

Ph.D. Thesis

Work environment factors
associated with long-term
sickness absence
and return to work

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Summary

The aim of this thesis is to summarize the results of the PhD-project 'Work Environment Factors Associated with Long-term sickness absence and return to work' carried out during the period January 2004 to June 2006 at the National Institute of Occupational Health, Denmark.

The project features five prospective cohort studies focusing on associations between work environment and different sickness absence and return to work outcomes. Specifically for the purpose of this project, a merger between two existing work environment cohorts and one national register was performed.

Results show that 20% of the employees accounted for 80% of total days of sickness absence. 'High sickness absence' defined as having an above mean level of self-reported days of sickness absence from work within a year was associated with working with arms lifted/hands twisted, extreme bending/stooping of the back/neck, repetitive monotonous work, low skill discretion, low decision authority, obesity, current or former smoking, poor self-rated health, female gender, increasing age and working for a public employer. The etiologic fraction attributable to differences in work environment exposures was calculated to be 40%.

Results regarding long-term sickness absence, defined as sickness absence periods exceeding 8 consecutive weeks according to a national sickness absence register, showed that long-term sickness absence was associated with female gender, age, no post-secondary education, and being employed by a municipality. Kindergarten teachers, people in day care, people in health care, janitorial and kitchen staff, and unskilled workers had above average risk. Managers, computer professionals, technicians and designers, and professionals had lower risks than average. The

health care and social service sectors had above average risk, whereas the private administration sector had a lower risk.

A number of work environment factors were found to predict long-term sickness absence: On the individual level, four of the studied physical risk factors predicted long-term sickness absence: Stooping work position, twisting the back, pushing/pulling heavy loads, and physical activity in work, while psychosocial risk factors showed no significant associations with long-term sickness absence. When aggregated to workplace level, three psychosocial factors were associated with increased risk of long-term sickness absence: Low decision authority, low supervisor support, and low management quality. Significant interaction effects were found for four combinations of individual and workplace level risk factors; twisting+management quality, pushing/pulling+ management quality, lifting+management quality and physical activity+management quality.

With regards to findings of predictors for duration of sickness absence and return to work; both individual level physical and psychosocial work environment factors significantly prolonged duration of sickness absence: Low meaning of work, stooping work position, twisting the back, repetitive job tasks was associated with return to work after four weeks, and stooping work position and repetitive job tasks predicted return to work after 12 months year. When aggregated to workplace level, no significant risk factors were found. No significant association between return to work and number of employees was found and no significant association was found between return to work and attitude to sickness absence on the individual level. And, the longer the time to first return to work, the fewer the work environment risk factors were associated with return to work.

It was also investigated if general self-efficacy was associated with sickness absence and return to work: General self-efficacy was significantly lower among those with sickness absence at baseline compared to the general working population. Self-efficacy showed, however, no statistically significant association with later sickness absence or with return to work.

The overall results describe and specify the basic epidemiology of sickness absence in the Danish labor market context. Furthermore, the findings of interaction effects between individual and workplace level dimensions are of importance for interventions aiming at reducing sickness absence. Intervention towards reducing sickness absence may be more effective if it simultaneously addresses both the individual and organizational level of the workplace.

Resumé

Formålet med denne afhandling er at sammenfatte resultaterne fra PhD-projektet 'Arbejds miljøfaktorer associeret med lang tids sygefravær og tilbagevenden til arbejde', udført i perioden fra januar 2004 til juni 2006 ved Arbejds miljøinstituttet, Danmark.

Dette Ph.D.-projekt består af fem prospektive kohortestudier om sammenhænge mellem arbejds miljø og forskellige definitioner af sygefravær og tilbagevenden til arbejde. Specielt med henblik på dette projekt, er der foretaget kobling mellem to allerede eksisterende arbejds miljøkohorter, og Beskæftigelsesministeriets DREAM-register.

Resultaterne viser, at 20% af lønmodtagerne står for 80% af sygefraværet. 'Højt sygefravær', defineret som havende flere selv-rapporterede sygefraværsdage i et givent år end gennemsnittet af befolkningen, var associeret med arbejde med hænderne løftet over skulderhøjde/hænderne drejet, arbejde med bøjet/vredet øvre ryg/nakke, ensidigt gentaget arbejde, lav indflydelse i arbejdet, lave udviklingsmuligheder i arbejdet, svær overvægt, status som nuværende eller forhenværende ryger, dårligt selv-vurderet helbred, køn, alder og ansættelse hos en kommunal arbejdsgiver. Forskelle i arbejds miljø kan forklare 40% af forskellene i sygefravær.

Hvad angår langtidssygefravær, defineret som sygefravær i over 8 sammenhængende uger i henhold til DREAM-registeret, viste at langtidssygefravær var associeret med køn, alder, uddannelsesniveau, og at arbejde for en kommunal arbejdsgiver. Hvad angår jobgrupper, havde daginstitutions- og dagplejepersonale, rengørings-, ejendoms-, og køkkenpersonale, sundhedsplejepersonale og ufaglærte arbejdere signifikant højere risiko end gennemsnittet af de øvrige grupper, hvorimod ledere,

akademikere og IT-personale lå signifikant under. Hvad angår brancher, havde social- og sundhedsbranchen højere risiko end gennemsnittet, mens privat administration lå signifikant under.

Flere arbejdsmiljøfaktorer prædikterede langtidssygefravær: På individniveau blev risikoen for langtidssygefravær øget af arbejde med ryggen foroverbøjet, arbejde med ryggen vredet, træk og skub af tunge byrder, og graden af fysisk aktivitet i arbejdet, mens ingen psykosociale faktorer øgede risikoen for langtidssygefravær. Når de individuelle arbejdsmiljøfaktorer blev aggregeret på arbejdspladsniveau, prædikteredes langtidssygefravær af lav indflydelse, lav støtte fra overordnede og lav ledelseskvalitet. Der blev fundet fire signifikante interaktioner mellem faktorer på individ- og virksomheds-niveau: Vred af ryg+ledelseskvalitet, træk/skub+ledelseskvalitet, løft+ledelseskvalitet og fysisk aktivitet i arbejdet+ledelseskvalitet.

Hvad angår faktorer af betydning for tilbagevenden til arbejde efter sygefravær, blev sygefraværperioden forlænget af både fysiske og psykosociale faktorer i arbejdet: Lav mening i arbejdet, arbejde med ryggen foroverbøjet, arbejde med ryggen vredet og ensidigt gentaget arbejde prædikterede tilbagevenden til arbejde efter 4 uger, og arbejde med ryggen foroverbøjet og ensidigt gentaget arbejde prædikterede tilbagevenden til arbejde efter 12 måneder. Der var ingen sammenhæng mellem langtidssygefravær og individuelle faktorer aggregeret på arbejdspladsniveau. Der var ingen sammenhæng mellem den enkeltes holdninger til sygefravær og tilbagevenden til arbejde. Jo længere tid en person var sygemeldt, jo mindre betydning havde arbejdsmiljøfaktorer målt før sygefraværet opstod.

Det blev ligeledes undersøgt, hvorvidt self-efficacy prædikterede sygefravær og tilbagevenden til arbejde: de personer, som var sygemeldt ved baseline havde signifikant lavere self-efficacy score end de personer der var i arbejde. Der var ingen sammenhæng mellem self-efficacy, incidens af sygefravær, eller tilbagevenden til arbejde.

Projektets resultater beskriver og præciserer sygefraværets epidemiologi på det danske arbejdsmarked. Fundet af interaktion mellem faktorer på individ og arbejdspladsniveau har betydning ved interventioner rettet mod nedbringelse af sygefravær på arbejdspladsniveau: Sådanne interventioner vil være mere effektive, hvis de samtidigt inddrager både det individuelle og virksomhedsniveauet.

Introduction

In 1965, a British researcher presented his considerations about sickness absence and return to work (RTW): ‘Ensuring that employees return to work as soon as possible after sickness absence is a problem which daily confronts the general practitioner. This is but one facet of the age-old tug of war which has been waged between management and worker since biblical times, through the Middle Ages, as during the building of Hampton Court, highlighted by the Industrial Revolution, and now possibly threatening the welfare state. But the difficulty of ensuring the prompt return to work after sickness absence is not limited to Britain, it permeates every industrial society.’ (Ashworth, 1965) Forty years have passed since Ashworth presented his considerations, yet, absence from work due to sickness still has considerable negative effects for employees, employers and the society today. Consequently, sickness absence constitutes a public health problem with economic burdens to modern society (Alexanderson and Nordlund, 2004; Bloch and Prins, 2001; Galizzi and Boden, 1996). *Long-term* sickness absence in particular contributes disproportionately to these economic burdens (Henderson et al., 2005; Bloch and Prins, 2001; Waddell, 2000; Spitzer et al., 1987). Additionally, longer sickness absence is associated with a reduced probability of RTW and subsequent economic and social deprivation (Kivimäki et al., 2004; Vahtera, 2004b, Kivimäki et al., 2003; Lund et al., 2001; Eshøj 2001; Waddell et al., 2000). Furthermore, sickness absence records may provide a useful risk marker for predicting future disability retirements (Kivimäki et al., 2004).

In Denmark there are no comprehensive statistics on sickness absence at the national level. This implies that estimates of prevalence, incidence, and development of sickness absence in Denmark are based on assemblies of fragmented and uncoordinated sources. Thus, these estimates may vary

accordingly. However, in a study performed in eight countries (Sweden, Norway, Finland, the Netherlands, the United Kingdom, Germany, France, and Denmark) it was estimated that Denmark has a lower sickness absence rate than the other Scandinavian countries and the Netherlands (Nyman, 2002). Still, sickness absence affects most of the working population: two thirds of employees during a given year experience sickness absence. The Danish Government has estimated sickness absence in Denmark to be equal to 142,000 full-time jobs yearly based on a composite of diverse statistical material. According to Statistics Denmark, the workforce consists of approximately 2.2 million people. Earlier studies have indicated that Denmark performs poorly in returning sickness absent employees to work: In a cross-national study of RTW among employees with sickness absence for at least three months due to low back pain conducted in six different countries, the investigators found differences in RTW rates of more than a factor of two, partially explained by system specific differences between the six countries. Denmark presented the poorest RTW rates at follow-up after one year: 32% of the population had returned, compared to, for example 73% in the Netherlands (Bloch and Prins, 2001).

As a consequence of the vast cost to employees, employers and society, the Government launched a plan for reducing especially long-term sickness absence and facilitating RTW (Danish Ministry of Employment, 2003), addressing the roles of, and challenges for, various stakeholders, including workplaces, employers' and employees' organizations, the healthcare system, and the case-managing municipal authorities, as well as researchers from a broad array of disciplines.

Unfortunately, there are still relatively few recent studies addressing long-term sickness absence and RTW in the Danish labor market (Lund et al., 2006; Lund et al., 2005; Høgelund, 2003; Eshøj, 2001; Høgelund et al., 2000; Nord-Larsen et al., 1991). Knowledge of the basic epidemiology of who is at risk for long-term

sickness absence and who returns to work is needed in order to plan programs in a specific labor market context (Loisel et al., 2005). Without knowledge of the basic associations between demographic factors, work environment, and workplace characteristics in a working population, it is difficult to target interventions aimed at reducing sickness absence.

Conceptual framework

Sickness absence and RTW are not uniquely biomedical outcomes, but are processes in a variety of social, psychological, and economic factors not necessarily specific to the underlying or precipitating injury or illness (Krause and Lund, 2004; Verbrygge and Jette, 1994). Sickness refers to another dimension than illness and disease, namely the social role that a person who has illness or disease is given, or takes, in a society. What legitimizes such a sick role varies widely over time and among cultures (Alexanderson and Nordlund, 2004). In general, the research field on sickness absence and RTW covers a wide spectrum of concepts from different scientific disciplines; as a consequence many different approaches, explanatory models and different sickness absence and RTW outcome measures are used (Allebeck and Mastekaasa 2004a). Similar terminology is used in the field of i.e. occupational health-, public health-, disability-, and rehabilitation research, but the terminology is not standardized. Different frameworks and models are used for classification of the ability to work.

For this project, a conceptual model which takes into account the dynamics of the work disability process was developed. This conceptual model encompasses both sickness absence and RTW.

The present model is partly inspired by a ‘work disability framework’ in which the concept of ‘disability’ is defined as a dynamic and time-related process (Loisel et al., 2001; Franche and Krause et al, 2002). Work disability is a

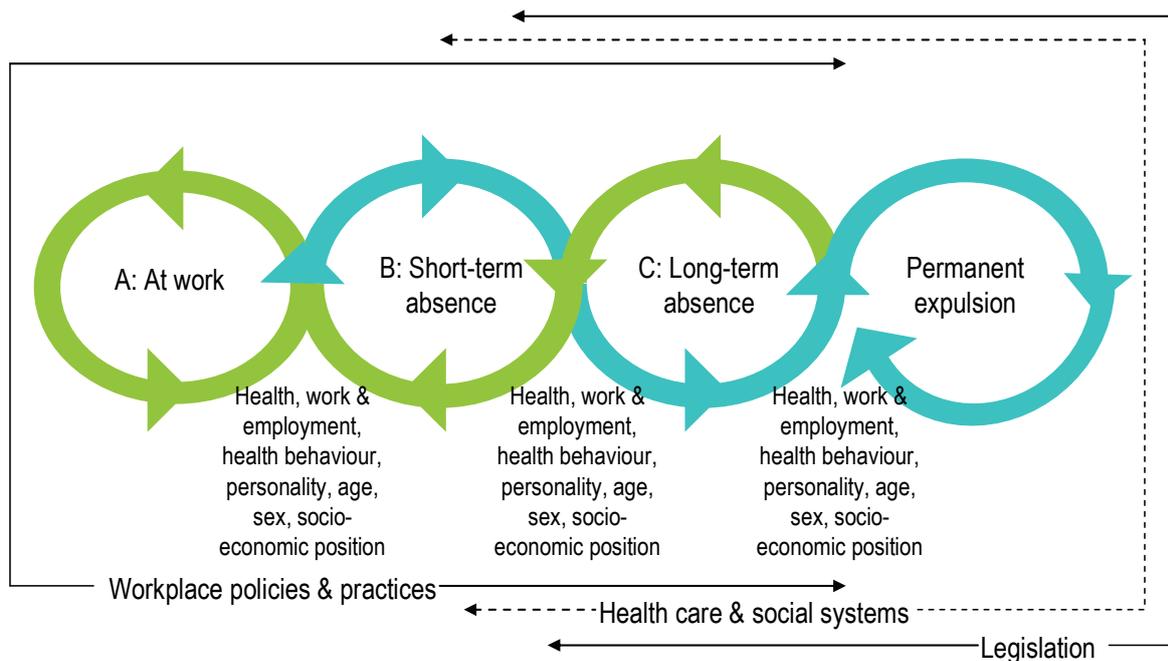
multidimensional problem: work-disabled employees interact with the workplace, healthcare- and social systems, yet little is known about the direct and indirect reasons for prolonged work disability (Loisel et al 2005, Janssen et al., 2003; Durand et al., 2003; Loisel et al., 2001). International theoretical and methodological research has stressed that the impact of risk factors may vary across different phases of the disability process and concomitant RTW (Franche and Krause, 2002; Krause et al 2001; Frank, 1996). When a health problem prevents an individual from working for a longer period of time, this health problem should not only be considered as a disease but also an issue of work disability (Loisel et al., 2005).

The model reflects that sickness absence and RTW is embedded in a context of different but overlapping layers that can be regarded as influencing the work disability process, i.e. health, work environment, individual characteristics, healthcare system, socio-economic aspects and socio-political aspects (Pransky et al., 2005; Loisel et al., 2005; Krause and Lund, 2004). The model illustrates the dimensions known to significantly affect the balance between sickness absence, RTW, and the different phases.

The model defines disability according to a 'social model', which can be distinguished from the medical definition that views disability as a biological characteristic of the individual. The social model is a societal/environmental construct that recognizes the importance of the interaction between the individual and the social and physical environment. Therefore, disability is the inability to perform normal activities or fulfill conventional societal roles. This means that work disability is related to a reduction of task performance and a restriction or incapacity to perform normal work. Because the impairment is related to normal work activities, identical impairments may result in different degrees of work disability according to labor market and social context (Allebeck and Mastekaasa, 2004b; Bloch & Prins, 2001). In one case, impairment may have no

incapacitating effects at all, whereas in another case it may have severe consequences on the ability to perform certain work-related tasks (Stattin, 2005).

Figure 1. Conceptual framework: **The Dynamic Work Disability Model**



This project adapts a workplace perspective on the disability process, meaning that focus is on identifying individual and workplace level factors affecting sickness absence and RTW. The focus is on identifying factors increasing the risk of an individual moving from left to right (from A to B, and from B to C) in the model, as well as factors promoting an individuals move from right to left (B to A, and from C to A), namely returning to work after sickness absence. Healthcare- and social system intervention as well as effects of legislation will not be assessed. The pathways in the conceptual framework of the project will be referred to by the use of AB and C in the text.

Sickness absence - empirical point of departure (from A to B/C in figure 1)

Sickness absence can be used as an integrated measure of physical, psychological, and social functioning in studies of working populations (Kivimäki et al., 2003., Marmot et al., 1995). Sickness absence is associated with health and other various factors, including work environment exposures.

With regard to the physical dimension of work, a recent literature review found weak documentation for the association between some physical exposures in the work environment and sickness absence (Allebeck and Mastekaasa, 2004b).

However, ergonomic conditions, for example uncomfortable working conditions such as heavy physical work, repetitive movements, and high physical demands, have been found to be associated with different definitions of sickness absence (Lund et al., 2006; Hoogendoorn et al., 2002; Voss et al., 2001; Boedeker, 2001; Trinkoff et al., 2001; Hoogendoorn et al., 2000a; Palsson et al., 1998; Blank and Diderichsen, 1995; Houtman et al., 1994).

Furthermore, related studies have demonstrated the association between physical factors in the work environment and musculoskeletal disorders known to be a precursor of sickness absence; static work, vibration and direct mechanical pressure on body tissues (Hartvigsen et al., 2001; Hoogendoorn et al., 2000a; Lings and Leboeuf-Yde, 2000; Battie et al., 1995; Nachemson, 1991). Different models have been used in the literature to explain this association - a strictly biomechanical model is considered to be too limited to fully explain work-related causation of musculoskeletal disorders and is replaced by a biopsychosocial model (Labriola 2004, Loisel et al., 2001; Nachemson and Jonsson, 2000; Bendix et al., 1999; Bendix et al., 1998; Engel 1997, Indahl et al., 1995; Houtman et al., 1994).

A broad range of psychosocial work environment exposures have been found to be associated with sickness absence, e.g. low job satisfaction, low decision latitude, lack of control, high demands, and other work environment stressors

(Lund et al., 2005; Hoogendoorn et al., 2002; Hoogendoorn et al., 2000b; Grossi et al., 1999; Niedhammer et al., 1998; Kivimäki et al., 1997; Hemingway et al., 1997; North et al., 1996; Blank and Diderichsen, 1995).

Only a few studies focus on the association between interpersonal relationships and sickness absence, and it is not possible to draw definite conclusions regarding support from colleagues or superiors. The results are not consistent: Kivimäki et al. found no association (Kivimäki et al., 1997), while a study by Niedhammer et al. and a study by North et al. found an association for men but not for women (Niedhammer et al., 1998; North et al., 1996).

These studies focused primarily on identifying the so-called independent effects of each set of factors on sickness absence when controlling for other exposures. Currently, in the sickness absence research field, interest is moving away from focusing on the effects of physical work environment factors or psychosocial components alone, and is moving towards encompassing the interaction between different dimensions (Lund et al., 2006; Hoogendoorn et al., 2002; Voss et al., 2001).

Furthermore, while most studies conceptualize and measure working conditions as individual exposures, only a few have identified contextual exposures in terms of organizational level risk factors affecting sickness absence (Christensen et al., 2005; Vahtera et al., 2004a; Lund and Csonka et al., 2003; Amick et al., 2000;). Amick *et al* found that duration of absence is shorter in companies promoting an interpersonal and value-focused environment (Amick et al., 2000). Christensen *et al* found that psychosocial factors at the workplace level may be important predictors of sickness absence (Christensen et al., 2005). In the study of Lund *et al* the risk of transition from employment to a combined measure of long-term sickness absence and disability pension was relatively smaller for employees in organizations scoring high on indices of 'employee development' and 'use of

supplementary training' (Lund and Csonka, 2003). And Vahtera *et al* found that job insecurity decrease the likelihood of taking sick leave.

Sickness absence - definitions and measurement

In most occupational health research on sickness absence, the outcome is short-term sickness absence, or there is no distinction between short- and long-term sickness absence.

In the sickness absence literature there is dissimilarity in the way different researchers from different countries define long-term sickness absence and short-term sickness absence. For example, in studies from Kivimaki *et al* long-term sickness absence is defined as sickness absence periods exceeding three days (Kivimäki et al. 2004), as opposed to other studies defining 'long-term' as periods of at least 8 weeks duration (Gjesdal et al., 2004; Eshøj et al., 2001). Only a few studies specifically examine the problem of work environment and long-term sickness absence in a general population (Post et al., 2006; Lund et al., 2006; Post et al., 2005; Lund et al., 2005; Bultmann et al., 2005; Giesdal et al., 2005; Giesdal et al., 2004; Blank and Diderichsen, 1995; Blank and Diderichsen, 1996; Mackenbach, 1992). In addition, there is a difference in inclusion criteria of sickness absence in the literature, for example uncertified and self-certified or covered by a doctor's certificate etc. Furthermore, the methods for calculating sickness absence vary: frequency of sick leave, length of absence, incidence rate, cumulative incidence and duration of sick leave (Hensing et al., 1998). 'Lost time' rate is the most common measure of absence; it expresses the percentage of total time available that has been lost due to absence. Also, frequency rate is used; the method shows the average number of absence days/spells per employee, expressed as a percentage. It gives neither an indication of the length of each absence period, nor an indication of employees who have more than one spell of absence.

Few studies have been conducted on the quality of measurements used in occupational health research. Eight studies were found featuring comparisons of self-reported data on sickness absence and data from employer records (Pole et al., 2006; Ferrie et al., 2005; van Poppel et al., 2002; Severens et al. 2000; Fredriksson et al., 1998; Burdorf et al., 1996; Agius et al., 1994; Bertera 1991). For retrospective measurement of sickness absence, there was little agreement on the duration of sickness absence episodes between questionnaire data and data from employer records. Nearly all report a high specificity of a single question for detecting workers' sickness absence. But at the same time, the results suggest not to use a recall period of more than two months (Severens et al., 2000). Except in the study by Ferrie *et al*, who found agreement between self-reported and recorded number of sickness absence-days over a 12-month period was reasonably good (Ferrie et al., 2005). Pole *et al* found a discrepancy between self-reported and administrative data and suggest that researchers collect both self-report and administrative data (Pole et al., 2006).

Based on these studies it seems that self-reported sickness absence data and employer recordings are equally useful when the recall period is under two months. This, of course, depends on the employer having a reliable registration system of sickness absence episodes. This is not always the case (van Poppel et al., 2002). Additionally, access to employers' sickness absence registers can be problematic, if not impossible (Ferrie et al., 2005).

Return to work - empirical point of departure (from C/B to A figure 1)

Returning to work during recovery after sickness absence benefits most workers (Kompier, 2003).

Studies have shown that the longer a worker is off work due to illness or injury the more likely the person is to be permanently excluded from labor market (Gjesdal et al, 2004; Kivimaki et al., 2004; Frank et al., 1996). The multifaceted

nature of the RTW process is reflected by the broad array of related determinants, representing behavioral, socio-demographic, health-related, work environmental, and employment-related dimensions (Krause and Lund, 2004). There seems to be general agreement on factors related to a longer time to return to work: female gender, increased age and low education (Krause and Lund, 2004). Regarding psychosocial job characteristics, the literature provides broad evidence that all the following factors have prolonging disability effects: low control over work, particularly over the work and rest schedule; high psychological job demands; low skill discretion, and high job stress or job strain (Krause and Lund, 2004). Inconsistent findings are reported for social support at work; some studies linked low supervisor support (Lotters et al., 2005; Krause et al., 2001) or low co-worker support (Post et al 2005., van der Weide et al., 1999) to prolonged disability; other studies reported no effect (Marklund, 1995).

The following physical job demands of various forms have been found to constitute important barriers to RTW: heavy physical labor, repetitive or continuous strain, musculoskeletal strain, and uncomfortable working positions all prolong work disability (Krause and Lund, 2004). Only one study found no effect of heavy physical labor on RTW (Infante-Rivard and Lortie, 1996).

Regarding the effects of company and firm ownership, disability seems to be prolonged if the company is private vs. public, whereas conclusions regarding number of employees are unclear (Krause and Lund, 2004; Krause et al., 2001; Galizzi and Boden, 1996). Both high physical and psychological job demands appear as independent barriers to RTW (Krause et al., 2001).

Concerning these studies on sickness absence and RTW, most studies conceptualize and measure working conditions as individual exposures, while only a few and relatively recent studies have identified contextual exposures in terms of organizational level risk factors affecting duration of sickness absence (Väänänen et al., 2003; Amick et al., 2000; Undén, 1996; Galizzi and Boden,

1996). Effects of negative health behavior have proven strong predictors of onset of work disability (Lund and Csonka, 2003; Lund et al., 2001) and permanent work disability (Rothenbacher et al., 1998). Health is naturally associated with sickness absence, and global health measures, such as self-reported health, have been proven as predictors of duration of sickness absence and RTW (Post et al., 2006; Marmot et al., 1995). One study by Bloch and Prins found unclear results on self-rated health and RTW; the variable general health was included, but the results were not described (Bloch and Prins, 2001).

Self-efficacy has been highlighted in the literature as playing an important role in the RTW process (Katz et al., 2005, Franche and Krause, 2002; Due et al., 2002; Arnstein, 2000). Self-efficacy is generally defined as confidence in being able to carry out a set of specified activities (Bandura, 1977). It is presumed to be a consequence of the interplay of the employment situation, the medical care process, and the individual worker's health and personal characteristics (Shaw and Huang, 2005).

From a study on challenges for future RTW research, the following conclusion was drawn: predictors of RTW originate from several levels, from the 'individual level' to 'society level' (Krause et al., 2001). These levels interact with each other in many ways, and models of disability are needed to describe these interactions qualitatively and quantitatively. Analytic methods of approaching such complex relationships include, for example, path analyses and structural equation modeling for multi-step processes as well as hierarchical regression modeling for multi-level analyses (Alexanderson and Hensing, 2004; Krause et al., 2001; Diez-Roux, 1998).

Return to work - definitions and measurement

Operationalizations of RTW vary considerably (Johansson et al., 2006; Krause and Lund, 2004; Krause et al., 2001). Some researchers see RTW as a misleading indicator of the effectiveness of healthcare intervention, because RTW does not

necessarily correlate with the health status of the worker (Ferguson, 2000). However, it can be argued from an occupational healthcare perspective, that RTW should be considered an important primary outcome measure. The term ‘RTW’ refers to a variety of related concepts and definitions of vocational outcomes after sickness absence that are used to describe the duration or extent of an inability to work due to impaired health or functional limitations. A recent RTW literature review presents the following summary of RTW definitions: duration of work disability can be defined (1) cumulatively, as the duration of all days lost from work, beginning with the first date of sickness absence, (2) categorically (e.g., RTW ever yes/no; working at time x yes/no), or (3) continuously, as time-to-RTW (e.g., calendar time from date of first sickness absence to date of first RTW; or to sustained RTW, i.e., the end of the last missed work day after a series of disability episodes). RTW may be qualified as return to the same employer or the same job. Measurements may be based on actual RTW; ability to RTW; time receiving workers’ compensation wage replacement benefits; earnings data; the presence of a job offer; sick-leave that is not paid for by workers’ compensation, but is sometimes a result of occupational injury or illness; or various sequential combinations of different RTW outcomes (‘RTW patterns’), with or without gaps. Several types of job separation may occur as indirect measures of RTW outcomes, including involuntary termination, unemployment, or retirement (Krause and Lund, 2004).

The outcomes time-to-RTW have limited value and should always be supplemented with measures more inclusive of recurrences (Krause et al., 2001; Dasinger et al., 1999; Galizzi and Boden, 1996): From an occupational healthcare perspective, successful RTW is achieved only when there is no relapse and work is sustained over a longer period of time. Hesitation to return to work after sickness absence involves not only concerns about re-occurrence of sickness absence, but also the perceived ability to perform expected tasks, meet role

expectations, and maintain job security (Shaw et al., 2002). Factors that force sick-listed employees into a premature and unsafe RTW are seldom considered in the literature. It is important to consider that fear of losing one's job and financial strain will weigh in the employee's decision balance and can contribute to the decision of returning to work too soon, increasing risk of re-injury and ill health (Pransky et al., 2005; Butler et al.,1995).

Objectives of the thesis

In order to facilitate intervention strategies in an efficient way, the impact of work environment risk factors in the work disability process needs to be established in a Danish context. In this thesis focus is on both the individual level and the workplace level.

1. Is there an association between psychosocial and physical work environment exposures and sickness absence taking into account health, health behavior, and employer characteristics?
2. What is the potential sickness absence reduction through work environment improvement?
3. Who is at excess risk for long-term sickness absence in the Danish working population?
4. Is general self-efficacy measured before occurrence of sickness absence associated with RTW after sickness absence?
5. Is there a difference in self-efficacy score between the general working population and sickness absent employees?
6. Are the effects of individual level measures of psychosocial and physical work environment factors on long-term sickness absence modified by workplace level factors?
7. Are the effects of individual level measures of psychosocial and physical work environment factors on RTW modified by workplace level factors?

The research questions are answered with five studies presented in the following five papers, which are referred to in the text by their roman numerals.

- I. **Labriola M**, Lund T, Burr H. Prospective study of physical and psychosocial risk factors for sickness absence.
- II. **Labriola M**, Lund T, Christensen KB, Albertsen K, Bültmann U, Villadsen E. Does self-efficacy predict return to work after sickness absence?
- III. Lund T, **Labriola M**, Villadsen E. Who is at risk for long-term sickness absence? A prospective cohort study of Danish employees.
- IV. **Labriola M**, Lund T, Christensen KB, Nielsen ML, Diderichsen F. Multilevel analysis of workplace and individual risk factors for long-term sickness absence.
- V. **Labriola M**, Lund T, Christensen KB, Kristensen TS. Multilevel analysis of contextual and individual factors as predictors of return to work.

Material

The five papers are based on data from two existing work environment cohorts and one national register:

- a) The Danish Work Environment Cohort Study (DWECS)
- b) Intervention Project on Absence and Well-being (IPAW)
- c) DREAM (a Danish acronym for The Register-based Evaluation of Marginalization)

Specifically for the purpose of this project, a merger between IPAW and DREAM was performed:

- a) The Danish National Work Environment Cohort Study (DWECS) features three panels: 1990, 1995, and 2000. For Study **I** the 1990-panel was used. In 1990, a random sample of 9653 persons between 19 and 59 years of age was drawn from the Central Population Register of Denmark. The cohort was re-interviewed in 1995 and a random sample of persons between 18 and 22 years of age was added; 333 persons had died or immigrated and the 1995 cohort then consisted of 10,703 adults between 18 and 64 years of age. Of these, 8583 (80.2%) agreed to be interviewed by telephone; 5575 were employees or had been so 2 months prior to the interview. They constitute the basis of analysis for Study **I**. Study **II** and **III** are based on the 2000-panel and feature a random sample of 11,437 people living in Denmark, of which 8583 (75%) participated in interviews. Of these 5357 were aged 18-69 and had worked as employees for at least 2 months prior to the baseline interview. The interviews include questions about work environment exposures, age, gender, education, family status, and health behavior. (Lund et al., 2006; Burr, 2003). Psychosocial work environment risk factors were measured with 42 items combined into 13 scales. The scales for decision authority, skill discretion,

and social support from co-workers and supervisor derive from the Danish translation (Netterstrøm, 1998) of the scales developed for the Whitehall II study. (Marmot et al., 1995) The scales for meaning of work and predictability were developed by Nielsen and colleagues (Nielsen et al., 2002). The characteristics of the psychosocial work environment scales are to be found elsewhere (Lund et al., 2005). Physical work environment risk factors were measured with 11 questions combined into 5 indices. Three indices measured uncomfortable work positions: extreme bending or twisting of the neck or back, working with arms lifted or hands twisted, and working mainly a standing or squatting position. Two indices measured physical workload in terms of lifting or carrying loads, and pushing or pulling loads (Lund et al., 2006).

b) IPAW includes a sample from 52 worksites (clusters) with 2730 employees. All 52 worksites belong to one of three organizations: 1) a major pharmaceutical company (production factories, packaging units, laboratories, canteens and cleaning departments; 13 workplaces, 731 respondents), 2) municipal workplaces in the care sector (15 nursing homes for the elderly and 7 institutions for the mentally handicapped; 994 respondents), and 3) the technical services of the municipality (cemeteries, parks, workshops, sewage pumping stations, road construction and repair, administrative offices; 17 workplaces, 343 respondents). The baseline questionnaire was sent to the participants between May 1996 and April 1997. Of the 2730 employees, 2053 completed the questionnaire, yielding a participation rate of 75.2%. The level of education and social status was generally low, 63% of the respondents were skilled, semi-skilled or unskilled workers. A more detailed description on the rationale, design, study population, and measurements of IPAW can be found elsewhere (Nielsen et al., 2004; Nielsen et al., 2002).

c) DREAM is a national register on social transfer payments and contains information on all social transfer payments for all citizens in Denmark since mid-1991, including all granted sickness absence compensation (SAC) since 1996. The type of social transfer payment is reported per week for each person. DREAM includes approximately 3.2 million people and is updated every three months. The register is further supplemented with information on ethnic background, marital status, town of residence, unemployment insurance fund membership, immigration, transition to old-age pension, and mortality. The weekly information on transfer payments is registered if a person has received any kind of transfer payment for more than one day. It is possible to register only one weekly type of information on transfer payment; if more are registered, the system will, in some cases, overwrite the codes when it is updated. SAC always has the higher priority. SAC is given to the employer, who can apply for a refund from the state for employees, after two weeks of sickness absence, providing the employee has been employed for 8 consecutive weeks prior to sickness absence and has worked for at least 74 hours during this period. The employee is eligible for SAC from the municipality if he or she has been employed for at least 13 consecutive weeks prior to sickness absence and has worked for at least 120 hours during this period. Exceptions to this rule can be made if the employee is a member of an unemployment insurance fund, has completed vocational training of at least 18 months within the last month, or is a trainee. Maternity related absence is excluded.

Methods

This section summarizes the analysis and outcome measurements used in the project.

All papers are based on prospective cohort studies. The design characteristics of the five papers are presented in Table 1.

Study	Design	Study population	Analysis
I	Prospective cohort study of employees with 60-month follow-up	DWECS 1995 (baseline) and 2000 (follow-up) panels. Questionnaire based. N=3792	Logistic regression
II	Prospective cohort study of employees with at least two weeks of sickness absence with 12-month follow-up	DWECS 2000 panel. Cases identified and followed-up in the DREAM register. Questionnaire and register based. N= 930	Cox proportional hazards model
III	Prospective cohort study of employees with 30-month follow-up	DWECS 2000 panel. Followed-up in the DREAM register. Questionnaire and register based. N=5357	Logistic regression
VI	Prospective cohort study of employees with 60-month follow-up	IPAW study baseline participants 1996-1997 followed-up in the DREAM register. Questionnaire and register based. N=1610	Multilevel logistic regression
V	Prospective cohort study of employees with at least two weeks of sickness absence with 12-month follow-up	IPAW study baseline participants 1996-1997. Cases identified and followed-up in the DREAM register. Questionnaire and register based. N=428	Multilevel logistic and Poisson regressions

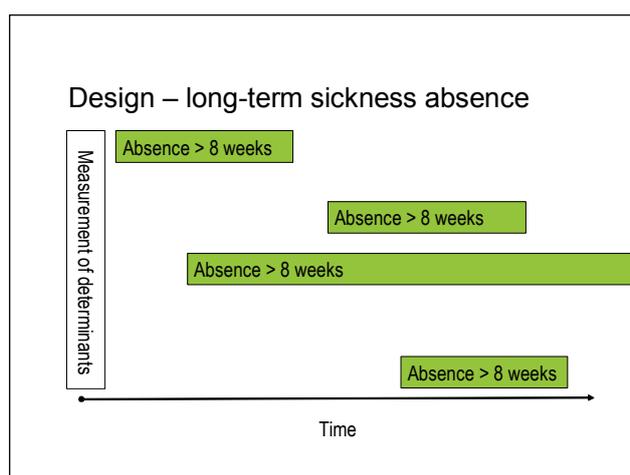
Study I) Analyses used in this cohort study based on DWECS were, firstly, logistic regression methods to analyze the associations between the risk factors and the outcome variable “high absence” defined as above-average number of days of self-reported absence in the previous year. Secondly, the proportion of high sickness absence attributable to differences in work environment exposures – the etiologic fraction - was calculated on the basis of this model (Hosmer and Lemeshow, 1989).

Studies II and III) Both studies are based on a merger between DWECS and DREAM. Study II the Cox proportional hazards model (time to event analyses, the event being RTW) was used to calculate age-adjusted Hazard Ratios for RTW. Logistic regression methods were used to analyze the associations between the baseline determinants and the outcome variable. Study III logistic regression analyses were performed to establish associations between socio-demographic characteristics, occupational characteristics, and long-term sickness absence.

Studies VI and V) For the purpose of these two studies, a merger between IPAW and DREAM was performed. A multi-level logistic regression model was used in both studies.

Measurement of sickness absence and return to work

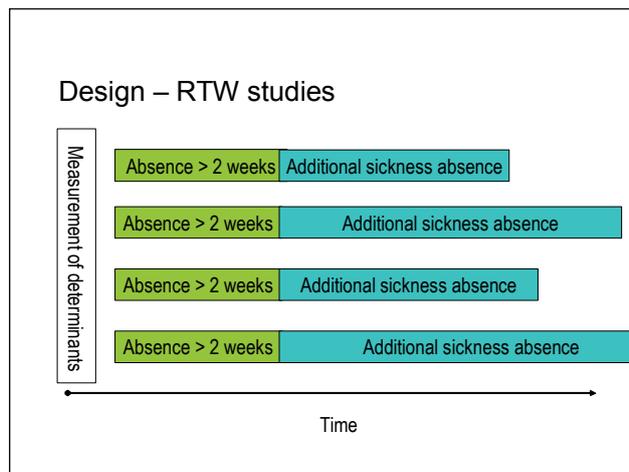
Self-reported sickness absence during the previous year was measured with one question in DWECS ‘How many workdays in total have you been sickness absent within the last 12 months?’ (Study I). The DREAM register was used to identify employees who experienced sickness absence periods exceeding two weeks between January 1, 2001 and June 30, 2002 (Study II).



Furthermore, DREAM was used to identify sickness absence for eight weeks or more. Eight weeks of sickness absence was chosen as the cut-off point for inclusion of individuals on sick leave, as this was the time at which it becomes known to the case managing municipal

authorities that an individual is on sick leave (Study III and VI).

The DREAM register was also used to measure RTW: people were assumed to



have returned to work upon cessation of sickness absence benefit and when having received no other social transfer benefits for at least one week. Further RTW definitions used in this project's study **V** are (1): 'RTW within four weeks of the onset of sickness absence', (2): 'RTW within one year of the onset of sickness

absence' and, (3): 'Duration of sickness absence'.

Summary of the five studies

This section briefly summarizes the results of the five papers that constitute the basis of this thesis.

A comprehensive overview of risk factors, determinants, and results is presented in Table 2.

I. Risk factors in work, health and health behavior for sickness absence: results from a longitudinal study of 3792 Danish employees.

This study gives a broad overview of risk factors associated with sickness absence (pathway from A to B in Figure 1 ‘Conceptual Framework’), defined in terms of self-reported number of days of absence from work during a year.

Additionally, the potential gain in sickness absence reduction through work environment improvement is estimated. The aim of the study was to examine the associations between psychosocial and physical work environment exposures, employer characteristics, self-rated health and health behavior, and sickness absence from work five years after exposure among employees in Denmark.

In 1995, a random sample of 5574 employees aged 18-64 was interviewed. In 2000, 3792 of those still employed supplied data on days absent from work the year preceding date of follow-up. Associations between risk factors at baseline and sickness absence at follow-up were studied. Logistic regression analyses were performed.

The 3792 employees reported a total of 23,767 days of sickness absence during the year preceding follow-up (mean = 6.27, range 0-215 days); 2310 employees (60.9%) reported one or more days of sickness absence. 20% of the employees accounted for 80% of total days of sickness absence. Sickness absence was associated with working with arms lifted/hands twisted, extreme bending/stooping of the back/neck, repetitive monotonous work, low skill discretion, low decision authority, obesity, current or former smoking, poor self-

rated health, female gender, increasing age and working for a public employer. The etiologic fraction attributable to differences in work environment exposures was calculated to be 40%.

II. Does self-efficacy predict return to work after sickness absence?

This study compares the levels of self-efficacy among the general working population and sick-listed people (compares A and B) and examines if general self-efficacy measured before occurrence of sickness absence predicts subsequent sickness absence (A to B) and RTW (pathway from C to A in Figure 1 ‘Conceptual Framework’).

In 2000, a random sample of 5357 employees, aged 18-69, was interviewed regarding work environment, health, and self-efficacy. People experiencing sickness absence periods of two weeks or more in a timeframe of 78 weeks were identified using DREAM and followed-up over one year from onset of sickness absence. The Cox proportional hazards model (time to event analysis, events being RTW) was used to calculate age-adjusted Hazard Ratios.

General self-efficacy was significantly lower among those on sick leave at baseline compared to the general working population. Self-efficacy showed, however, no statistically significant association with later sickness absence or with RTW.

III. Who is at risk for long-term sickness absence? A prospective cohort study of Danish employees

This paper gives an overview of demographic and workplace characteristics associated with long-term sickness absence (A to C in Figure 1 ‘Conceptual Framework’). The objective was to pinpoint populations and jobs with excess risk and jobs rather than causal relations. In 2000, a random sample of 5357

employees aged 18-69, was interviewed; the cohort was followed-up in the DREAM register from January 1, 2001 to June 30, 2003.

The outcome of this study, long-term sickness absence, was defined as receiving sickness absence compensation for at least eight consecutive weeks registered in DREAM. Determinants in this study were gender and baseline age, and educational level. Employer characteristics were measured by number of employees and employer ownership. The population was divided into job groups and sectors.

Logistic regression methods were used to analyze the associations between the baseline determinants and the outcome variable, which was onset of long-term sickness absence exceeding eight weeks. During the follow-up period 486 persons (9.1%) experienced one or more periods of long-term sickness absence. The study shows statistically significant associations between long-term sickness absence and female gender, age, no post-secondary education, and being employed by a municipality. Kindergarten teachers, people in day care, people in health care, janitorial and kitchen staff, and unskilled workers had above average risk. Managers, computer professionals, technicians and designers, and professionals had lower risks than average. The health care and social service sectors had above average risk, whereas the private administration sector had a lower risk.

The two studies based on IPAW/DREAM are as follows:

VI. Multilevel analysis of workplace and individual risk factors for long-term sickness absence

This study examined if psychosocial and physical work environment factors predict long-term sickness absence at the individual level and at the workplace level (A to C in Figure 1 ‘Conceptual Framework’).

Data were collected in 52 Danish workplaces during the IPA W project. Psychosocial factors were aggregated as workplace means. Multilevel logistic regression models were used with psychosocial factors as predictors of onset of long-term sickness absence during a 5-year period based on data from DREAM. A total of 402 (25%) of the 1610 persons experienced at least one period of long-term sickness absence during the 5-year follow-up period. A number of work environment factors were found to predict long-term sickness absence: On the individual level, four of the studied physical risk factors predicted long-term sickness absence: Stooping work position, twisting the back, pushing/pulling heavy loads, and physical activity in work, while psychosocial risk factors showed no significant associations with long-term sickness absence. When aggregated to workplace level, three psychosocial factors were associated with increased risk of long-term sickness absence: Low decision authority, low supervisor support, and low management quality. Significant interaction effects were found for four combinations of individual and workplace level risk factors; twisting+management quality, pushing/pulling+management quality, lifting+management quality and physical activity+management quality.

V. Multilevel analysis of contextual and individual factors as predictors of Return to Work.

This study examined the effects of physical and psychosocial work environment risk factors and RTW outcomes (C to A in Figure 1 ‘Conceptual Framework’). Furthermore the potential effect of number of employees and employee attitude to sickness absence was studied.

Baseline data from 52 workplaces were linked to DREAM; 428 persons with more than two weeks of sickness absence during a two-year period were identified. Follow-up was one year in order to examine three RTW outcomes. Multilevel logistic and Poisson regression models were used.

Of the 428 persons, 367 (85.7%) returned to work within one year after the onset of sickness absence. Of these, 315 (85.8%) returned to a job in the same organization. The mean duration of sickness absence was 9.1 weeks. The median duration was 4 weeks.

With regards to findings of predictors for duration of sickness absence and return to work; both individual level physical and psychosocial work environment factors significantly prolonged duration of sickness absence: Low meaning of work, stooping work position, twisting the back, repetitive job tasks was associated with return to work after four weeks, and stooping work position and repetitive job tasks predicted return to work after 12 months year. When aggregated to workplace level, no significant risk factors were found. No significant association between return to work and number of employees was found and no significant association was found between return to work and attitude to sickness absence on the individual level. And, the longer the time to first return to work, the fewer the work environment risk factors were associated with return to work.

Overview of results

Table 2 Overview of results

Study	Main risk factors	Co-variables	Outcome	Results
I	Physical and psychosocial work environment, health behavior, Self-rated health, number of employees, employer ownership, age, gender	Risk estimates calculated for all included variables	Above mean number of self-reported days of sickness absence from work the year prior to interview.	Arms lifted/hands twisted (OR=1.3) Bending/stooping (OR=1.45) Repetitive monotonous work (OR=1.23) Low skill discretion (OR=1.23) Low decision authority (OR=1.23) BMI \geq 30 (OR=1.57) Current (OR=1.61) or former (OR=1.32) smoking Poor Self-rated Health (OR=1.69) Female gender (OR=1.31) 1 year increase in age (OR=1.02) Public employer (OR=1.26) Etiologic fraction: Differences in work environment account for 40% of high sickness absence.
II	Self-efficacy	Age	Onset of sickness absence periods <3 weeks, RTW defined as cessation of sickness absence benefits after sickness absence periods of two weeks or more during a 12-month follow-up	Those sick-listed at baseline had lower self-efficacy (mean=75.1) than those working (mean=82.9). Among those working at baseline, self-efficacy showed no association with sickness absence/RTW.
III	Age, gender, education, number of employees, employer ownership, job group (12 groups), business sector (11 sectors)	None. All estimates for main determinants are unadjusted	Onset of sickness absence periods of 8 weeks or more during a 30-month follow-up	Female gender (PPR=1.36) Age 40-49 (PPR=1.68) No post-school education (PPR=3.68) Municipal employer (PPR=1.75) Kindergarten teachers/daycare jobs (PPR=1.80) Healthcare jobs (PPR=1.41) Cleaners, janitors and kitchen staff (PPR=1.63) Unskilled workers (PPR=1.40) Managers (PPR=0.61) Computer pros/technicians/designers (PPR=0.37) Professionals (PPR=0.26) The healthcare/social work sector (PPR=1.63) Private administration sector (PPR=0.55)

IV	Physical (6 measures) and psychosocial (7 measures) work environment	Age, family status, organization, intervention assignment, smoking status, alcohol consumption, BMI, attitude to absence	Onset of sickness absence periods of 8 weeks or more during a 30-month follow-up	<p>Individual level Stooping work position (OR=1.20) Twisting the back (OR=1.33) Pushing/pulling heavy loads (OR=1.15) Physical activity in work (1.43) Low decision authority (OR=2.17) Low supervisor support (OR=2.04) Low management quality (OR=1.75) Workplace level Low decision authority (OR=2.17) Low supervisor support ((OR=2.04) Low management quality (MQ) (OR=1.75) Interactions (OR for combined effects) Twisting X MQ (OR=2.94) Pushing/pulling X MQ (OR=3.08) Lifting X MQ (OR=3.82) Physical activity X MQ (OR=3.22)</p>
V	Physical (7 measures) and psychosocial (8 measures) work environment	Age, family status, organization, intervention assignment, smoking status, alcohol consumption, BMI, attitude to absence	<p>1. RTW within 4 weeks after sickness absence periods of 2 weeks or more during a 12-month follow-up</p> <p>2. RTW within 4 weeks after sickness absence periods of 2 weeks or more during a 12-month follow-up</p> <p>3. Duration of sickness absence periods of 2 weeks or more during a 12-month follow-up</p>	<p>1. Individual level Low meaning of work (OR=0.67) Stooping work position (OR=0.71) Twisting the back (OR=0.75) Repetitive job tasks (OR=0.74)</p> <p>2. Individual level Stooping work position (OR=0.68) Repetitive job tasks (OR=0.64)</p> <p>3. Individual level Low decision authority (RR=1.15) Low meaning of work (RR=1.25) Lifting more than 30 kg (RR=1.29) Pushing/pulling heavy burdens (RR=1.18)</p>

General discussion

Methodological and theoretical aspects

The aim of this part of the thesis is to discuss study designs, results and the relevance and appropriateness of the methods used. Lastly, implications for future sickness absence and RTW research based on this project will be suggested.

Design

According to a recent review of sickness absence research, the majority of studies performed and reported in international literature suffer from severe methodological deficiencies when it comes to causality, selection and confounder control (Allebeck and Maastekaasa, 2004b). The use of longitudinal designs improve the likelihood of drawing conclusions on causal relations, or at least argue that certain statistical associations can be understood in a causal term, as opposed to cross-sectional designs (Taris and Kompier, 2003). Two observations are adequate for studying individual processes; two observations can provide information about change over time: ‘Two waves of data are still better than one’ (Taris and Kompier, 2003). However, limitation arises from collecting the data at two points in time; no information is collected on events taking place in the years between baseline and follow-up that might affect the outcome under study. This, however, is most likely to be the case in the studies with the longest follow-up periods, namely **I**, **IV** and to a lesser extent **III**. Also, for all five studies, baseline exposures are measured as point estimates, giving no information on duration of exposure.

Concerning occupational factors, most studies conceptualize and measure working conditions as individual exposures, while only a few and relatively recent studies have identified contextual exposures in terms of organizational level risk factors affecting duration of sickness absence (Lund and Csonka, 2003;

Väänänen et al. 2003; Amick et al 2000; Undén et al., 1996; Galizzi and Boden, 1996). In order to address interactions between individual and contextual levels, a prospective design with clustersamples was used in Study **IV**, and psychosocial factors were aggregated as workplace means. In Study **V** the same design was used but here the outcome was RTW. Using clustersamples and multilevel analysis opens up the possibility to simultaneously examine the effect of individual level and workplace level. Aggregated data are constructed by combining information at the lower level of which the higher level is composed. The idea is that aggregated variables are merely summaries of the properties of lower level units and not measures of higher level properties. Besides aggregated data, independent workplace level variables could be of scientific interests for future research designs. In studies **IV** and **V** the workplace mean is the best measure of the workplace level of psychosocial factors. For use of workplace mean in future research, workplaces with equal size would be preferable, to calculate the mean accurately.

Bias

In much occupational health research, the study population is from the same job group or company, and thus more homogeneous with regard to work environment exposures than the working population in general. This might reduce exposure contrast and reduce the generalizability of the results.

In the case of the three studies from DWECS, selection bias occurs not from the sampling procedure while data is from a representative sample of the Danish population, but due to a non-response rate between 20% (Study **I**) and 25 % (studies **II** and **III**). One source of error could be that not all the subjects selected, completed and returned the questionnaires, and non-responders may have had a different work environment or health from those who replied.

Estimating the effect of work environment in a working population introduces some limitations due to the ‘healthy worker effect’. It is likely that the effect of the studied risk factors on sickness absence is underestimated, as the most severe cases, such as employees becoming disability pensioners during the study period, are not included in the studied population. This only concerns Study **I**, as the remaining studies **II** through **V** only study persons under risk for sickness absence, censoring disability pensioners, old age pensioners, people who immigrate, and all others no longer under risk for sickness absence. Follow-up bias was limited while register data was used in studies **II**, **III**, **IV** and **V**. Underestimation of days of sickness absence is discussed in further detail in the section on sickness absence measurements.

The two studies on the IPAAC cohort, studies **IV** and **V**, are not representative of the working population in Denmark, but rather tend to represent occupational subgroups known to have an above-average level of absence. This could influence the balance between effects of psychosocial and physical risk factors, as these are unequally distributed between jobs, and the presented long-term sickness absence incidence estimates are not representative of the population in general.

Confounding

The studies also feature a broad array of potential confounders otherwise known to affect the outcomes under study. With regard to selection of potential confounders, selection was made based on studies of relevant literature reviews, encompassing variables relating to age, gender, physical and psychosocial work environment, health behavior, family status, educational level, and employer characteristics. In the literature on the physical risk factors, no gold standard was found. Some studies adapt a broad understanding of physical work environment,

additionally encompassing exposures to, for example, vibration and unpleasant temperature (Hansson and Jensen, 2004, Vahtera, 2000).

These residual confounders, as well as effects of health care and social systems, and legislation, were not included in any of the performed studies. Therefore, their independent and combined effects with the risk factors studied here are unknown. In order to be included in any of the five studies, people should be working without sickness absence for at least two months prior to inclusion. This was done in order to minimize confounding effects of poor health. Control for health at baseline would have underestimated the effects of work environment in these designs, as it would overlook the effect of work environment on health. Study **I** was controlled for self-rated health status at baseline, which had no effect on the explanatory value of the work environment under study.

Furthermore, when interpreting the results of Studies **I**, **II** and **III** specifically, it should be considered that exposure data were gathered with a work environment surveillance purpose, rather than a sickness absence research purpose. For example, in Study **II**, the self-efficacy measurement was shortened from 9 to 3 items because it was meant for surveillance and not for sickness absence research. As a consequence, some residual confounding cannot be ruled out, as many workplace exposures were not measured. For future research on sickness absence and RTW, cohorts designed for this purpose are preferable. Conversely, the broad scope of DWECS has enabled a more explorative analysis perspective than would otherwise have been the case.

In order to take into account the confounding effects of baseline sickness absence, the studies specifically addressing onset of sickness absence (**I**, **III**, **IV**) included only people who were employed and who had no sickness absence two months prior to entering the studies. With regard to the study on RTW (**V** and partly **II**), the study populations were identified using sickness absence registers

in order to include only people beyond specific threshold levels of sickness absence.

Exposures

In Studies **III**, **IV** and **V** the psychosocial scales decision authority, skill discretion, and social support from co-workers and supervisor derive from the Danish translation (Netterstrøm, 1998) of the scales developed for the Whitehall II study (Marmot et al., 1995; North et al., 1996). When reviewing the literature on occupational risk factors for sickness absence, consensus was found on these psychosocial measurements (Lindberg, 2006). The questions were transformed into indices and scales. All scales used for these studies were statistically validated, either in these studies or in previous studies (Lund et al., 2006; Lund et al., 2005); the same applies for health behavior and employer characteristics. Baseline data were collected according to the best instrument at the time of design if the study. Development since then have led to new instruments exploring other, related, dimensions of the psychosocial work environment, originating from i.e. organizational justice (Elovainio et al., 2002) and effort/reward imbalance (Siegrist, 1996). A future challenge could be to explore the explanatory value of these measures in relation to sickness absence and RTW. The physical risk factor measures in the work environment used in Studies **I**, **IV** and **V** are based on employee self-report, as opposed to other recent studies on physical work environment and sickness absence (Voss et al., 2001; Boedeker 2001; Trinkoff et al., 2001). This raises the discussion of so-called subjective and objective measures. The studies by Boedeker and Trinkoff *et al* differ in terms of measurement method: the study by Trinkoff *et al* was based on employees' self-reported assessment of exposure, (Trinkoff et al., 2001), whereas the study by Boedeker featured an external expert evaluation of exposures (Boedeker 2001; Trinkoff et al., 2001). In relation to this project, the issue of subjectivity of the

measurement of physical exposures is considered to be less relevant because of the longitudinal design allowing (employee reported) exposure assessment before (register recorded) onset of long-term sickness absence. While baseline measurements were questionnaire-based and register data were used to establish the outcome, the possible common method variance and the related positive bias is eliminated (Spector et al., 1987).

Measurement of sickness absence

Studies I-V applied a variety of measures of sickness absence, as different risk factors are associated with different length of absence. Based on these five studies (I-V), there is reason to believe there are different causes for short and long-term sickness absence. Few studies specifically examine the problem of long-term sickness absence (Henderson et al., 2005; Gejsdal et al., 2004, Eshøj et al., 2001). In this thesis, cases have had a period receiving sick-leave compensation of eight weeks or more. Eight weeks is a long period compared to the definition of long-term and short-term sickness absence used in some other studies.

Finally, the use of self-reported data on sickness absence to establish outcome must be addressed.

Only a few studies have been conducted on the quality of measurements used in occupational research (Ferrie et al., 2005; van Poppel et al., 2002; Severens et al., 2000; Fredriksson et al., 1998; Burdorf et al., 1996; Bertera 1996; Agius et al., 1994), and based on these studies it seems that self-reported sickness absence data and employer recordings are equally useful when the recall period is under two months. By using employer records, the problem of recall bias is eliminated. Nevertheless, any systematic recording of non-illness related absence as well as sickness absence in the lower grade, or under-recording in the higher grades may introduce another source of bias.

In relation to Study I the basic retrospective measure of frequency was used 'How many workdays in total have you been sickness absent within the last 12 months?' According to the majority of the found studies, the recall period is too long, and the possibility of a systematic over- or underestimation of sickness absence is present, most probably a systematic underestimation (Severens et al., 2000). It is therefore likely, that the identification of the part of the population contributing to 80% of the sickness absence in this study would have yielded similar results using register-based data. According to this result, an identical distribution of absence was found in a population of 5111 employees from 10 Finnish hospitals, where 20% of the population accounted for 80% of the total absence (personal communication March 2006, Prof. Mika Kivimäki, Principal Investigator of The Finnish Hospital Personnel Study) and very similar data were found in a Norwegian study showing a 30/70 distribution (Dahle and Petersen., 2005).

Study I furthermore addresses the fraction of sickness absence that can be attributed to work environment exposures. Various types of attributable fractions can be calculated; adjusted, sequential and average attributable fractions (Eide and Heuch, 2001). Due to having multiple occupational exposures the adjusted attributable fractions was calculated. This fraction is used as an indicator of the potential for reducing sickness absence through work environment improvement. In Study I, the estimate of this potential is based on the assumption, that the work environment for everybody should be improved to the same level as for the 10% with the best work environment. Such an assumption is considered to be more theoretical than practical, and the indicated potential for sickness absence reduction is therefore assumed to be more theoretical than practical.

Studies II, IV and V sickness absence was established using register data from DREAM. In the register data there is also a possibility of systematic over- or underestimation of sickness absence; the weekly information on transfer

payments is registered if a person has received any kind of transfer payment for more than one day. It is possible to register only one weekly type of information on transfer payment, and if more are registered the system will, in some cases, overwrite the codes when it is updated. Sickness absence compensation always has the higher priority. This could lead to an overestimation of a single day on sickness absence compensation counting as an entire week. In contrast, there could be an underestimation of sickness absence as a whole, because companies may not report all sickness absence, especially short-term absence.

Better and more knowledge are needed about the importance of using different types of data, and about the quality of data from the different kinds of register (Hensing, 2004).

Measurement of RTW

In Studies **II** and **V** the outcome RTW was used, in this case people were taken to have returned to work upon cessation of sickness absence benefit and subsequently receiving no other social transfer benefits.

The goal adopted in the area of RTW research is generally achievement of an early and safe RTW. Unfortunately, the DREAM register does not provide this kind of data, thus introducing a limitation when constructing RTW outcomes. Factors that force sick-listed employees into a premature and unsafe RTW are not considered in this study. It is important to consider that fear of losing one's job and financial strain will weigh in the employee's decision balance and can contribute to the decision of returning to work too soon, increasing risk of re-injury and ill health (Pransky et al., 2005). The outcome time-to-RTW has limited value and should always be supplemented with measures more inclusive of recurrences, supplement by other measurements i.e. work ability index, work-role –functioning, quality of life.

Future research should include both self-reported and administrative data on disability and RTW, in order to insure a comprehensive assessment of work-related disability and to provide the means to assess the magnitude of reporting biases from any one data source.

However, considering the overall aim of the thesis, the initial choice of methods has proven relevant, with certain limitations: The issue of addressing the importance of self-efficacy was not performed optimally. The measurement of self-efficacy was not designed for sickness absence or RTW research, and the complete self-efficacy scale should have been tested. Overall, the associations between predictors in work environment, long-term sickness absence, and RTW were conducted using high-quality cohort data in prospective designs, and the applied strategy of analysis generated results relevant to the aim of the project.

Conclusion

1. Is there an association between psychosocial and physical work environment exposures and sickness absence, taking into account health, health behavior, and employer characteristics?

Sickness absence was associated with working with arms lifted/hands twisted, extreme bending/stooping of the back/neck, repetitive monotonous work, low skill discretion, low decision authority, obesity, current or former smoking, poor self-rated health, female gender, increasing age and working in the public sector (**Study I**). Furthermore the following physical work environment exposures were associated with long-term sickness absence: stooping work position, twisting the back, pushing/pulling heavy loads, physical activity in work. Also, there are psychosocial environment exposures: low decision authority, low supervisor support and low management quality was associated with long-term sickness absence, taking into account health behavior, age, and attitude to sickness absence (**Study IV**).

2. What is the potential gain in sickness absence reduction through work environment improvement?

The potential gain in sickness absence reduction through work environment improvement was found by calculating the etiologic fraction: the etiologic fraction attributable to differences in work environment exposures was calculated to 40% (**Study I**).

3. Who is at excess risk for long-term sickness absence in the Danish working population?

Higher risk of long-term sickness absence was associated with gender, age, educational level, and the public sector. Kindergarten teachers and those employed in daycare, healthcare, janitorial work, food preparation, and unskilled workers were at greatest risk. Managers, computer professionals, technicians and designers, and professionals had lower risks. The healthcare and

social service sectors were also in the higher risk category, whereas the private administration sector had a lower risk. The majority of the findings were expected and in accordance with the literature, but there were a couple of exceptions with regard to the effect of number of employees and high-risk job groups and sectors. (Study III).

4. Is general self-efficacy measured before occurrence of sickness absence associated with RTW after sickness absence? General self-efficacy was significantly lower among those sick-listed compared to the general working population (Study II).

5. Is there a difference in self-efficacy score among the general working population and sickness absent sick-listed employees? Self-efficacy showed no statistically significant association with later onset of sickness absence or with RTW (Study II).

6. Are the effects of individual level measures of psychosocial and physical work environment factors on long-term sickness absence modified by workplace level factors? Long-term sickness absence was predicted by physical work environment factors at the individual level and psychosocial work environment factors at workplace level. Interaction between the individual physical and workplace level psychosocial risk factors was found (Study IV).

7. Are the effects of individual level measures of psychosocial and physical work environment factors on RTW modified by workplace level factors? At the individual level, significant associations were found between one psychosocial and four physical factors and RTW within four weeks. Two physical factors predicted RTW within one year. Two psychosocial and two

physical factors significantly prolonged duration of sickness absence. No significant contextual level risk factors were found (**Study V**).

This thesis is a comprehensive study coupling two cohorts of employees with register data on social transfer benefits, covering a wide range of risk factors reflecting the complex process of work disability. Some exposures are not covered in this particular study, e.g., healthcare system, registrations, diagnosis, level of function, work ability, workplace policy and practice etc. However, this study supports the concept of a multifactorial etiology of work disability. While recognizing the link between health and sickness absence, this study strongly suggests the role of work environment factors in the etiology of work disability. Due to the complexity of work disability, this thesis adds only limited knowledge in understanding this multidimensional problem as a whole, in contrast the results add knowledge about risk factors associated with the different phases of the dynamic work disability in a Danish context.

This thesis contributes to an understanding of the proportions and basic epidemiology of sickness absence in the Danish labor market context.

Furthermore, the findings of interaction effects between individual and workplace level dimensions are of importance for interventions aiming at reducing sickness absence.

Intervention towards reducing sickness absence may be more effective if it simultaneously addresses both the individual and organizational level of the workplace.

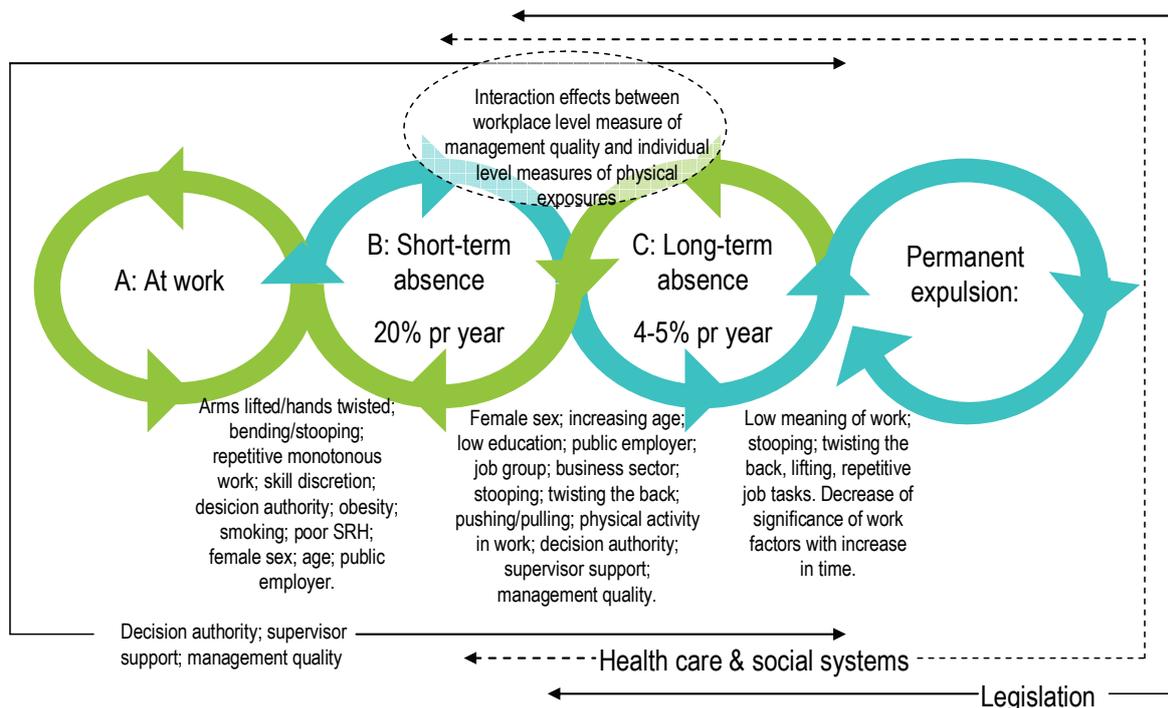
Lastly, long-term sickness absence contributes disproportionately to the sickness absence figures. Although, those on long-term sickness absence constitute only a small fraction of the people who are sickness absence, longer absence comprise

more than 80% of total sickness absence days. Long-term sickness absence periods are associated with a reduced probability of eventual RTW.

Model meets empiricism

In the introduction, the dynamic work disability model was described with the dimensions known to significantly affect the balance between the different phases based on the literature. Below, the model presented contains the results of the five studies (Figure 2). These findings may not be generalized to other countries with different legislation, but contribute to the different phases and levels of the sickness absence research in a Danish context.

Figure 2: **The Dynamic Work Disability Model** and the results



Practical implications

- In relation to long term sickness absence reduction, the study suggests a potential for reducing long term sickness absence through interventions towards both physical and psychosocial work environment exposures.

- Targeted sub-groups; job-specific interventions research, to successfully implement policies that will lead to decreasing especially long-term sickness absence.
- Multilevel interventions: Intervention towards reducing sickness absence may be more effective if it simultaneously addresses both the individual and organizational level of the workplace

Further research

Based on the findings presented in this thesis and experience during the research process, further research could include the following:

- Developing new measurements and cohorts specifically designed for sickness absence and RTW research
- Developing new designs in order to estimate multiple levels of risk factors
- Investigating how long it takes for the causal work environment variable to affect the sickness absence outcome
- Exploring RTW self-efficacy and work environment factors
- Incorporating existing work-ability assessment tools in a Danish context or develop new ones
- Studying relapse, among the RTW cohorts in order to address the usefulness of cessation of sickness absence compensation as a RTW measure
- Exploring the use of supported employment and part-time sick-listed from employers' perspective
- Discovering what are the incentives or hindrances for RTW at workplace level.

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