects on health, lifestyle and sick leave among the participating companies compared to the control group [106]. The key factors of a healthy workplace found in Study II and employee health were used to evaluate the AHA intervention based on production loss. A common method in productivity and efficiency studies, called DEA, was used to create a work capacity index, which was used to evaluate the effects of the intervention (Study III). The results showed that the intervention had an effect in terms of more employees who were healthy and healthier employees, measured as improvement in the work capacity index, among the

companies that worked actively with the intervention. The company that put less effort into the method did not have the same positive effect as the others did. This suggests that the AHA method is a good approach to improving employees' ability to perform at work.

It has been suggested that going from a sickness-oriented culture to one of health is more successful to be able to decrease health-care costs, since it is suggested that it is easier and cheaper to keep people healthy than to treat people who have developed diseases [104]. There is an increased demand for evidence-based health-promotion programs with "return-on-investment" guarantees. The different programs' effectiveness and the payoff for companies have been evaluated [35, 134-139], but most of them are interventions that only target the individuals' health. Estimating the costs associated with unhealthy workplaces is difficult, but it is clear that they are vast in terms of personal, economic and societal aspects [19]. Health promotion should be treated as an asset for the organization to be able to achieve higher profits through productivity enhancement. By focusing on enhancing productivity instead of cutting medical costs, which is often seen in health-promotion programs, company goals are targeted.

Organizational factors have previously been shown to be important for the health of employees [45, 140]. In a study by Lindström et al. [26] that evaluated the results of an intervention targeting organizational change as well as employee health, it was shown that those who received a more intensive intervention had a better outcome in both well-being and organizational characteristics. However, changes in employee well-being were only slightly related to the intervention carried out. It was suggested that an improvement of employee well-being might not be a direct effect of the intervention but rather an indirect effect of changes in job and organizational characteristics. A similar result was found in the AHA study. The intervention on the organizational level, so-called survey feedback, did not contribute to a decrease in sick leave but did contribute to improvements in organizational commitment and perception of leadership [107]. The results of the study by Lindström et al. [26] also demonstrated that a workplace intervention could have an effect on job and organizational characteristics, and thus on organizational effectiveness. Different types of interventions were related to productivity and good profitability among the participating companies. In the evaluation of the AHA study (Study III) both psychosocial work factors and employee health were included, and those factors that were directly or indirectly related to changes in production loss were used (Study II). The results of Studies I and II indicate that improvements in employee health and decreases in production loss are related to improvements in the psychosocial work factors, similar to the results of the study by Lindström et al. [26].

One of the main tasks of management is to organize workers' efforts to achieve the economic objectives set up by the organization. Every decision made by the manager will have behavioral consequences [14]. HRM strategies affect performance both directly and indirectly through the work climate [56]. WHP investments could be equalized with other kinds of investments in employees, i.e. competence development. However,

putting money and effort into health-promotion strategies has been questioned by people who claim that it is not possible to combine health promotion with organizational effectiveness [17]. Conversely, several studies show that this kind of belief is not supported in the literature. Economic evaluations have shown return on investment for companies that perform health-promotion interventions, but a change in employees' work ability has also been shown to be strongly correlated to changes in company productivity [141]. WHP investments could be related to productivity, to evaluate their contribution to changes in company productivity.

A model presented by O'Donnell [12] links health promotion to the work environment and to employees' physical and emotional well-being and desire to work. The work environment has a direct affect on the ability and desire to work, and on performance. Employee ability and desire to work affect absenteeism, presenteeism and performance. The idea is that people who are physically and emotionally well, and have a desire to work, perform better than those who are not. Their ability and desire to work can be directly affected by health-promotion programs but also through improvements in the organizational climate and employee morale. However, there is no direct link suggested between work environment and production loss. Work demands, work control and role compatibility are factors that are related to presenteeism (Study II). If commitment is considered to be related to work environment and morale or the desire to work, a direct link from work environment to production loss is also suggested. O'Donnell's model shows the complexities of this area, and that several steps are required before company productivity and profit will increase.

6.3 TRANSFER KNOWLEDGE INTO PRACTICE

To be able to create healthy workplaces, the results of research need to be communicated to the practitioners and put into practice [19]. This should not only result in the treatment of different diseases, but also be complemented with primary intervention, such as a reduction in workplace stressors [19]. Improvements in occupational well-being, measured as morale, distress, health and job satisfaction, will only be achieved if the focus is on improving leadership and managerial practices as well as other aspects of psychosocial work factors. A combination of health-promotion programs targeting health conditions as well as employee attitudes and corporate cultures and improvement of the organization are all factors that are important for organizational success [142]. Research suggests that interventions can be designed to change conditions in the workplace to improve employee health as well as organizational performance. The results of this thesis suggest that involving employees in their work environment and working with improvements enable them to achieve better health and work ability, and thus decrease production losses.

Despite the growing evidence from research, there are still very few organizations that implement measures to assess, intervene and improve the health of their workforce [143], even though health-promotion programs have shown return on investments [35, 134, 135, 144]. The reason for this slow implementation could be insufficient information to managers.

Instead of focusing on cost savings and decreases in sickness absence, interventions should be complemented with information on productivity enhancement [143].

Today, more jobs are dependent on the employee's competence and ability. If a worker is unmotivated and unable to perform, it will have a negative effect on the organization. The individuals working at the company are suggested to be the most relevant facilitators of the success of a company [17, 145]. The creation of a healthy workplace is done through changing the work environment. When people perceive their work environment as healthy this will contribute to healthier employees, which in turn will reduce production loss. People's perception of their work environment seems to play a very important role. Their perception of different situations, and not the objective situation itself, is important for employee health [21, 146], which in turn is important for organizational performance [20]. Motivational and behavioral reactions to the work environment are mediated by the subjective perception of the environment [21]. This is one reason why employers should measure how workers perceive their workplace and work toward improving their experience from an organizational perspective. The criticism of earlier research concerned the lack of comprehensive questionnaires and the use of few measures of employee well-being. Through using an explorative approach and collecting data using a comprehensive questionnaire, we have been able to identify some important psychosocial work factors: leadership, organizational commitment, social climate, job demands, job control and role compatibility. These are suggested as key performance indicators for measuring a healthy workplace.

6.4 CONCEPTUAL DIFFICULTIES

An attempt to merge several disciplines will always encounter some difficulties. One obstacle lies within the concepts used in the different research fields. In this thesis the focus has been on psychosocial work factors, employee health and production. Health is measured as a combination of employees' mental and physical health. However, in other studies different concepts of health are used. Some researchers use the concept quality of work life, which is often measured as job satisfaction or dissatisfaction [15]. Cotton and Hart used the concept occupational well-being in which they included morale, job satisfaction and distress [9]. The difference in meaning of the concepts is not only common for how employee health or well-being is measured; the same applies to performance, production and productivity. Productivity is used as a measure of efficiency and effectiveness of individuals, groups, units and organizations, but is also used as synonym for output, motivation, sickness absence, presenteeism, individual performance, organizational effectiveness, production, cost effectiveness, and profitability [147]. This problem was also found in the systematic review presented in this thesis [72]. It is a challenge to try to incorporate several disciplines to further develop a research field, and needs to be considered. It is necessary to better define the concepts used, and also to strive for common theoretical concepts to reach consensus and develop conceptual clarity.

6.5 LIMITATIONS AND METHODOLOGICAL CONSIDERATIONS

Some of the limitations in previous studies have been the use of a cross-sectional design or a non-comprehensive questionnaire [19]. Combining a longitudinal design with comprehensive questionnaires was the strength of the papers in this thesis. However, some potential limitations need to be brought up.

Study I had an explorative approach and tested several psychosocial work factors to investigate their contribution to changes in employees' health. Except for those that were found significant, there were several factors that did not contribute to an explanation of changes in health. For example, job demands and job control separately did not have significant effects. These are factors that previously have been found to be related to employee health [30]. Social support from colleagues, having an innovative climate, mastery of work, role conflict and role clarity also did not have significant effects. The investigated changes were estimated at a three-year follow-up. It is possible that a shorter follow-up than the three years used here could have changed the results a bit by capturing potential changes that occur in the meantime. It is also possible that a different measure of health could have affected the results. Factors that were found here are related to a global measure of HRQL. However, others may affect mental or physical health separately and still remain to be investigated.

The conceptual model used in Study II had the hypothesis that several psychosocial work factors were related to production loss, and that this relationship was mediated by employee health. Those factors that did not have a direct effect on either sick leave or presenteeism were excluded from further analysis. It is possible that other factors would have been included in the study if the theoretical model had instead investigated whether psychosocial work factors affect production loss indirectly through employee health.

In Study III the AHA intervention was evaluated. The result was evaluated overall for all companies and then presented on company level. It could not be determined whether the effect was a result of the actual intervention or was due to, for example, organizational factors such as culture, structure or policies. The companies that participated in the study enrolled voluntarily and it is therefore possible that this kind of strategical thinking contributed to the results.

In summary, WHP strategies could have increased productivity through either improvements in human capital as primary goal, or improving health [37]. Improvements in health on an individual level can lead to an increase in employee production, due to enhanced physical energy and mental acuity, increased yearly output for the company as a result of reduced sick leave, and to better career outputs through decreased morbidity and/or increased longevity. At an aggregated level, individual improvements could result in improved labor productivity and/or increased living standard [37]. Creating a healthy workplace is not achieved by a single intervention. Instead, it is a process that needs to be maintained and constantly preserved. This focus must be part of the organizational culture, structure and climate.

7 CONCLUSIONS

- Improvements to employee health and decreases in production loss are related to improvements in psychosocial work factors. A good work environment contributes to improved employee health, which in turn affects organizational production.

- Changes in leadership, social climate, organizational commitment and job strain are related to changes in employees' HRQL.

- To be able to minimize production loss it is essential to consider the social climate, role compatibility, work control, organizational commitment and work demands.

- Two of the psychosocial work factors were related to both measures of production loss, namely social climate and organizational commitment. These factors could be regarded as key factors of production loss.

- Creating a healthy workplace is not achieved by a single intervention. Instead, it is a process that needs to be maintained and constantly preserved. This focus must be part of the organizational culture, structure and climate.

- The results of the research done here, as well as previous research, suggest that a healthy workplace is not only of value for companies, it is also of good value for the people who work there.

- It is a challenge to try to incorporate several disciplines to further develop a research field, and this needs to be considered. It is necessary to better define the concepts used, and also to strive for common theoretical concepts to reach consensus and develop conceptual clarity.

8 FUTURE RESEARCH

Examining the work done within the field of healthy workplaces, it is evident that there are two major fields investigating how an organization can contribute to employee well-being and organizational effectiveness. Employee well-being is measured in terms of either health, worker attitudes and work-related well-being, and effectiveness is measured in terms of either production loss, performance or turnover. To obtain a more comprehensive view of how these different aspects are related to each other and to create a healthy workplace, these two research areas must be integrated. To understand how work organization and work environment affect employees' mental and physical health, as well as their motivation and attitudes toward work and how these are related to employee effectiveness, more studies investigating this relationship over time are needed.

Research in the field of production loss thus far investigates what factors are related to production loss measured as absenteeism and/or presenteeism. Researchers have also investigated the economic consequences for companies of production loss due to health-related problems. Being sickness-present has more recently been shown to be related to future ill health and future sick leave. The long-term consequences of high levels of presenteeism for employees as well as companies need to be investigated further.

Most research is analyzed on an individual level; only one article in the systematic review had taken an organizational perspective. Factors of overall importance for organizations might differ from those that affect the individuals. To be able to find factors of importance for the organizations, more studies should include both an individual- and organizational-level perspective. Multilevel studies on company, unit, work group and individual level to investigate whether the same factors affect health and production on all levels are therefore suggested.

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10 REFERENCES

1. Ariens GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Psychosocial risk factors for neck pain: a systematic review. *Am J Ind Med*. 2001;39:180-93.
2. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: A review of the epidemiological literature. *Am J Ind Med*. 2002;41:315-42.
3. Stansfeld S, Candy B. Psychosocial work environment and mental health--a meta-analytic review. *Scand J Work Environ Health*. 2006;32:443-62.
4. Van der Doef M, Maes S. The Job Demand-Control(-Support) model and psychological well-being: a review of 20 years of empirical research. *Work and Stress*. 1999;13:87-114.
5. de Jonge J, Dormann C, Janssen PPM, Dollard MF, Landeweerd JA, Nijhuis FJN. Testing reciprocal relationships between job characteristics and psychological well-being: A cross-lagged structural equation model. *Journal of Occupational and Organizational Psychology*. 2001;74:29-46.
6. Sverige. Arbetsmarknadsdepartementet. *Swedish legislation on the working environment*. Stockholm: The Ministry; 1978: 71.
7. Taylor FW. *The principles of scientific management*. New York: Harper & Brother; 1911: 144.
8. Mayo E. *The social problems of an industrial civilization : With an appendix on the political problem*. 6. impr. ed. London,; 1975.
9. Cotton P, Hart PM. Occupational wellbeing and performance: A review of organisational health research. *Australian Psychologist*. 2003;38:118-127.
10. Commission of the European Communities. *Communication from the Commission. Adapting to change in work and society: a new Community strategy on health and safety at work 2002-2006.*:Communities CotE; 2002.
11. Menckel E. Workplace health promotion in Sweden: A collaborating network with 15 EU member states. *Am J Ind Med*. 1999;Suppl 1:42-3.
12. O´Donnell M. Health and Productivity Management: the Concept, Impact, and Opportunity: Commentary to Goetzel and Ozminkowski. *American Journal of Health Promotion*. 2000;14:215-217.
13. Jaffe DT. The Healthy Company: Research Paradigms for Personal and Organizational Health. In: Sauter SL, Murphy LR, eds. *Organizational risk factors for job stress.* Washington DC: American Psychological Association; 1995: 13-40.
14. McGregor D. *The human side of enterprise*. New York: McGraw-Hill; 1960: 246.
15. Sainfort F, Karsh BT, Booske BC, Smith MJ. Applying quality improvement principles to achieve healthy work organizations. *Jt Comm J Qual Improv*. 2001;27:469-83.
16. Wilson MG, DeJoy DM, Vandenberg RJ, Richardson HA, McGrath AL. Work characteristics and employee health and well-being: Test of a model of healthy work organization. *Journal of Occupational and Organizational Psychology*. 2004;77:565-588.
17. Shoaf C, Genaidy A, Karwowski W, Huang SH. Improving performance and quality of working life: A model for organizational health assessment in emerging enterprises. *Human Factors and Ergonomics in Manufacturing*. 2004;14:81-95.
18. Kelloway EK, Day AL. Building healthy workplaces: What we know so far. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement*. 2005;37:223-235.
19. Kelloway EK, Day A. Building Healthy Workplaces: Where We Need to Be. *Canadian Journal of Behavioural Science/Revue canadienne des Sciences du comportement*. 2005;37:309-312.

20. Harter JK, Schmidt FL, Hayes TL. Business-unit-level relationship between employee satisfaction, employee engagement, and business outcomes: A meta-analysis. *Journal of Applied Psychology. Vol 87(2) Apr 2002, 268-279*. 2002.
21. Parker CP, Baltes BB, Young SA, Huff JW, Altmann RA, Lacost HA, Roberts JE. Relationships between psychological climate perceptions and work outcomes: a meta-analytic review. *Journal of Organizational Behavior*. 2003;24:389-416.
22. Grawitch MJ, Gottschalk M, Munz DC. The Path to a Healthy Workplace: A Critical Review Linking Healthy Workplace Practices, Employee Well-being, and Organizational Improvements. *Consulting Psychology Journal: Practice and Research. Vol 58(3) Sum 2006, 129-147*. 2006.
23. van den Berg TIJ, Alavinia SM, Bredt FJ, Lindeboom D, Elders LAM, Burdorf A. The influence of psychosocial factors at work and life style on health and work ability among professional workers. *Int Arch Occup Environ Health*. 2008;81:1029-1036.
24. Bjurvald M, Hogstedt C, Marklund S, Palmer E, Theorell T. Vad kan förklara den höga sjukfrånvaron? Försök till syntes. *Den höga sjukfrånvaron - Problem och lösningar*.
25. Swedish Work Environment Authority (2007) Occupational accidents and work-related diseases 2006 - Preliminary report, Swedish Work Environment Authority.
26. Lindström K, Schrey K, Ahonen X, Kaleva S. The effects of promoting organizational health on worker well-being and organizational effectiviness in small and medium sized enterprises. In: Murphy, Cooper, eds. *Healthy and productive work*. London: taylor & Francis; 2000: 83-104.
27. Way M, MacNeil M. Organizational characteristics and their effect on health. *Nurs Econ*. 2006;24:67-76, 55.
28. Lowe GS, Schellenberg G, Shannon HS. Correlates of employees' perceptions of a healthy work environment. *American Journal of Health Promotion*. 2003;17:390-399.
29. Karasek R, Theorell T. *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life*: BasicBooks; 1990: 31-82.
30. de Lange AH, Taris TW, Kompier MA, Houtman IL, Bongers PM. "The very best of the millennium": longitudinal research and the demand-control-(support) model. *J Occup Health Psychol*. 2003;8:282-305.
31. Gershon RR, Stone PW, Zeltser M, Faucett J, MacDavitt K, Chou SS. Organizational climate and nurse health outcomes in the United States: a systematic review. *Ind Health*. 2007;45:622-36.
32. Siu OL. Occupational stressors and well-being among Chinese employees: The role of organisational commitment. *Applied Psychology-an International Review-Psychologie Appliquee-Revue Internationale*. 2002;51:527-544.
33. Hogan R, Kaiser RB. What We Know About Leadership. *Review of General Psychology*. 2005;9:169-180.
34. Nyberg A, Alfredsson L, Theorell T, Westerlund H, Vahtera J, Kivimaki M. Managerial leadership and ischaemic heart disease among employees: the Swedish WOLF study. *Occup Environ Med*. 2009;66:51-5.
35. Riedel JE, Lynch W, Baase C, Hymel P, Peterson KW. The effect of disease prevention and health promotion on workplace productivity: a literature review. *Am J Health Promot*. 2001;15:167-91.
36. Berger ML, Murray JF, Xu J, Pauly M. Alternative Valuations of Work Loss and Productivity. *Jounal of Occupational and Environmental Medicine*. 2001;43:18-24.
37. Tompa E. The Impact of Health on Productivity: Empirical Evidence and Policy Implications. In: Sharpe A, St-Hilaire F, Banting K, eds. *The Review of Economic Performance and Social Progress - Towards a Social Understanding of Productivity* Quebec: The Institute for Research on Public Policy; 2002: 181-202.
38. Boles M, Pelletier B, Lynch W. The relationship between health risks and work productivity. *J Occup Environ Med*. 2004;46:737-45.

39. Burton WN, Conti DJ, Chen CY, Schultz AB, Edington DW. The role of health risk factors and disease on worker productivity. *J Occup Environ Med*. 1999;41:863-77.
40. Burton WN, Chen CY, Conti DJ, Schultz AB, Pransky G, Edington DW. The association of health risks with on-the-job productivity. *J Occup Environ Med*. 2005;47:769-77.
41. Pelletier B, Boles M, Lynch W. Change in Health Risks and Work Productivity Over Time. *Jounal of Occupational and Environmental Medicine*. 2004;46:746-754.
42. Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW. The Association Between Health Risk Change and Presenteeism Change. *Jounal of Occupational and Environmental Medicine*. 2006;48:252-263.
43. Edington DW, Schultz AB. The total value of health: a review of literature. *International Journal of Workplace Health Management*. 2008;1.
44. Loeppke R, Taitel M, V. H, Parry T, Kessler R, Jinnett K. Health and Productivity as a Business Strategy: A Multiemployer Study. *Journal of Occupational and Environmental Medicine*. 2009;51:1-18.
45. Allen H. Using routinely collected data to augment the management of health and productivity loss. *J Occup Environ Med*. 2008;50:615-32.
46. Li X, Gignac MA, Anis AH. The indirect costs of arthritis resulting from unemployment, reduced performance, and occupational changes while at work. *Med Care*. 2006;44:304-10.
47. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W. Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. *J Occup Environ Med*. 2004;46:398-412.
48. Kivimaki M, Head J, Ferrie JE, Hemingway H, Shipley MJ, Vahtera J, Marmot MG. Working while ill as a risk factor for serious coronary events: The Whitehall II study. *American Journal of Public Health*. 2005;95:98-102.
49. Bergstrom G, Bodin L, Hagberg J, Lindh T, Aronsson G, Josephson M. Does sickness presenteeism have an impact on future general health? *Int Arch Occup Environ Health*. 2009;82:1179-90.
50. Bergström G, Bodin L, Hagberg J, Aronsson G, Josephson M. Sickness Presenteeism Today, Sickness Absenteeism Tomorrow? A Prospective Study on Sickness Presenteeism and Future Sickness Absence. *Journal of Occupational and Environmental Medicine*. 2009;51:629-638.
51. Hansen CD, Andersen JH. Sick at work - a risk factor for long-term sickness absence at a later date? *Journal of Epidemiology and Community Health*. 2009;63:397-402.
52. Beehr TA, Jex SM, Stacy BA, Murray MA. Work stressors and coworker support as predictors of individual strain and job performance. *Journal of Organizational Behavior*. 2000;21:391-405.
53. Baruch-Feldman C, Brondolo E, Ben-Dayan D, Schwartz J. Sources of social support and burnout, job satisfaction, and productivity. *J Occup Health Psychol*. 2002;7:84-93.
54. Daniels K, Harris C. Work, psychological well-being and performance. *Occupational Medicine-Oxford*. 2000;50:304-309.
55. Noblet AJ, McWilliams J, Teo STT, Rodwell JJ. Work characteristics and employee outcomes in local government. *International Journal of Human Resource Management*. 2006;17:1804-1818.
56. Gelade G, Gilbert P. Work Climate and Organizational Effectiveness: The Application of Data Envelopment Analysis in Organizational Research. *Organizational Research Methods*. 2003;6:482-501.
57. Vinberg S, Gelin G. Organizational and health performance in small enterprises in Norway and Sweden. *Work*. 2005;24:305-16.
58. Vinberg S. Workplace health interventions in small enterprises: a Swedish longitudinal study. *Work*. 2008;30:473-82.
59. Bakker AB, Demerouti E, Verbeke W. Using the job demands-resources model to predict burnout and performance. *Human Resource Management*. 2004;43:83-104.

60. Anderzen I, Arnetz BB. The impact of a prospective survey-based workplace intervention program on employee health, biologic stress markers, and organizational productivity. *J Occup Environ Med*. 2005;47:671-82.
61. Bakker AB, Van Emmerik H, Van Riet P. How job demands, resources, and burnout predict objective performance: A constructive replication. *Anxiety Stress and Coping*. 2008;21:309-324.
62. Abramis DJ. Relationship of Job Stressors to Job-Performance - Linear or an Inverted-U. *Psychological Reports*. 1994;75:547-558.
63. Piirainen H, Rasanen K, Kivimaki M. Organizational climate, perceived work-related symptoms and sickness absence: a population-based survey. *J Occup Environ Med*. 2003;45:175-84.
64. Head J, Kivimaki M, Martikainen P, Vahtera J, Ferrie JE, Marmot MG. Influence of change in psychosocial work characteristics on sickness absence: The Whitehall II Study. *J Epidemiol Community Health*. 2006;60:55-61.
65. Andrea H, Beurskens AJ, Metsemakers JF, van Amelsvoort LG, van den Brandt PA, van Schayck CP. Health problems and psychosocial work environment as predictors of long term sickness absence in employees who visited the occupational physician and/or general practitioner in relation to work: a prospective study. *Occup Environ Med*. 2003;60:295-300.
66. D'Souza RM, Strazdins L, Broom DH, Rodgers B, Berry HL. Work demands, job insecurity and sickness absence from work. How productive is the new, flexible labour force? *Australian and New Zealand Journal of Public Health*. 2006;30:205-212.
67. Caverley N, Cunningham B, MacGregor J. Sickness Presenteeism, Sickness Absenteeism, and Health Following Restructuring in a Public Service Organization. *Journal of Management Studies*. 2007;44:304-319.
68. Alavinia SM, Molenaar D, Burdorf A. Productivity loss in the workforce: associations with health, work demands, and individual characteristics. *Am J Ind Med*. 2009;52:49-56.
69. Van den Heuvel SG, Geuskens GA, Hooftman WE, Koppes LLJ, van den Bossche SNJ. Productivity Loss at Work; Health-Related and Work-Related Factors. *Journal of Occupational Rehabilitation*. 2009; Online publication.
70. Kristensen TS. Sickness absence and work strain among danish slaughterhouse workers: An analysis of absence from work regarded as coping behaviour. *Social Science & Medicine*. 1991;32:15-27.
71. De Joy DM, Wilson MG. Organizational health promotion: broadening the horizon of workplace health promotion. *Am J Health Promot*. 2003;17:337-41.
72. Lohela Karlsson M, Björklund C, Vingård E, Jensen IB. Does psychosocial work environment and employee health affect production? A systematic review *Submitted*. 2010.
73. Hagberg M, Tornqvist EW, Toomingas A. Self-reported reduced productivity due to musculoskeletal symptoms: associations with workplace and individual factors among white-collar computer users. *J Occup Rehabil*. 2002;12:151-62.
74. Hagberg M, Vilhemsson R, Tornqvist EW, Toomingas A. Incidence of self-reported reduced productivity owing to musculoskeletal symptoms: association with workplace and individual factors among computer users. *Ergonomics*. 2007;50:1820-34.
75. Martimo KP, Shiri R, Miranda H, Ketola R, Varonen H, Viikari-Juntura E. Self-reported productivity loss among workers with upper extremity disorders. *Scand J Work Environ Health*. 2009;35:301-8.
76. Meerding WJ, IJzelenberg W, Koopmanschap MA, Severens JL, Burdorf A. Health problems lead to considerable productivity loss at work among workers with high physical load jobs. *J Clin Epidemiol*. 2005;58:517-23.
77. Musich S, Hook D, Baaner S, Spooner M, Edington DW. The association of corporate work environment factors, health risks, and medical conditions with presenteeism among Australian employees. *Am J Health Promot*. 2006;21:127-36.
78. van den Heuvel SG, Ijmker S, Blatter BM, de Korte EM. Loss of productivity due to neck/shoulder symptoms and hand/arm symptoms: results from the PROMO-study. *J Occup Rehabil*. 2007;17:370-82.

79. Byrne ZS, Hochwarter WA. I get by with a little help from my friends: the interaction of chronic pain and organizational support on performance. *J Occup Health Psychol*. 2006;11:215-27.
80. Rego A, Cunha MPE. Authentizotic climates and employee happiness: Pathways to individual performance? *Journal of Business Research*. 2008;61:739-752.
81. Parker PA, Kulik JA. Burnout, self- and supervisor-rated job performance, and absenteeism among nurses. *Journal of Behavioral Medicine*. 1995;18:581-599.
82. Donald I, Taylor P, Johnson S. Work Environments, Stress, and Productivity: An Examination Using ASSET. *International Journal of Stress Management*. 2005;12:409-423.
83. Park KO, Wilson MG, Lee MS. Effects of social support at work on depression and organizational productivity. *Am J Health Behav*. 2004;28:444-55.
84. Taris TW, Schreurs PJG. Well-being and organizational performance: An organizational-level test of the happy-productive worker hypothesis. *Work and Stress*. 2009;23:120-136.
85. Eriksson N. *The psychosocial work environment and worker health*. Umeå studies in sociology, 110. Umeå: Univ.; 1996: 70.
86. Jeding K, Arbetslivsinstitutet. *Ett friskt arbetsliv : fysiska och psykosociala orsakssamband samt möjligheter till prevention och tidig rehabilitering*. Arbete och hälsa, 1999:22. Stockholm: Arbetslivsinstitutet; 1999: 95 s.
87. Siegrist J, Marmot M. Health inequalities and the psychosocial environment-two scientific challenges. *Soc Sci Med*. 2004;58:1463-73.
88. WHO (1948) Official records of the World Health Organization, vol. 2. Geneve, World Health Organization.
89. Medin J, Alexanderson K. *Begreppen hälsa och hälsofrämjande : en litteraturstudie*. Lund: Studentlitteratur; 2000: 180 s.
90. Nordenfelt L. Health and disease: two philosophical perspectives. *J Epidemiol Community Health*. 1986;40:281-4.
91. Nordenfelt L. *On the nature of health. An action-theoretic approach.* Dordrecht: Kluwer Academic Publishers; 1987.
92. Eriksson K. *Hälsans idé*. Vårdserie,. Stockholm: Almqvist & Wiksell; 1984: 100 ;.
93. Rydqvist L-G, Winroth J. *Idrott, friskvård, hälsa & hälsopromotion*. Ny, revid. uppl. ed. Stockholm: SISU idrottsböcker; 2002: 264.
94. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav*. 1997;38:21-37.
95. Bjorner BJ, Kristensen TS, Orth-Gomér K, Tibblin G, Sullivan M, Westerholm P (1996) Self-rated health : a useful concept in research, prevention and clinical medicine. Stockholm, Sweden, Forskningsrådsnämnden (Swedish Council for Planning and Coordination of Research), pp. 144.
96. Ludvigsson M, Svensson T, Alexandersson K, Arbetslivsinstitutet. *Begreppet arbetsförmåga : en litteraturgenomgång*. Arbete och hälsa, 2006:8. Stockholm: Arbetslivsinstitutet; 2006: 19.
97. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. *J Epidemiol Community Health*. 2000;54:502-9.
98. Schultz AB, Edington DW. Employee Health and Presenteeism: A Systematic Review. *J Occup Rehabil*. 2007.
99. Biron C, Brun J-P, Ivers H, Cooper CL. At work but ill: psychosocial work environment and well-being determinants of presenteeism propensity. *Journal of Public Mental Health*. 2006;5:26-37.
100. *Ottawa charter for health promotion : Charte d'Ottawa pour la promotion de la santé*. Ottawa ,; 1986: 4.
101. Hanson A. *Hälsopromotion i arbetslivet*. Lund: Studentlitteratur; 2004: 296 ;.
102. Polanyi MFD, Frank JW, Shannon HS, Sullivan TJ, Lavis JN. Promoting the Determinants of Good Health in the Workplace. In: Poland BD, Green LW, Rootman I, eds. *Settings for Health Promotion: Linking Theory and Practice*. Thousand Oaks, CA: Sage; 2000.

103. Kuoppala J, Lamminpaa A, Husman P. Work health promotion, job well-being, and sickness absences--a systematic review and meta-analysis. *J Occup Environ Med*. 2008;50:1216-27.
104. Edington DW. *Zero Trends: Health as a Serious Economic Strategy*. Ann Arbor: University of Michigan, Health Management Research Center; 2009: 191.
105. Barlow DH, Hayes SC, Nelson RO. *The scientist practitioner : research and accountability in clinical and educational settings*. Pergamon general psychology series, 128. New York: Pergamon Press; 1984: xii, 359.
106. Bergström G, Björklund C, Fried I, Lisspers J, Nathell L, Hermansson U, Helander A, Bodin L, Jensen IB. A Comprehensive workplace intervention and its outcome with regard to lifestyle, health and sick leave: The AHA study. *Work*. 2008;31:167-180.
107. Bjorklund C, Grahn A, Jensen I, Bergstrom G. Does survey feedback enhance the psychosocial work environment and decrease sick leave? *European Journal of Work and Organizational Psychology*. 2007;16:76-93.
108. Bergström G, Jensen I, Fried I, Björklund C, Grahn A, aha-group (2004) Work and Health in the Processing and Engineering Industries (In Swedish). Final report, part one. Stockholm, Department of Clinical Neuroscience. Section for Personal Injury Prevention. Karolinska Institute.
109. Lindström K, Nordiska ministerrådet. *Review of psychological and social factors at work and suggestions for the general Nordic questionnaire (QPSNordic) : description of the conceptual and theoretical background of the topics selected for coverage by the Nordic questionnaire*. Nord (København), 1997:15. Copenhagen Stockholm: Nordic Council of Ministers Nordiska ministerrådet ; Fritze distributör; 1997: 80.
110. Lindström K, Ørhede E, Elo A-L, Skogstad A, Dallner M, Gamberale F, Hottinen V, Knardahl S. *User's guide for the QPSNordic : General Nordic Questionnaire for Psychological and Social Factors at Work*. TemaNord, 2000:603. København: Nordic Council of Ministers; 2000: 74.
111. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30:473-83.
112. Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, J.E. B, Bullinger M, Kaasa S, Leplege A, Prieto L, Sullivan M. Cross-validation of item selection and scoring for the SF-12 health survey in nine coutries: Results from the IQOLA project. *Journal of Clinical Epidemiology*. 1998;51:1171-1178.
113. Kind P, Brooks R, Rabin R. Eds. EQ-5D concepts and methods: a development history. Springer, Dordrecht, Netherlands, 2005.
114. Brooks RG, Jendteg S, Lindgren B, Persson U, Björk S. Euroqol: health-related quality of life measurement. Results of the Swedish questionnaire exercise. *Health Policy*. 1991;37-48.
115. Macran S, Weatherly H, Kind P. Measuring population health: a comparison of three generic health status measures. *Med Care*. 2003;41:218-31.
116. Wittrup-Jensen KU, Lauridsen JT, Gudex C, Brooks R, Pedersen KM. Estimating Danish EQ-5D Tariffs Using the Time Trade-Off (TTO) and Visual Analogue Scale (VAS) Method. *Proceedings of the 18th Plenary Meeting of the EuroQol Group*. 2001.
117. Lindström K, Björklund C, Mykletun RJ, Furunes T, Gard G, Pahkin K (2008) Nordic Questionnaire for Monitoring the Age Diverse Workforce, ed. Ministers NCo. Copenhagen.
118. Dallner M. *Validation of the General Nordic Questionnaire (QPSNordic) for Psychological and Social Factors at Work*. Nord (København) 2000:12. Copenhagen: Nordic Council of Ministers [Nordiska ministerrådet]; 2000.
119. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159:702-6.
120. Weiss RE. *Modeling longitudinal data*. Springer texts in statistics. New York ; London: Springer; 2005: 429.
121. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Dec 1986. *Journal of Personality and Social Psychology*. 1986;Vol.51:pp.

122. Charnes A, Cooper C, Rhodes E. Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*. 1978;2:429-444.
123. Farrell M. The measurement of productive efficiency. *Journal of Royal Statistical Society, Series A*. 1957;120:253-290.
124. Coelli TJ, Prasada Rao DS, O'Donnell CJ, Battese GE. *An Introduction to Efficiency and Productivity Analysis*. Vol. Second Edition. New York: Springer; 2005.
125. Färe R, Grosskopf S. Eds. New Directions: Efficiency and Productivity. Springer, New York, 2005.
126. Färe R, Grosskopf S, Roos P. Malmquist Productivity Indexes: A survey of theory and practice In: Färe R, Grosskopf S, Russell RR, eds. *Index numbers: Essays in honour of Sten Malmquist*. Massachusetts: Kluwer Academic Publishers; 1998.
127. Steyrer J, Schiffinger M, Lang R. Organizational commitment-A missing link between leadership behavior and organizational performance? *Scandinavian Journal of Management*. 2008;24:364-374.
128. Nyberg A, Westerlund H, Magnusson Hanson LL, Theorell T. Managerial leadership is associated with self-reported sickness absence and sickness presenteeism among Swedish men and women. *Scand J Public Health*. 2008;36:803-11.
129. Fjell Y, Osterberg M, Alexanderson K, Karlqvist L, Bildt C. Appraised leadership styles, psychosocial work factors, and musculoskeletal pain among public employees. *Int Arch Occup Environ Health*. 2007;81:19-30.
130. Chiok Foong Loke J. Leadership behaviours: effects on job satisfaction, productivity and organizational commitment. *J Nurs Manag*. 2001;9:191-204.
131. Göransson S, Näswall K, Sverke M. Work-related health attributions: their impact on work attitudes. *International Journal of Workplace Health Management*. 2009;2:6-21.
132. Uegaki K, de Bruijne MC, Anema JR, van der Beek AJ, van Tulder MW, van Mechelen W. Consensus-based findings and recommendations for estimating the costs of health-related productivity loss from a company's perspective. *Scand J Work Environ Health*. 2007;33:122-30.
133. Lindin Arwedson I, Roos S, Björklund A. Constituents of healthy workplaces. *Work*. 2007;28:3-11.
134. Aldana SG. Financial impact of health promotion programs: a comprehensive review of the literature. *Am J Health Promot*. 2001;15:296-320.
135. Tompa E, Dolinschi R, de Oliveira C, Irvin E. A systematic review of occupational health and safety interventions with economic analyses. *J Occup Environ Med*. 2009;51:1004-23.
136. Nyman JA, Barleen NA, Dowd BE. A Return-on-Investment Analysis of the Health Promotion Program At the University of Minnesota. *J Occup Environ Med*. 2009;51:54-65.
137. Engbers LH, van Poppel MN, Chin APMJ, van Mechelen W. Worksite health promotion programs with environmental changes: a systematic review. *Am J Prev Med*. 2005;29:61-70.
138. Stein AD, Shakour SK, Zuidema RA. Financial incentives, participation in employer-sponsored health promotion, and changes in employee health and productivity: HealthPlus Health Quotient Program. *J Occup Environ Med*. 2000;42:1148-55.
139. Mills PR, Kessler RC, Cooper J, Sullivan S. Impact of a health promotion program on employee health risks and work productivity. *American Journal of Health Promotion*. 2007;22:45-53.
140. Marklund S, Bolin M, von Essen J. Can individual health differences be explained by workplace characteristics?--A multilevel analysis. *Soc Sci Med*. 2008;66:650-62.
141. Roos P, Jensen I, Ødegaard F, Bergström G, Bertilson H, Färe R (2005) Health and Productivity (In Swedish), Final report, part 2, AHA-study; Work and Health in the Processing and Engineering Industries, Department of Clinical Neuroscience. Section for Personal Injury Prevention. Karolinska Institute. Institute for applied economics, Malmö., pp. 16.

142. De Greef M, Van den Broek K (2004) Quality of the working environment and productivity, ed. Work EAfSaHa. Belgium, European Agency for Safety and Health at Work.
143. Mills PR. The development of a new corporate specific health risk measurement instrument, and its use in investigating the relationship between health and well-being and employee productivity. *Environ Health*. 2005;4:1.
144. Aldana SG, Merrill RM, Price K, Hardy A, Hager R. Financial impact of a comprehensive multisite workplace health promotion program. *Prev Med*. 2005;40:131-7.
145. Zink KJ. Human factors, management and society. *Theoretical Issues in Ergonomics Science*. 2006;7:437-445.
146. Haller M, Hadler M. How social relations and structures can produce happiness and unhappiness: An international comparative analysis. *Social Indicators Research*. 2006;75:169-216.
147. Pritchard RD. Organizational productivity. In: Dunnette MD, Hough LM, eds. *Handbook of Industrial/ Organizational Psychology (2nd Edition)* Vol. 3. Palo Alto, CA: Consulting Psychologists Press; 1992: 443-471.