Workplace-registered sick leave in the municipal eldercare sector: Identification of risk factors of long-term sick leave and disability pension

PhD dissertation

Christina Malmose Stapelfeldt

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Public Health/Clinical Social Medicine and Rehabilitation
“To dare is to lose one's footing momentarily, not to dare is to lose oneself”
Søren Kierkegaard (1813-1855)
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This PhD dissertation is based on the following three papers

**Paper I:**
Stapelfeldt CM, Nielsen CV, Andersen NT, Krane L, Fleten N, Borg V, Jensen C
Title: Are environmental characteristics in the municipal eldercare, more closely associated with frequent short sick leave spells among employees than with total sick leave: a cross-sectional study

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**Paper II:**
Stapelfeldt CM, Jensen C, Andersen NT, Fleten N, Nielsen CV
Title: Validation of sick leave measures: Self-reported sick leave and sickness benefit data from a Danish national register compared to multiple workplace-registered sick leave spells in a Danish municipality

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**Paper III:**
Stapelfeldt CM, Nielsen CV, Andersen NT, Krane L, Borg V, Fleten N, Jensen C
Title: Sick leave patterns as predictors of being granted a disability pension or experiencing long-term sick leave: A 6.75-year follow-up study in municipal eldercare workers

*Submitted to BMJ Open, September 2013*
Preface

This thesis is based on three studies performed during my employment at Public Health and Quality Improvement, Central Denmark Region from September 2009 to June 2013.

This PhD project has been accomplished owing to the much appreciated help of numerous people:
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To my husband, Henrik and to my children, Christian and Ida Marie - I simply love you.

Christina Malmose Stapelfeldt, June 2013
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<table>
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<th>Full Form</th>
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<tr>
<td>AUC</td>
<td>Area Under the Curve</td>
</tr>
<tr>
<td>95% CI</td>
<td>95% Confidence Interval</td>
</tr>
<tr>
<td>CIP</td>
<td>Cumulative Incidence Proportion</td>
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<td>COPSOQ</td>
<td>Copenhagen Psychosocial Questionnaire</td>
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<td>CPR</td>
<td>Unique personal identification</td>
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<td>DREAM</td>
<td>Danish Register for Evaluation of Marginalisation</td>
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<td>JD-R model</td>
<td>Job Demands-Resources model</td>
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<tr>
<td>NRCWE</td>
<td>National Research Centre for the Working Environment</td>
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<tr>
<td>OR</td>
<td>Odds Ratio</td>
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<tr>
<td>PPV</td>
<td>Positive Predictive Value</td>
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<tr>
<td>ROC curve</td>
<td>Receiver Operating Characteristic curve</td>
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<tr>
<td>RR</td>
<td>Relative cumulative incidence / relative risk</td>
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<tr>
<td>RTW</td>
<td>Return To Work</td>
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<td>SD</td>
<td>Standard Deviation</td>
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<tr>
<td>STARD</td>
<td>Standards for Reporting of Diagnostic Accuracy</td>
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<td>STROBE</td>
<td>Strengthening the Reporting of Observational Studies in Epidemiology</td>
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Chapter 1: Background

Introduction
This dissertation is based on three studies of the municipal eldercare sector in general and the employees engaged in care of the elderly in particular. The average sick leave rates among employees in this care sector are higher than among employees in other occupations (1;2). The municipal healthcare sector also reports problems in recruiting and holding on to new employees. Demographic changes such as the growing size of the population of elderly citizens, expectably in demand of personal care and home care, add further to this vicious circle. Moreover, constant demands for efficiency improvements expressed in downsizing, strict time recordings, lowering of core output quality, etc., have left the impression in the public that employment in municipal eldercare is a low-status occupation; an impression that may also exist among eldercare employees themselves (3). Sick leave has considerable consequences not only at the societal and personal level, but also at the workplace level. Sick leave contributes to existing staff shortages in the healthcare sector and has been reported to adversely affect the efficiency of care and patient outcomes (4;5). It is therefore important to recognise healthcare workers at risk of sick leave at an early stage.

The current situation is somewhat paradoxical; we may all become dependent on the services provided by this sector, and we are most likely having high expectations to the type of care of which we are in need. The hypotheses raised in the present dissertation were inspired by the possible imbalance between the demands expressed by different stakeholders in political and economic arenas of society and by the citizens in need of health care and the resources available in the municipal healthcare sector in itself and among the eldercare employees.

1.1 Theoretical framework
Ecological Systems Theory
The founder of Ecological Systems Theory, Urie Bronfenbrenner, changed the way social sciences approached the study of human beings in their environment. Before this theory emerged, psychologists, sociologists, anthropologists, economists and political scientists separately studied the individual and the environment within which the individual acted. Bronfenbrenner argued that in order to understand the development of the individual, one has to include and to consider a number of dimensions which constitute the ecological system with which an individual interacts. These dimensions are organised in layers each inside the other like a Russian doll starting with the innermost level and moving towards the outside (micro-, meso-, exo-, macro-, and chronosystems) (6).
In the perspective of working life and the individual’s workability, occupational health is inspired by the assumptions put forward by Bronfenbrenner; that the disabled worker and his/her personal characteristics (micro-system) interact with the workplace, healthcare and social security systems (meso-system) and economic, social and legislative factors (macro-system) (7). Patrick Loisel developed a model inspired by the *Ecological Systems Theory* to illustrate the arena in which the prevention of work disability takes place and which stakeholders may be involved in this arena (Figure 1, reproduced from the original without correction of linguistic errors) (8).

*Figure 1* The arena in work disability prevention

Patrick Loisel started his career as a back surgeon, but he realised that surgery did not necessarily cure a patient suffering from a back disorder; patients did not return to work (RTW), and their sick leave levels were not reduced (9). A biomedical approach towards workers disabled due to back disorder appeared to be insufficient (7). Thus, it seemed to be important to involve other stakeholders than the physician in the management of the disabled worker to prevent prolonged disability and to enhance the possibility for the worker’s RTW (7). *The arena in the work disability prevention* model conceptualises those of the disabled worker’s characteristics that may influence the worker’s chances of maintaining his/her work or his/her
RTW process; the healthcare system that provides the rehabilitation services to the disabled worker; the workplace at which the disabled worker is intended to stay and to which the disabled worker is expected to return; and, finally, the social security system that compensates the employee/employer while the worker is sick-listed. This disability paradigm has been used in several intervention studies targeting work disability due to musculoskeletal pain (10-13) and such intervention studies have been found to enhance the RTW process. Work disability intervention studies exploring disability caused by factors unrelated to the musculoskeletal system have been inspired by this paradigm as well (14). Cancer survivors (15) and workers sick-listed due to mental problems (16-18) may also benefit from an occupational/vocational rehabilitation process perspective that engages relevant stakeholders like those depicted in Figure 1.

The arena in the work disability prevention model offers an overview of important stakeholders within the field of occupational health research that may be considered when epidemiologic and intervention studies are planned or/and carried out. However, the model has been criticised for not operationalising the assumed interactions between the stakeholders (7). Moreover, it lacks the dynamic and time-related characteristics of the disabled worker, his/her time off work and the RTW process (19). An attempt to compensate for the lack of dynamic properties in The arena in the work disability prevention model is offered within the Job Demands-Resources Model (JD-R model) by Arnold B. Bakker and Evangelia Demerouti (20). The JD-R model seems to address time-related aspects in the continuum from unaffected workability to permanently reduced workability; the model performed well in the prediction of hypothesised effects of exposure to job demands within a working environment where workers had different levels of resources (21).

This dissertation focuses on the municipal eldercare employee with or without reduced workability (operationalised into sick leave patterns), and it includes the arenas of the workplace system (occupation and psychosocial work factors), the personal system (gender and age) and the legislative and insurance system (sickness benefits and disability pension).

1.1.1 The workplace system and sick leave
It has been suggested that frequent short-term sick leave is associated with unfavourable work environment factors, whereas long-term sick leave is associated mainly with ill health and health-related reduced workability (22;23). Confirmation of this hypothesis may widen the possibilities for identification of early risk markers of future reduced workability and may inform employers and healthcare professionals about potential targets for prevention and intervention. However, few studies have analysed if psychosocial work factors are more strongly associated with frequent short-term sick leave than with long-term sick leave (21).
The Job Demands-Resources Model
Several models have been developed in an attempt to capture positive and/or negative factors in the working environment that have adverse effects on employees, i.e. sick leave, turn-over intentions, low engagement, etc. Two models have gained general acceptance in the field of occupational health: the effort-reward imbalance model (24) and the demand-control-(support) model (25). However, these two models may be too narrow, i.e. the items used do not offer adequate descriptions of important work environment characteristics in all occupational settings (20). A contemporary JD-R model (21) proposes that every organisation has its own unique working environment characterised by demands and resources that may predict sick leave frequency and sick leave length. It is further claimed that health may be affected by sustained, high job demands; and turnover intentions may be a consequence of consistently low job resources (20). The exposure to sustained, high job demands is seen as a strain process, and it may predict high levels of involuntary sickness absence, i.e. be a marker of sick leave length where sick leave length is defined by the total number of sick leave days per year. Inversely, the presence of high job resources is seen as motivational and may predict low levels of voluntary sickness absence, i.e. less frequent sick leave spells (21) where frequency is defined as the number of sick leave spells.

Work environment characteristics in the healthcare sector
According to the JD-R model, every occupation may be described in terms of a unique set of work environment factors that may differ from those of other occupational settings. The eldercare employees are organised in teams responsible for defined tasks, such as dressing, bathing, cleaning, helping with meals, etc. A team leader delegates the specific assignments to the team members in the morning on a daily basis. The teams work as a part of a three-shift system, i.e. day, evening, and night shifts. The citizens who are cared for are living in their own homes or in institutions in defined geographical areas that is served by a specific team of eldercare workers. These work conditions constitute both job resources and demands that may be evaluated differently by the individual employees (26;27) and they may lead to sick leave if resources and demands are not balanced.

In studies of health care workers, the total number of sick leave days per year was associated with high psychological demands, high physical workload (28) and low social support (29). The number of sick leave spells was found to be related to physical and psychological work demands (29-31). Elstad et al. reported proportionality in the association between the number of perceived stressful work environment characteristics and the number of sick leave spells (32). Bullying is another factor that is associated with an increased risk of a new sick leave spell (31). High levels of decision authority, perceived meaningfulness of work, commitment to the workplace, quality of leadership and a good team climate may protect against sick leave
The effect of social support on spells of sick leave varies between studies (29;35;36). Inconsistencies in the reported associations between work environment factors and sick leave are large. This was suggested to be due partly to the different measures of sick leave themselves (22;37). Hence, most studies analysed the length of sick leave and the frequency of spells separately, and any independent association between length versus frequency and psychosocial work factors therefore remains unknown. However, one study of the educational level of hospital staff and its association with sick leave patterns found that nursing assistants’ sick leave patterns were significantly different from those of doctors. Nursing assistants had more incident spells than doctors, and they had a higher risk of incident sick leave spells of 1-3 days and of 4-14 days than doctors when the figures were adjusted for the remaining sick leave spell pattern categories and work environment factors (38).

Copenhagen Psychosocial Questionnaire

The National Research Centre for the Working Environment (NRCWE) conducted a national survey among municipal eldercare employees in Denmark in 2004-2005 (39). *The Copenhagen Psychosocial Questionnaire* (COPSOQ) (40) was used for collection of self-reported data on work environment factors among the eldercare employees. The COPSOQ is theory-based, but not a theory in itself. It is designed in accordance with the JD-R model and accordingly appreciates that the working environment is far more complex than formulated in the effort-reward imbalance model and the demand-control-(support) model (41).

The survey reported a 34% higher level of sick leave among home-care personnel than among administrative employees within the eldercare sector (42). Numerous demands and resources in the psychosocial and physical working environment along with lifestyle factors were found to be associated with high self-reported sick leave levels (42).

1.1.2 The personal system and sick leave

Age and gender are viewed upon as important determinants of sick leave and are therefore often treated as confounders (22).

*Gender*

Women in general have higher sick leave levels than men (22). Caring for the elderly is a profession mainly occupied by women (43). The municipal sector in general and the eldercare sector in particular have high sick leave levels (2).
Age

Within the eldercare sector, young age is generally related to a higher frequency of sick leave spells (30;32;35;36;44), whereas old age is associated with few, but long spells (30;31;44). Moreover, age seems to modify the associations between work factors and different sick leave measures (45). This hypothesis was supported in the survey conducted by the NRCWE. The results of the survey showed a significantly higher risk of having high (more than four weeks) and moderate (one to four weeks) levels of sick leave among young homecare employees (<40 years). This increased risk was partly explained by the experience of more role conflict, less commitment to the workplace and less wellbeing among the young eldercare workers (46). A study by Johansen et al. investigated whether an upward trend in sick leave levels was apparent during a 20-year period in Denmark (47). The study did not prove an upward trend in sick leave levels; however, between 2000 and 2007, a significant increase in the cumulative incidence proportion (CIP) of sick leave was found. This increase was mainly explained by an increase among women aged 30-39 years.

1.1.3 The legislative and insurance system and sick leave

Countries vary much in terms of the national structures of their social security systems and their use of compensatory benefits, i.e. sickness benefits and pensions in the form of disability pensions. The Scandinavian countries have similar welfare systems, even if differences do exist (48). These dissimilarities are important explanatory factors for differences in sick leave levels (48) and the prevalence/incidence of disability pensioners (49) between the Scandinavian countries.

Sources of sick leave data

Among the four sources (employer’s personnel files, insurance-based data, national social security registers and self-reported data) from which sick leave data are traditionally retrieved, register-based sick leave data are available only in few countries. Even where registers are available, self-reported sick leave data are usually more easily acquired than data from other sources. In Denmark, the opportunities for register-based research are unique (50;51).

Data on social public transfer payments like sickness benefits and disability pension are registered on a weekly basis in a national register called DREAM (52). DREAM is a Danish acronym (Dänische Registerbasierte Evaluierung Af Marginaliseringsomfanget), which translates into “The evaluation of marginalised groups of individuals based on registered social public transfer payments”. DREAM was originally created as a tool for monitoring the national expenditure on public transfer payments. However, the register has been extensively used in scientific work (Paper II) (53).
One attempt has been made to validate the DREAM register (54). It was concluded that the DREAM register is a feasible tool for social and economic research in Denmark. However, focusing solely on sickness benefit, Hjøllund et al. identified 82 persons in the DREAM register receiving this kind of transfer payment and of those, 38 reported this kind of income; this yielded a positive predictive value (PPV) of 31.7%.

Sick leave measures and validity

Sick leave has a multi-factorial aetiology (22;55;56). Sick leave has been explored from multiple scientific perspectives and approaches have been many even within the epidemiological framework: frequency of sick leave spells per individual, total length of absence during a specified period, incidence rate, cumulative incidence and duration of absence spells (37). However, in light of the large number of studies on sick leave, it is remarkable that only few validation studies have been performed.

We identified 12 sick leave validation studies in a systematic literature search. The validity of sick leave data reported in questionnaires or in interviews was studied and analysed against data retrieved from employers’ personnel files (57-64), insurance companies (62;65-67) and a national social security register (68). Among the validation studies, none validated employers’ personnel files against insurance-based data either from companies or from national social security registers.

The validation studies found discrepancies between self-reported length of absence and insurer-reported compensation payments. These inconsistencies spoke against self-reporting and were associated with work status, cause of absence as well as personal characteristics (65;67).

A study from the Netherlands found poor agreement between workplace-registered sick leave data and data collected in a questionnaire (63). The remaining nine studies concluded that self-reports yielded acceptable validity (57-62;64;66;68). The total length of absence was the most widely used measure of sick leave (57-62;64;66). Other measures included prevalence (57;59;68), frequency of spells (57), and incidence and duration of sick leave spells (66).

Recall periods, which ranged from 2 weeks to 4 years, were discussed in several papers (60-62;68). These studies were largely unanimous that shorter recall periods could increase the precision of self-reported sick leave. In two papers, the optimum recall period was recommended to be no longer than 2-3 months to obtain valid measures of absence lengths (60;61).

The Whitehall II study and a Swedish replication of the Whitehall II study found a worse recollection the longer the absence length (58;64), which indicates that valid self-reporting may be limited to absence of short duration. Finally, relatively high sensitivities were found in studies where data on absence length, frequency and prevalence of absence were provided as pre-specified categorical questionnaire options (57;68).
1.1.4 Reduced workability among eldercare employees

Access to vocational/occupational rehabilitation may prevent the inflow of persons who are disabled to disability benefit schemes, but studies show that rehabilitation measures are used either rarely and/or too late (49). The JD-R model offers one attempt of addressing the challenge of identifying employees at risk of future reduced workability by focusing on the working environment, which leaves room for introduction of preventive strategies (20). The arena in the work disability prevention model illustrates how many stakeholders are involved in these processes (8). Employment in the Danish eldercare sector has been identified as an occupation involving high levels of work stress (1). Furthermore, the eldercare sector mainly employs women with limited educational accomplishments. A low level of education is recognised as a risk factor for future work disability, and eldercare workers are therefore a particular vulnerable group and a natural object of preventive, occupational health care research (69).

Risk factors for disability pension and long-term sick leave

Many studies seem to agree that sick leave length is an important risk factor for future disability pension (70-72). The public sector in general and the health care sector in particular is challenged by high sick leave rates among home-care personnel (2;73); this group also has the highest incidence of being granted a disability pension next to citizens with no labour experience in Denmark (74).

Employees in the eldercare sector also have high levels of sickness presenteeism, i.e. they go to work despite ill health (32). Commitment to the elderly and their colleagues probably explains some of this phenomenon. Exposure to an unfavourable working environment has been shown to increase the number of episodes of presenteeism; and the risk of future sick leave may well increase with more presenteeism episodes (32). Studies of general work populations have shown that work environment factors are independent risk factors for being granted a disability pension (75-78). Thus, it may be of particular importance to take work environment factors into consideration in studies of the risk of being granted a disability pension among eldercare employees. Besides sick leave length, the definition of sick leave spell patterns and which risk they may pose vary greatly between studies; long-term sick leave spells with durations defined by more than 14 days (79), 28 days (80), and 54 days (81), respectively, increased the risk of being granted a disability pension. However, studies exploring whether short-term sick leave spells involve a risk of being granted a disability pension do not reach consistent conclusions (70;82). Frequent sick leave spells have been found to predict recurrence of a frequent sick leave spell pattern (83) and future long-term sick leave (82;83). It is relevant to study whether a pattern with frequent short-term sick leave spells may be a predictor of disability pension because such a pattern may be associated with work environment factors and may occur at an early stage of reduced functioning (21). Thus, a progression in the frequency and the duration of
sick leave spells has been described as a common sick leave track prior to disability pension (72;81).

1.2 To conclude

Eldercare employees have high sick leave rates and they are facing an increased risk for being granted a disability pension. Sick leave contributes to existing staff shortages in the eldercare sector and may adversely affect the efficiency of care and patient outcomes as well. This makes it important to identify eldercare employees who are at risk of long-term sick leave as early as possible and before their workability is permanently reduced. This dissertation focuses on the municipal eldercare employee with or without reduced workability and includes the arenas of the workplace system, the personal system, and the legislative and insurance system. The JD-R model is a theory that operationalises sick leave length and sick leave frequency and the associations of these parameters with the working environment. Associations between unfavourable work environment factors and sick leave may be due more to sick leave spell frequency than to sick leave length. Moreover, a progression in the frequency and the duration of sick leave spells has been described as common features of a sick leave track preceding disability pension. It is therefore relevant to study whether a sick leave pattern with frequent short-term sick leave spells may be a predictor of disability pension because such a pattern may be associated with work environment factors and may occur at an early stage of reduced functioning.

Validation of sick leave measures is limited. Thus, a validation study of the sick leave measures used in this dissertation is a prerequisite to reduce biased results.
Chapter 2: Hypotheses and Aims

2.1 Hypotheses

Paper I: An association between total sick leave length and a poor working environment is more likely to be due to a frequent short-term sick leave pattern than to a non-frequent long-term sick leave pattern, and even more so in young employees than in older colleagues. Long-term sick leave spells, on the other hand, are more strongly associated with a poor general health than short spells.

Paper II: a) DREAM data on sickness benefits are in accordance with workplace-registered sick leave spells. 
b) Self-reported sick leave length based on one-year recollections is less accurate than workplace-registered sick leave.

Paper III: A frequent short-term sick leave pattern is an early indicator of disability pension and long-term sick leave.

2.2 Aims

Paper I: To explore associations between sick leave patterns and psychosocial work factors in elderly care and thereby enhance the potential for using the employers’ sick leave register to launch interventions aimed at improving the working environment and, hence, the employees’ wellbeing, productivity and viability.

Paper II: a) To validate registered sickness benefit data from DREAM against workplace-registered sick leave spells of at least 15 days. 
b) To validate self-reported sick leave days during one year against workplace-registered sick leave.

Paper III: To study whether a workplace-registered frequent short-term sick leave spell pattern was an early indicator of future disability pension or future long-term sick leave among municipal eldercare workers.
Chapter 3: Materials and Methods

3.1 Paper I

3.1.1 Design
A cross-sectional design was chosen because we wanted to use sick leave measures as an indicator of a poor working environment; not to study causal pathways.

3.1.2 Data
We used workplace-registered sick leave data from municipal eldercare workers in Aarhus, Denmark. Questionnaire data on the working environment were collected in 2005 by the NRCWE.

Sick leave patterns
Data on absence in 2005 were retrieved from the workplace records, which also contained the stated reasons for each absence spell. Only spells related to sick leave were included. The dates of the first and the last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days or not. Overlapping, consecutive or duplicate sick leave spells were merged into a single spell.

First, sick leave was measured as the total number of sick leave days including all spells that ended in 2005. We dichotomised this measure into 0-14 days (42;45;46;84;85) and 15-581 days. In 2005, the public insurance system reimbursed sickness benefits for sick leave spells lasting more than 14 days in conformity with the Danish Sickness Benefit Act (86).

Second, sick leave was categorised into patterns with short, long or a combination of short and long spells. We defined short spells as spells lasting zero to seven calendar days. This definition has also been used in other studies (44;87). Long spells were defined as spells lasting eight calendar days or more. Based on the above-mentioned measures, the sick leave patterns were:

Length of sick leave per year: 0-14 days and more than 14 days.

Spell patterns: 0-2 short spells, 3-9 short spells, 2-13 mixed spells and 1-3 long spells.

Psychosocial work environment factors
The COPSOQ (40) was used to collect information on eldercare workers’ perceived work-related demands and resources.

The environmental factors suggested to be the most important variables in explaining the self-reported high levels of sick leave among eldercare workers (42;46) were selected from the survey. These were: work pace, emotional demands, demands for hiding emotions, physical
work load, influence, meaning of work, commitment to the workplace, role conflict and quality of leadership. These factors were scored on five-point Likert scales (always, often, sometimes, seldom, and never/hardly ever). The scores were transformed into 0-100 scores. The mean values of the different work environment scales were measured in a representative sample of working Danes in 2004/2005 (88). In the present study, the selected work environment scales were dichotomised into favourable / unfavourable scores according to these mean scores. This was done for all scales except for physical work load which was dichotomised according to the mean value found in our data. The response categories for bullying and threats of violence were: at least once a month, from time to time and never. They were dichotomised into: at least from time to time and never. The response categories on general health were: excellent, very good, good, fair and poor. This variable was dichotomised into: excellent-good and fair-poor. Reference scores were not available for bullying, threats of violence and general health.

Socio-demographics and potential confounders
Age (=<40/>40 years) and gender were retrieved from the personnel files, whereas occupation (categorised as administration, manager, therapist/ nurse, home care and non-care) was retrieved from the questionnaire. We used the cut point of 40 years of age to allow direct comparisons with the results of the analyses carried out by NRCWE (42;46).

3.1.3 Statistical analysis
Univariable and multivariable logistic regression models were applied to find associations between total sick leave days / spell patterns and unfavourable scores in work factors and general health.
In the first analysis, using total sick leave days as the independent variable, we adjusted the model for age, gender, occupation and number of spells (continuous variable ranging from 0 to 13).
In the second analysis, using spell pattern as the independent variable (0-2 short-term sick leave spells was the reference), we adjusted the models for age, gender, occupation and total sick leave days categorised into four: (0 days, 1-14 days, 15-56 days and >57 days). A Wald test was performed to establish the overall difference in the odds of having unfavourable work factor scores between the sick leave patterns.
In the third analysis, using spell pattern as the independent variable, we again performed the same adjustments as mentioned in the second analysis. Based on the literature, we expected that unfavourable work factor scores and total sick leave length were more likely to be due to frequency of spells than duration, and that this association would be more pronounced among young employees than among their older colleagues. Long-term spells, on the other hand, were believed to be more strongly associated with poor general health than short-term spells.
In this analysis, emphasis was on the odds of having unfavourable work factor scores / general health scores among eldercare workers with many short spells compared with few but long spells. We also sought to establish whether these associations were stronger among young employees than among older colleagues by including an interaction term between age and spell pattern.

The significance level was set at \( p<0.05 \). The results are shown as crude and adjusted figures. STATA version 12.1 was used as statistical software.

Approval (2012-41-1290) for using workplace-registered sick leave records and questionnaire data was obtained from the Danish Data Protection Agency: http://www.datatilsynet.dk/english/.

3.2 Paper II

3.2.1 Design

The validation studies of DREAM-registered sickness benefits and self-reported sick leave days are both cross-sectional study designs.

3.2.2 Data

Workplace-registered sick leave data (a)

The dates of the first and last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days or not. Overlapping, consecutive or duplicate sick leave spells were merged into a single spell.

Sick leave spells entitled to municipal refunding according to the Danish Sickness Benefit Act include the following four categories: 1) spells lasting more than 14 days; 2) spells related to pregnancy; 3) spells due to sick leave in a “flexi job”, i.e. a job that has been modified due to permanently reduced workability; or 4) recurrent or anticipated spells due to chronic disease. Spells in categories 2) to 4) shorter than or equal to 14 days were exempted from the employer period and refundable from the first day of absence. For every refundable sick leave spell, we identified the week number in which the spells were seen.

Measures of sickness benefit

The DREAM register includes all Danish citizens with a unique personal identification (CPR) number who have received social public transfer payments at some point since mid-July 1991 (52). Each person is registered once a week with a code representing the type of reimbursement received that particular week. Codes are ordered hierarchically; low-ranked codes are overwritten by high-ranked codes, e.g. sickness benefit codes (Table 1).
The weekly recordings cover reimbursements of one to five days of actual workdays lost. By January 2006, data on more than 3.5 million citizens of a total Danish population of 5.4 million had been entered into the DREAM register.

The weeks of 2006 were isolated in the DREAM register, and the 3,554 employees were identified by their CPR number. The weeks in 2006 coded 891, 892, 894 or 895 were identified.

**Workplace-registered sick leave data (b)**

All sick leave spells 12 months prior to the response date were identified. If a spell encompassed the response date or the date 365 days prior to that, the spell was “shortened” to ensure that the duration did not exceed these dates. All sick leave spells were summarised into total length in calendar days. These workplace registrations were compared to the self-reported sick leave days from the questionnaire.

**Self-reported sick leave data (b)**

The survey in 2005 conducted by NRCWE also included the question: “How many sick leave days have you had within the past 12 months?”

### 3.2.3 Statistical analysis (a)

A receiver-operating characteristic curve (ROC curve) was used to study the performance of DREAM data on sickness benefit. Weekly cut-off points in DREAM were used to find the optimum discrimination of sick leave spell durations of > 8 weeks defined in the workplace register.

We calculated the mean duration of the first workplace-registered sick leave spell and the corresponding number of weeks of sickness benefit reimbursement registered in DREAM. Differences between and averages of these durations formed a Bland-Altman plot, and this plot was used to illustrate the relationship between the two durations. The assumptions underlying
a paired t-test were also appraised from this plot (Wilcoxon´s signed rank test is the non-parametric test equivalent). Included in the analyses were the first spells of sick leave retrieved from the employer’s personnel files and the first registration of sickness benefit in DREAM, whenever agreement about the starting week had been established.

3.2.4 Statistical analysis (b)
The mean annual length and the differences in days between workplace-registered and self-reported sick leave days, respectively, were stratified on gender, age, profession, and working hours per week. To enhance the comparability with other studies, we used some of the same sick leave measures as those used in a Swedish study (64). Both measures of sick leave were categorised into: (0 days, 0>days<7, 7>days>14, 14>days<28, 28>days<56 and 56 days or more). An expanded 2x2 table was constructed, and sensitivity and specificity were calculated. All analyses were performed in Stata version 11.2.

Approval (2009-41-3828) for conducting this register-based study was obtained from the Danish Data Protection Agency: http://www.datatilsynet.dk/english/

3.3 Paper III
3.3.1 Design
An observational follow-up study with a potential follow-up period of 6.75 years was applied.

3.3.2 Data
Eldercare workers employed in the municipality of Aarhus (the second largest city in Denmark) employed throughout 2004 were included.
The employer’s sick leave register was merged with the DREAM register (52).

Exposure variable: Sick leave patterns
Data on absence in 2004 were retrieved from the workplace records, and spells related to sick leave were included. The dates of the first and the last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days or not. Overlapping, consecutive or duplicate sick leave spells were merged into a single spell.
The sick leave data were categorised into patterns with short, long or a combination of short and long spells. We defined short spells as spells lasting one to seven calendar days. This definition has also been used in other studies (44;87). Long spells were defined as spells lasting eight calendar days or more. This definition was used in a previous study conducted on the same population (Paper I) (89). Based on the above-mentioned measures, the sick leave
patterns were defined as patterns with: 0-2 short spells, 3-17 short spells, 3-13 mixed spells and 1-5 long spells.

**Outcome variables**
Outcome variables were retrieved from the DREAM register (52).

**Disability pension**
Disability pension is granted if a person’s workability and capacity for work is reduced to such an extent that it makes self-support impossible, even in a flexible working arrangement. Disability pension is available to people aged 18 to 65 in Denmark (90). While it is possible to RTW or work part time while receiving disability benefit, these options are rarely used, and disability benefit in reality means permanent exit from the labour market.

**Long-term sick leave**
Long-term sick leave as outcome was defined as a consecutive period of nine weeks on sick leave. In a previous study of the municipal eldercare workers, we compared DREAM-registered sickness benefits with workplace-registered long-term sick leave (Paper II) (53). A nine-week optimum cut-off point in the DREAM register was required to discriminate between a sick leave spell duration of eight weeks or more defined in the workplace register. Empirical evidence indicates that long-term absentees and in particular more than eight-week absentees generally involve a substantially increased risk of not returning to work (91) because the municipal authority responsible for the sickness benefit payout is legally bound to discuss occupational and/or vocational rehabilitation with the absentees when this period ends (92).

**Potential confounders**
Age and occupation were dichotomised into: ($<=$40/$>$40 years) and (care/non-care), respectively. The care category was defined by employees engaged in the eldercare, and the non-care category comprised employees from the administration, kitchen personnel, cleaners, staff engaged in maintenance, therapists, nurses and managers. Total sick leave days in 2004 were categorised into four groups (0 days, 1-14 days, 15-56 days and $>$57 days) in order to study the long-term effects of being exposed to a frequent short-term sick leave spell pattern adjusted for the effect of the total sick leave length.

Questionnaire data on the working environment were collected by the NRCWE in the municipal eldercare sector in Aarhus from February to July in 2005. Work factors associated with self-reported high levels of sick leave among eldercare workers (42;46) were selected from the survey. These were: work pace, emotional demands, demands for hiding emotions, physical
work load, influence, meaning of work, commitment to the workplace, role conflict and quality of leadership. They were scored on five-point Likert scales (always, often, sometimes, seldom, never/hardly ever) and transformed into 0-100 scores, dichotomised into favourable / unfavourable according to the mean values of the different work environment scales measured in a representative sample of working Danes in 2004/2005 (88). This was done for all scales except for physical work load which was dichotomised according to the mean value found in our data. Response categories for bullying and threats of violence were at least once a month, from time to time and never. They were dichotomised into at least from time to time and never. Reference scores were not available for bullying and threats of violence. The number of individual unfavourable work factors was counted (range 0 to 11).

3.3.3 Statistical analysis
The CIP as a function of the number of follow-up weeks was estimated using the Kaplan-Meier curve. The relative cumulative incidence of being granted a disability pension or experiencing long-term sick leave within 352 weeks was analysed in a generalised linear regression model using the pseudo values method (93;94).

The entry date was defined as 1 January 2006 and the end of follow-up was week 39 in 2012. The year of 2005 was used as a “wash-out” period (70;71). The sick leave patterns were based on sick leave spells that started or/and ended in 2004; spells prolonged into 2005 were excluded. According to the Danish Sickness Benefit Act, sickness benefits are not reimbursed beyond 52 weeks which, in principle, is defined as the maximum duration of a sick leave spell (92). A one-year “wash-out” period was therefore sufficient to eliminate the potential confounding effects of long-term sick leave immediately before follow-up started.

The outcome variable disability pension consisted of two measures: an event indicator (yes or no) and the time allowed to code the disability benefit in the DREAM register (75) or end of follow-up / competing risks (early retirement benefit, retirement pension or death) / censored observations (emigration), whichever came first. Likewise, the outcome variable long-term sick leave also consisted of two measures: an event indicator (yes or no) and time to nine consecutive DREAM-registered sick leave benefit weeks (Paper II) (53) or end of follow-up / competing risks (early retirement benefit, retirement pension, disability pension or death) / censored observations (emigration), whichever came first.

A Wald test was performed to establish the overall difference in the relative cumulative incidence of being granted a disability pension or experiencing long-term sick leave between the sick leave patterns.

Events were few and the models analysing the risk for being granted a disability pension may therefore suffer from over-fitting due to the adjustments for the number of unfavourable work
factors and the total number of sick leave days. However, priority was given to the identicalness of the adjustment procedure in both risk populations. The significance level was set at p<0.05. The results are shown as crude and adjusted relative cumulative incidences, i.e. relative risks (RR), and corresponding 95% confidence intervals (95% CI).

STATA version 12.1 was used as statistical software.

Approval (2012-41-1290) for using workplace-registered sick leave records, DREAM-registered sickness and disability benefit data and questionnaire data was obtained from the Danish Data Protection Agency: http://www.datatilsynet.dk/english/.
Chapter 4: Main Results

The selection of study participants for each of the three studies was guided by three shared principles: First, we excluded students. Second, employees who were absent due to maternal/paternal leave were excluded. Third, we wanted to include all of the employees within the eldercare sector. However, we had to exclude employees who did not work the entire year of interest in order to be able to construct sick leave patterns per year (Study I and III) and to ensure that DREAM-registered sickness benefits corresponded to sick leave spells from the municipal eldercare sector in Aarhus (Study II); (Figure 2).

The median age was calculated by 1 January of the three years, respectively, and it was approximately the same within the three study populations. Small fluctuations in the distribution of eldercare workers were seen within all the categories during the three years (Table 2). The total number of eldercare employees increased from 2004 to 2006.
Table 2: Description of eldercare workers employed throughout 2005 (Paper I), 2006 (Paper II) and 2004 (Paper III) in the municipality of Aarhus.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2,534</td>
<td>812</td>
<td>3,554</td>
<td>2,774</td>
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</table>

**Age in years, median (min-max)**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (female)</td>
<td>2,433</td>
<td>96</td>
<td>751</td>
<td>93</td>
<td>3,387</td>
<td>95.3</td>
<td>2,660</td>
<td>95.9</td>
</tr>
</tbody>
</table>

**Workplace, local centres:**

- Frederiksberg: 239 (9.4 %), 97 (12.2 %), 326 (9.2 %), 276 (10.0 %)
- Hasle-Gellerup-Toftegården: 198 (7.8 %), 75 (9.3 %), 267 (7.5 %), 228 (8.2 %)
- Holme og Skåde: 197 (7.8 %), 76 (9.6 %), 264 (7.4 %), 200 (7.2 %)
- Hærgården og Vejby: 190 (7.5 %), 76 (10.3 %), 289 (8.1 %), 212 (7.6 %)
- Skelager/Bjørnshøj: 120 (4.7 %), 43 (5.4 %), 148 (4.2 %), 138 (5.0 %)
- Trøjborg og Abildgården: 125 (4.9 %), 49 (6.0 %), 199 (5.6 %), 166 (6.0 %)
- Viby og Rosenvang: 142 (5.6 %), 35 (4.3 %), 235 (6.6 %), 136 (4.9 %)
- North: 204 (8.1 %), 55 (6.8 %), 251 (7.1 %), 211 (7.6 %)
- Northwest: 195 (7.7 %), 58 (7.5 %), 267 (7.5 %), 202 (7.3 %)
- South: 217 (8.6 %), 64 (7.9 %), 291 (8.2 %), 241 (8.7 %)
- Southwest: 132 (5.2 %), 29 (3.6 %), 197 (5.5 %), 95 (3.4 %)
- West: 237 (9.4 %), 84 (10.3 %), 324 (9.1 %), 277 (10.0 %)
- City: 165 (6.5 %), 69 (8.5 %), 255 (7.2 %), 195 (7.0 %)
- Others: 173 (6.8 %), 64 (7.9 %), 241 (6.8 %), 197 (7.1 %)

**Profession:**

- Administration: 127 (5.0 %), 1 (0.1 %), 190 (5.4 %), 170 (6.1 %)
- Activity: 167 (6.6 %), missing, 222 (6.3 %), 153 (5.5 %)
- Kitchen and café staff: 34 (1.3 %), missing, 39 (1.1 %), 45 (1.6 %)
- Cleaning: 134 (5.3 %), missing, 195 (5.5 %), 156 (5.6 %)
- Homecare personnel: 1,756 (69.3 %), 4 (0.5 %), 2,419 (68 %), 1,926 (69.4 %)
- Nurse: 305 (12.0 %), missing, 369 (10.4 %), 282 (10.2 %)
- Maintenance: 11 (0.4 %), missing, 21 (0.6 %), 14 (0.5 %)
- Missing: 0 (0.0 %), 807 (99.4 %), 99 (2.8 %), 28 (1.0 %)

**Hours worked per week:**

- 37: 660 (26.0 %), 224 (27.6 %), 686 (19.3 %), 600 (21.6 %)
- 30-36: 1,653 (65.2 %), 490 (60.3 %), 2,498 (70.3 %), 1,921 (69.3 %)
- 20-29: 183 (7.2 %), 73 (9.0 %), 237 (6.7 %), 219 (7.9 %)
- 20: 24 (0.9 %), 15 (1.8 %), 39 (1.1 %), 22 (0.8 %)
- Missing: 14 (0.6 %), 10 (1.2 %), 94 (2.6 %), 12 (0.4 %)

**Total sick leave, n (%):**

- 0-14 days: 1,909 (75.9 %), 549 (68 %), 2,069 (74.6 %)
- More than 14 days: 625 (24.1 %), 263 (32 %), 705 (25.4 %)

**Spell patterns, n (%):**

- 0-2 short spells: 1,378 (54 %), 380 (47 %), 1,465 (52.8 %)
- 3-9/17 short spells: 490 (19 %), 162 (20 %), 574 (20.7 %)
- 2-13 mixed spells: 515 (20 %), 183 (23 %), 593 (21.4 %)
- 1-3/5 long spells: 151 (6 %), 87 (11 %), 142 (5.1 %)

**Total number of spells, Median (min-max):**

<table>
<thead>
<tr>
<th></th>
<th>Paper I</th>
<th>Non-responders</th>
<th>Paper II</th>
<th>Non-responders</th>
<th>Paper III</th>
<th>Non-responders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>median</td>
<td>(min-max)</td>
<td>median</td>
<td>(min-max)</td>
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<td>(min-max)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 (0-13)</td>
<td>2 (0-11)</td>
<td></td>
<td></td>
<td></td>
<td>2 (0-17)</td>
</tr>
</tbody>
</table>
4.1 Paper I

4.1.1 Total sick leave days

We estimated the odds of having unfavourable work factor scores among eldercare workers with more than 14 sick leave days compared with 0-14 days (Table 3). In crude analyses, the odds ratios (OR) for all psychosocial work environment factors were statistically significantly different from 1. Adjustment for age, gender, occupation and number of spells reduced the strength in all of the associations. Still, the odds remained statistically significant for having unfavourable scores in work pace 1.41 (95% CI: 1.1 - 1.7), demands for hiding emotions 1.56 (95% CI: 1.2 - 2.0), quality of leadership 1.41 (95% CI: 1.1 - 1.7) and being bullied from time to time 1.50 (95% CI: 1.1 - 2.0).

<table>
<thead>
<tr>
<th>Demand</th>
<th>More than 14 sick leave days, OR (95% CI)</th>
<th>More than 14 sick leave days, Adjusted *, OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work pace</td>
<td>1.48 (1.2 - 1.8)</td>
<td>1.41 (1.1 - 1.7)</td>
</tr>
<tr>
<td>Emotional</td>
<td>1.19 (1.0 - 1.4)</td>
<td>1.08 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Hiding emotions</td>
<td>1.65 (1.3 - 2.0)</td>
<td>1.56 (1.2 - 2.0)</td>
</tr>
<tr>
<td>Physical work load</td>
<td>1.34 (1.1 - 1.6)</td>
<td>1.15 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Influence</td>
<td>1.36 (1.1 - 1.6)</td>
<td>1.13 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Meaning of work</td>
<td>1.32 (1.1 - 1.6)</td>
<td>1.14 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Commitment to the workplace</td>
<td>1.49 (1.2 - 1.8)</td>
<td>1.23 (1.0 - 1.5)</td>
</tr>
<tr>
<td>Role conflict</td>
<td>1.31 (1.1 - 1.6)</td>
<td>1.11 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Quality of leadership</td>
<td>1.50 (1.2 - 1.8)</td>
<td>1.41 (1.1 - 1.7)</td>
</tr>
<tr>
<td>Bullying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>1.68 (1.3 - 2.2)</td>
<td>1.50 (1.1 - 2.0)</td>
</tr>
<tr>
<td>Threats of violence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>1.21 (1.0 - 1.5)</td>
<td>1.03 (0.8 - 1.3)</td>
</tr>
</tbody>
</table>

* Age, gender, occupation, number of spells

4.1.2 Zero to two short-term spells compared with any other spell pattern

Crude analyses showed that the odds for having unfavourable work factor scores were significantly higher for employees with spell patterns featuring 3-9 short spells or 2-13 mixed spells than for employees with 0-2 short-term spells (Table 4). However, according to the crude analyses, employees having 1-3 long-term spells did not give statistically significantly more unfavourable scores to emotional demands, physical work load, influence, meaning of work or role conflict than employees with 0-2 short-term spells. After adjustment for age,
gender, occupation and total sick leave days, employees having 3-9 short-term spells had significantly higher odds of unfavourable scores for *role conflict* 1.50 (95% CI: 1.2-1.9) than employees with 0-2 short-term spells. For the mixed spell pattern, the odds of having unfavourable work factor scores compared with 0-2 short-term spells were highest in *emotional demands* 1.62 (95% CI: 1.1-2.5) after adjustment. *Work pace* 2.24 (95% CI: 1.4-3.7) was more strongly associated with 1-3 long spells than with 3-9 short-term spells and 2-13 mixed spells.

The odds of having a fair-poor *general health* were most strongly associated with 1-3 long-term spells; even after adjustments, the OR was statistically significantly different from one; 2.10 (95% CI: 1.1-3.9).

The Wald test showed an overall statistically significant difference in the odds of having unfavourable scores in *work pace*, *role conflict* and *general health* between the sick leave patterns (Table 4).

**Table 4:** The odds of having unfavourable psychosocial work factor / general health scores among eldercare workers

<table>
<thead>
<tr>
<th>Demand</th>
<th>3-9 short spells</th>
<th>3-9 short spells</th>
<th>2-13 mixed spells</th>
<th>2-13 mixed spells</th>
<th>1-3 long spells</th>
<th>1-3 long spells</th>
<th>p-value</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work pace</td>
<td>1.26 (1.0-1.6)</td>
<td>1.28 (1.0-1.6)</td>
<td>1.51 (1.2-1.9)</td>
<td>1.52 (1.0-2.2)</td>
<td>2.10 (1.4-3.0)</td>
<td>2.24 (1.4-3.7)</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Emotional</td>
<td>1.32 (1.1-1.7)</td>
<td>1.32 (1.0-1.7)</td>
<td>1.40 (1.1-1.7)</td>
<td>1.62 (1.1-2.5)</td>
<td>1.27 (0.9-1.8)</td>
<td>1.37 (0.8-2.3)</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Hiding emotions</td>
<td>1.40 (1.1-1.8)</td>
<td>1.21 (0.9-1.6)</td>
<td>1.55 (1.2-1.20)</td>
<td>0.97 (0.6-1.5)</td>
<td>2.15 (1.5-3.1)</td>
<td>1.42 (0.8-2.4)</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Physical work load</td>
<td>1.52 (1.2-1.9)</td>
<td>1.29 (1.0-1.7)</td>
<td>1.51 (1.2-1.9)</td>
<td>1.20 (0.8-1.8)</td>
<td>1.36 (0.9-2.0)</td>
<td>1.16 (0.7-1.9)</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Influence</td>
<td>1.28 (1.0-1.6)</td>
<td>1.01 (0.8-1.3)</td>
<td>1.51 (1.2-1.8)</td>
<td>1.19 (0.8-1.7)</td>
<td>1.29 (0.9-1.8)</td>
<td>1.13 (0.7-1.8)</td>
<td>0.83</td>
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<tr>
<td>Meaning of work</td>
<td>1.33 (1.1-1.7)</td>
<td>1.11 (0.9-1.4)</td>
<td>1.43 (1.2-1.8)</td>
<td>1.03 (0.7-1.5)</td>
<td>1.14 (0.8-1.6)</td>
<td>0.81 (0.5-1.3)</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>Commitment to the workplace</td>
<td>1.46 (1.2-1.8)</td>
<td>1.17 (0.9-1.5)</td>
<td>1.67 (1.3-2.1)</td>
<td>1.28 (0.9-1.9)</td>
<td>1.50 (1.0-2.1)</td>
<td>1.19 (0.7-1.9)</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>Role conflict</td>
<td>1.54 (1.2-1.9)</td>
<td>1.50 (1.2-1.9)</td>
<td>1.43 (1.2-1.7)</td>
<td>1.25 (0.9-1.8)</td>
<td>1.25 (0.9-1.8)</td>
<td>1.05 (0.7-1.7)</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Quality of leadership</td>
<td>1.27 (1.0-1.6)</td>
<td>1.17 (0.9-1.5)</td>
<td>1.56 (1.3-1.9)</td>
<td>1.38 (0.9-2.0)</td>
<td>1.56 (1.3-1.9)</td>
<td>1.77 (1.1-2.9)</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Bullying</td>
<td>At least from time to time</td>
<td>1.46 (1.1-2.0)</td>
<td>1.29 (0.9-1.8)</td>
<td>1.68 (1.3-2.2)</td>
<td>1.14 (0.7-2.0)</td>
<td>2.27 (1.5-3.5)</td>
<td>1.39 (0.7-2.6)</td>
<td>0.41</td>
</tr>
<tr>
<td>Threats of violence</td>
<td>At least from time to time</td>
<td>1.45 (1.2-1.8)</td>
<td>1.17 (0.9-1.5)</td>
<td>1.34 (1.1-1.7)</td>
<td>1.19 (0.8-1.8)</td>
<td>1.37 (1.0-1.9)</td>
<td>1.28 (0.8-2.1)</td>
<td>0.55</td>
</tr>
<tr>
<td>General health</td>
<td>Fair-poor</td>
<td>1.84 (1.3-2.5)</td>
<td>1.56 (1.1-2.3)</td>
<td>2.98 (2.2-4.0)</td>
<td>1.29 (0.7-2.2)</td>
<td>4.97 (3.3-7.4)</td>
<td>2.10 (1.1-3.9)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* Adjusted for age, gender, occupation, total sick leave days; # Wald test for overall difference in work factor score between sick leave patterns
4.1.3 Effect modification by age
Age significantly modified the association between a frequent short-term sick leave pattern and commitment to the workplace and between frequent short-term sick leave spells and quality of leadership (Table 5). For those below 40 years of age, the OR of having unfavourable scores in commitment to the workplace was 1.33 (95% CI: 0.8 - 2.2) for a frequent spell pattern compared with 1-3 long spells, whereas older colleagues had an OR of 0.14 (95% CI: 0.03 - 0.6). Among young employees, the OR of having unfavourable scores in quality of leadership was 0.80 (95% CI: 0.5 - 1.3) among frequent absentees compared with those having 1-3 long spells. Among older employees, this OR was 0.30 (95% CI: 0.1 - 0.7). No statistically significant effect modification was seen in relation to general health.

Table 5: The modifying effect of age on associations between unfavourable psychosocial work factor / general health scores and spell pattern.

<table>
<thead>
<tr>
<th></th>
<th>3-9 short spells</th>
<th>Interaction term</th>
<th>Old age (&gt;40)</th>
<th>Young age (=&lt;40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work pace</td>
<td>0.57 (0.3 - 0.9)</td>
<td>0.28</td>
<td>0.86 (0.4 - 2.1)</td>
<td>0.51 (0.3 - 0.9)</td>
</tr>
<tr>
<td>Emotional</td>
<td>0.97 (0.6 - 1.6)</td>
<td>0.75</td>
<td>0.87 (0.3 - 2.2)</td>
<td>1.02 (0.6 - 1.8)</td>
</tr>
<tr>
<td>Hiding emotions</td>
<td>0.85 (0.5 - 1.4)</td>
<td>0.84</td>
<td>0.78 (0.3 - 2.3)</td>
<td>0.87 (0.5 - 1.5)</td>
</tr>
<tr>
<td>Physical work load</td>
<td>1.11 (0.7 - 1.8)</td>
<td>0.85</td>
<td>1.22 (0.5 - 3.1)</td>
<td>1.11 (0.6 - 1.9)</td>
</tr>
<tr>
<td>Influence</td>
<td>0.90 (0.6 - 1.4)</td>
<td>0.22</td>
<td>0.56 (0.2 - 1.4)</td>
<td>1.01 (0.6 - 1.7)</td>
</tr>
<tr>
<td>Meaning of work</td>
<td>1.37 (0.8 - 2.2)</td>
<td>0.11</td>
<td>0.74 (0.3 - 1.8)</td>
<td>1.63 (0.9 - 2.8)</td>
</tr>
<tr>
<td>Commitment to the workplace</td>
<td>0.98 (0.6 - 1.6)</td>
<td>0.004</td>
<td>0.14 (0.03 - 0.6)</td>
<td>1.33 (0.8 - 2.2)</td>
</tr>
<tr>
<td>Role conflict</td>
<td>1.42 (0.9 - 2.3)</td>
<td>0.06</td>
<td>0.66 (0.3 - 1.7)</td>
<td>1.69 (1.0 - 2.8)</td>
</tr>
<tr>
<td>Quality of leadership</td>
<td>0.66 (0.4 - 1.1)</td>
<td>0.05</td>
<td>0.30 (0.1 - 0.7)</td>
<td>0.80 (0.5 - 1.3)</td>
</tr>
<tr>
<td>Bullying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>0.93 (0.5 - 1.7)</td>
<td>0.66</td>
<td>1.17 (0.4 - 3.8)</td>
<td>0.89 (0.5 - 1.7)</td>
</tr>
<tr>
<td>Threats of violence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>0.91 (0.6 - 1.5)</td>
<td>0.55</td>
<td>1.15 (0.5 - 2.8)</td>
<td>0.86 (0.5 - 1.4)</td>
</tr>
<tr>
<td>General health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair-poor</td>
<td>0.74 (0.4 - 1.3)</td>
<td>0.22</td>
<td>0.41 (0.1 - 1.2)</td>
<td>0.83 (0.5 - 1.5)</td>
</tr>
</tbody>
</table>

* Adjusted for age, gender, occupation, total sick leave days

4.2 Paper II
4.2.1 The DREAM register compared with the workplace register
The following results are based on analyses that include the first sick leave spell of 356 employees without inclusion of pregnancy-related sick leave. The ROC curve (Figure 3) illustrates that a nine-week optimum cut-off point in the DREAM register was required to discriminate between a sick leave spell duration of eight weeks or more defined in the workplace register. The area under the curve (AUC) was 98.77% (95% CI: 97.8-99.7). This...
implies that a cut-off point of nine weeks in the DREAM register will correctly identify approximately 99% of workplace-registered sick leave durations of eight weeks or more.

![ROC-curve](image)

**Figure 3** The accuracy of DREAM in identifying workplace-defined sick leave spells of > 8 weeks.

The agreement between the two registers in terms of the duration of the first sick leave spell is illustrated in Figure 4. The mean difference between DREAM data on sickness benefit and the employers’ personnel files was -1.4 (standard deviation (SD) 3.9) weeks, i.e. DREAM data overestimated sick leave by an average of 1.4 weeks compared with the workplace register. According to the Bland-Altman plot, the difference was not evenly distributed around the y-line=0 as DREAM data overestimated the workplace-registered sick leave in most cases. Furthermore, the difference was not independent of the average value; thus, the clustering of dots illustrates that the shorter average duration, the less difference between the two registers. The average difference between the two registers was statistically significantly different from zero (p<0.001).
4.2.2 Self-reported data compared with the workplace register

The self-reported mean annual length of sick leave was lower than the workplace-registered sick leave. The mean difference between workplace-registered and self-reported sick leave was 4.3 (95% CI: 3.4-5.2) days for women and 4.8 (95% CI: 0.4-9.2) days for men. The youngest age group (19-29 years) recalled their absence with a lower precision (mean difference 7.2 (95% CI: 3.1-11.2) days) than the age group of 40-49 years (mean difference 3.9 (95% CI: 2.7-5.1) days). Totally, 1,063 individuals underestimated their sick leave, 662 individuals recalled precisely and 586 individuals overestimated their sick leave.

When workplace-registered and self-reported sick leave lengths were categorised as shown in Table 6, 518 individuals underestimated their sick leave, 1,502 recalled their sick leave accurately and 251 eldercare workers overestimated their sick leave. The highest agreement was found in the categories 0, 0-7 and >56 days. In these categories, the responders were able to accurately recall annual lengths in 85.3% (95% CI: 81.4 – 88.6), 78.1% (95% CI: 75.3 – 80.8) and 58.5% (95% CI: 51.1 – 65.6) of the cases, respectively. In total, of those having at least one sick leave day according to the workplace register (n=1,910), 1,805 individuals also reported so themselves, which yields a sensitivity of 94.5% (95% CI: 93.4-
95.5). Among the eldercare workers who had no sick leave days (n=401), 342 individuals reported so, which amounts to a specificity of 85.3% (95% CI: 81.4 – 88.6). The sensitivity of recalling having had >28 sick leave days was 64.7% (95% CI: 59.4 – 69.7) and the sensitivity of recalling having had >56 sick leave days was 58.5% (95% CI: 51.1 – 65.6). The corresponding specificities were 98.3% (95% CI: 97.6 – 98.8) and 98.9% (95% CI: 98.3 – 99.3).

Table 6: Workplace-registered and self-reported sick leave days among municipal eldercare workers in a 12-month period.

<table>
<thead>
<tr>
<th>Workplace-registered weeks</th>
<th>0 days</th>
<th>0&gt;days=&lt;7</th>
<th>7&gt;days=&lt;14</th>
<th>14&gt;days&lt;28</th>
<th>28&gt;=days&lt;56</th>
<th>&gt;=56 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported weeks</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>0 days</td>
<td>342</td>
<td>85.3</td>
<td>88</td>
<td>9.7</td>
<td>9</td>
<td>2.4</td>
</tr>
<tr>
<td>0&gt;days=&lt;7</td>
<td>47</td>
<td>11.8</td>
<td>711</td>
<td>16.8</td>
<td>146</td>
<td>38.7</td>
</tr>
<tr>
<td>7&gt;days=&lt;14</td>
<td>6</td>
<td>1.5</td>
<td>96</td>
<td>10.8</td>
<td>179</td>
<td>47.5</td>
</tr>
<tr>
<td>14&gt;days&lt;28</td>
<td>3</td>
<td>0.8</td>
<td>10</td>
<td>0.8</td>
<td>11</td>
<td>1.1</td>
</tr>
<tr>
<td>28&gt;=days&lt;56</td>
<td>3</td>
<td>0.8</td>
<td>2</td>
<td>0.2</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>&gt;=56 days</td>
<td>0</td>
<td>0.0</td>
<td>3</td>
<td>0.3</td>
<td>1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Any sick leave

| Sensitivity | 94.5% ** | 64.7% ** | 58.5% ** |
| Specificity | 85.3% *** | 98.3% *** | 98.9% *** |

Percentages in bold shows perfect agreement between self-reported and workplace-registered sick leave weeks

* (910-88)+(377-9)+(275-3)+(348-5) / (910+377+275+348)
** (401-3)+(910-5)+(377-4)+(275-22) / (401+910+377+275)
*** (401-0)+(910-3)+(377-1)+(275-4)+(160-16) / (401+910+377+275+160)

4.3 Paper III

4.3.1 Disability pension

The unadjusted RR of being granted a disability pension among responders (n=1,978) was 1.84 (95% CI: 1.04-3.28) for employees exposed to a frequent short-term sick leave spell pattern, 2.58 (95% CI: 1.54-4.32) for employees exposed to a mixed or a long-term sick leave spell pattern and 3.33 (95% CI: 1.56-7.12) for employees with a non-frequent long-term sick leave spell pattern (Table 7).
Table 7: The relative cumulative incidence (RR) of being granted disability pension within 352 weeks for employees exposed to a frequent short-term, mixed or long-term sick leave pattern compared with a non-frequent sick leave pattern.

<table>
<thead>
<tr>
<th></th>
<th>Non-responders (n=661)</th>
<th>Responders (n=1,978)</th>
<th>Adjusted *</th>
<th>Adjusted **</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pseudo values</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>Overall difference between the spell patterns</td>
<td></td>
<td>p=0.008</td>
<td>p=0.0008</td>
<td>p=0.004</td>
</tr>
<tr>
<td>Sick leave pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 short sick leave spells</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
</tr>
<tr>
<td>3-17 short sick leave spells</td>
<td>0.78 (0.25-2.39)</td>
<td>1.84 (1.04-3.28)</td>
<td>1.62 (0.84-3.12)</td>
<td>1.29 (0.67-2.48)</td>
</tr>
<tr>
<td>3-13 mixed sick leave spells</td>
<td>3.09 (1.44-6.63)</td>
<td>2.58 (1.54-4.32)</td>
<td>2.41 (1.39-4.17)</td>
<td>0.90 (0.12-6.54)</td>
</tr>
<tr>
<td>1-5 long sick leave spells</td>
<td>0.84 (0.11-6.31)</td>
<td>3.33 (1.56-7.12)</td>
<td>3.46 (1.34-8.93)</td>
<td>1.20 (0.15-9.56)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;= 40 years</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td>1.42 (0.60-3.37)</td>
<td>1.29 (0.44-3.76)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-care</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homecare personnel</td>
<td>1.39 (0.71-2.70)</td>
<td>1.55 (0.67-3.57)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable work factor</td>
<td>1.11 (0.96-1.27)</td>
<td>1.13 (0.93-1.37)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total sick leave</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 days</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-14 days</td>
<td>1.67 (0.46-6.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-56 days</td>
<td>2.88 (0.36-22.75)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 56 days</td>
<td>7.46 (0.88-62.99)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Age, occupation and unfavourable work factors  ** Age, occupation, unfavourable work factors and total sick leave

Adjustment for age, occupation and number of unfavourable work factors did not alter the results except for the frequent short-term sick leave spell pattern, which became statistically insignificant. The overall difference in RR between the sick leave patterns remained statistically significantly different from one (Table 7).

The RR from the exposure to any of the sick leave patterns was not statistically significantly different from one when total sick leave was added to the model.

4.3.2 Long-term sick leave

The unadjusted RR of experiencing long-term sick leave among responders (n=1,797) was statistically significantly increased for all sick leave patterns compared with a non-frequent short-term spell pattern (Table 8). Adjustment for age, occupation and number of unfavourable work factors attenuated the RR. The overall difference between the sick leave patterns remained statistically significantly different from one (p<0.0001). Being engaged in homecare (RR=1.37; 95% CI: 1.15-1.62) and experiencing a one-point increase in
unfavourable work factors (RR=1.03; 95% CI: 1.01-1.06) independently increased the risk of long-term sick leave (Table 8).

Table 8: The relative cumulative incidence (RR) of experiencing long-term sick leave within 352 weeks for employees exposed to a frequent short-term, mixed or long-term sick leave pattern compared with a non-frequent sick leave pattern.

<table>
<thead>
<tr>
<th>Pseudo values</th>
<th>Unadjusted Non-responders (n=570)</th>
<th>Unadjusted Responders (n=1,797)</th>
<th>Adjusted * Responders (n=1,797)</th>
<th>Adjusted ** Responders (n=1,797)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall difference between the spell patterns</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>Overall difference between the spell patterns p&lt;0.0001</td>
<td>p&lt;0.0001</td>
<td>p&lt;0.0001</td>
<td>p=0.19</td>
<td></td>
</tr>
<tr>
<td>Sick leave pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 short sick leave spells</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3-17 short sick leave spells</td>
<td>1.50 (1.13-1.98)</td>
<td>1.44 (1.21-1.71)</td>
<td>1.35 (1.12-1.62)</td>
<td>1.20 (0.99-1.46)</td>
</tr>
<tr>
<td>3-13 mixed sick leave spells</td>
<td>2.00 (1.53-2.62)</td>
<td>1.78 (1.51-2.08)</td>
<td>1.64 (1.40-1.94)</td>
<td>1.31 (0.99-1.72)</td>
</tr>
<tr>
<td>1-5 long sick leave spells</td>
<td>1.24 (0.68-2.26)</td>
<td>1.61 (1.20-2.15)</td>
<td>1.52 (1.13-2.03)</td>
<td>1.23 (0.87-1.74)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;= 40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td></td>
<td>1.04 (0.87-1.24)</td>
<td>1.02 (0.86-1.22)</td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homecare personnel</td>
<td></td>
<td></td>
<td>1.37 (1.15-1.62)</td>
<td>1.35 (1.14-1.60)</td>
</tr>
<tr>
<td>Unfavourable work factor scores</td>
<td></td>
<td></td>
<td>1.03 (1.01-1.06)</td>
<td>1.03 (1.00-1.05)</td>
</tr>
<tr>
<td>Total sick leave</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-14 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-56 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 56 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Age, occupation and unfavourable work factors</td>
<td>** Age, occupation, unfavourable work factors and total sick leave</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Further adjustment for total sick leave did not affect the risk estimates in relation to age, occupation and unfavourable work factors. The relative cumulative incidence associated with being exposed to a frequent short-term, a mixed and a long-term sick leave spell pattern compared with a non-frequent short-term spell pattern was attenuated and became non-significant when adjusting for total sick leave length (Table 8).
Chapter 5: Methodological Considerations

The reporting guidelines provided by the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) (95) statement and the *Standards for Reporting of Diagnostic Accuracy* (STARD) (96) statement offer valuable guidelines on how to report scientific work in a way that enables the assessment of strengths and weaknesses along with the generalisability of the results. STROBE (Paper I and III) and STARD (Paper II) are used as lenses through which study design, selection and information bias, confounding, and generalisability may be critically assessed.

5.1 Paper I

5.1.1 Design
We chose a cross-sectional design because our aim was to investigate if a hypothesised frequent short-term sick leave pattern was present at the same time as self-reported unfavourable work environment factors. Potential causality was thus not an objective, and the sick leave patterns were therefore constructed within the same year (2005) as the eldercare employees responded to the work environment questionnaire (between February and July).

5.1.2 Selection bias
Students were excluded from the study because their situation is different from that of the permanent staff, and an analysis of these differences was not an objective of Paper I. Employees on maternity/paternity leave and workers not employed throughout 2005 were also excluded for reasons partly accounted for in Paper I. A total 779 employees were thus excluded; 40 responders to the questionnaire about the working environment were missed. They were younger (median age 40.1 years) than the study population, and 85% were employed in home care. This might have reduced the power in the analyses because their mean work factor scores were neither more nor less favourable than the responders’. We did not account for the 734 potential participants who were excluded due to maternity/paternity leave. Their median age was 33.3 years (range 21 to 52 years); this excluded group counts a large number of participants who were younger than 41 years of age. Sixty-two percent were occupied in homecare, and nurses and therapists accounted for 30%. We lost information on the work environment factors from 372 to 402 responders. Their responses did not differ much from the answers of those who were included in the study. However, their mean scores of *meaning of work*, *commitment to the workplace*, and *role conflict* were statistically significantly more unfavourable than the scores of those who were included in the study. The results may have been biased toward the null hypothesis due to
selection in the analyses of associations between sick leave patterns and unfavourable work factor scores. However, the results of whether age modified the association between a frequent short-term sick leave pattern and unfavourable work factor scores in meaning of work and role conflict compared with the long-term pattern may have been underestimated. Non-responders (24%) to the questionnaire were more likely to be young, to have more than 14 sick leave days in total and to have more long-term sick leave spells than responders. This might have weakened the association between sick leave length/long-term sick leave spell pattern and work factors due to selection bias. We also cannot rule out a possible underestimation of the association between spell frequency and work factors adjusted for sick leave length.

5.1.3 Information bias

It strengthened our results that the sick leave measures were constructed from workplace-registered sick leave data rather than from self-reported sick leave data. As such, the risk of making trivial associations was limited (97). However, the questionnaire-obtained evaluations of the psychosocial working environment are not an objective measure, and they are most likely influenced by the characteristics of the person answering the questionnaire. This may cause non-differential/differential misclassification which will lead to biased associations between the work environment factors under study and, for instance, sick leave (98). In Paper I, the selected work environment scales were dichotomised into favourable/unfavourable scores according to the mean scores identified in a representative sample of working Danes in 2004/2005 (88). This procedure reduced the variation between individuals and, hence, the risk of misclassification.

The dichotomisation of sick leave length into 0-14 days and 15-581 days was in conformity with the Danish Sickness Benefit Act (86). In 2005, the public insurance system reimbursed sickness benefits for sick leave spells lasting more than 14 days. Moreover, several studies outside Denmark have used the same cut-off point (45;84;85).

The construction of sick leave patterns was less literature-based than the dichotomisation of sick leave length (44;87). Sensitivity analyses of the definition of frequent short-term and mixed sick leave patterns were performed. Instead of using 3-9 short and 2-13 mixed spells, we used 4-9 and 5-9 short spells (1.81 (95% CI: 1.0-3.2)) as well as 4-13 and 5-13 mixed spells (1.71 (95% CI: 0.9-3.2)), which increased the OR of having unfavourable scores in emotional demands, respectively compared with 1.62 (95% CI: 1.1-2.5, Table 4). This tendency was not as clear for physical work load and role conflict. However, for influence and commitment to the workplace (viewed upon as resources at work), the OR for unfavourable scores rose when using 4-13 and 5-13 mixed spells, respectively, compared with the OR for 2-13 mixed spells.
We studied demands and resources that were found to be associated with self-reported sick leave length in a representative sample of Danish eldercare employees (42;46). We have no evidence, though, that these work factors uniquely describe demands and resources within the eldercare sector from a theoretical point of view. Future research should focus on the identification of the unique work environment factors that characterise the eldercare sector (21). Such research may inform interventions that aim at improving the working environment in this particular work setting.

5.1.4 Confounding
Adjustments were made for age (22), gender (2;22;43) and occupation (2). This adjustment did not significantly alter the associations between work factors and either sick leave length or spell pattern. Thus, the associations were most affected by the inclusion of the number of sick leave spells and by the categorised sick leave length.

We cannot rule out the possibility of residual confounding. Independent risk factors of sick leave like health-related variables (22;99) are treated as potential confounders in studies with aims similar to those of Paper I (30;33;38;87). We also think of general health as an intermediate factor in the association between sick leave and unfavourable work factor scores. This point of view was also made by Schaufeli et al.: long term sick leave was found to be predicted by the exposure to work demands; however, it was recognised that health status may as well influence the long-term sick leave (21).

5.1.5 To conclude about generalisability
A high power was achieved owing to the large size of the sample and because workplace-registered sick leave measures are more accurate than self-reported data (Paper II) (53); both of these factors contribute to the internal validity of the study, but the internal validity might have been threatened by potential selection bias introduced by the exclusion of employees on maternity/paternity leave and possible misclassification with regards to favourable/unfavourable work factor scores. However, the inclusion of an entire municipal eldercare workforce in the second largest city of Denmark was a major strength in terms of external validity. The results may be generalised to eldercare sectors in large cities where a comparable public sector is the main supplier of healthcare and, more specifically, to homecare employees older than 40 years of age.
5.2 Paper II

5.2.1 Design

Paper II was conducted in a cross-sectional study design. However, the time span between the sick listing reported to the workplace (reference standard) and the matching appearance of DREAM-registered sickness benefit and the respondents’ abilities to recall accurately (index tests) speaks in favour of a retrospective study design. In fact, the numerous procedures that took place during this time span sparked both the first aim (a), viz. to check if DREAM data on sickness benefit matched the sick leave spells registered by the workplace, and the second aim (b), i.e. to determine if the respondents’ self-reported one-year recollection of sick leave was as accurate as the workplace-registered sick leave.

5.2.2 Selection bias

a) The same principles as those described in Figure 2 were applied in the inclusion of participants to this study. We have no reason to believe that the exclusion of employees on maternity/paternity leave and those who were not employed throughout 2006 would bias the results because these employees would have used exactly the same procedures as those that are used to report sick leave to the workplace and to pass the data on to the DREAM register. Ninety-five women had pregnancy-related sick leave and were excluded in the final analyses because of very low sensitivities of DREAM data on sickness benefit related to their sick leave spells.

Of the 789 employees, 433 were excluded in the analyses of the duration of sick leave spells for purely technical reasons. To be able to correctly identify the corresponding sick leave spell in the DREAM register, we had to restrict the analyses to the first sick leave spell encountered by the 789 eligible participants. Furthermore, it was required that the workplace register and the DREAM register were in agreement as to the starting week of this sick leave spell. We do not believe that this procedure introduced selection bias.

b) A total of 3,147 eldercare workers were employed throughout 2004 and 2005, but only 2,311 (73%) responded. The mean workplace-registered annual sick leave length was 2.5 (SD: 5.0) weeks among responders and 4.2 (SD: 8.0) weeks among non-responders. We expect those whose absence length was longest to be less precise in their recall than those with shorter lengths. Selection bias may therefore have been present and may have meant that we
overestimated the results regarding agreement – which is in line with the findings of Burdorf et al. (57). This is a major disadvantage of self-reports as compared with register data.

**5.2.3 Information bias**

*a) and b)*

We chose workplace-registered sick leave as the reference standard because it is considered to be more accurate than other sources given that these data are also used for calculating earnings (57;58;61;100). Thereby employer and employee both have an interest in the correctness of these data.

*a)*

There was less agreement between DREAM data and workplace data in the measures obtained at the beginning and towards the end of 2006 than during the remaining part of the year. This can be explained by different registration procedures. We do not expect that the exclusion of these weeks has caused information bias because sick leave spells would be randomly distributed over these particular weeks.

**5.2.4 Confounding**

*a)*

We performed logistic regression analyses to be able to adjust for young (<41 years) and old age, gender, occupation and workplace.

The agreement between DREAM data on sickness benefit and workplace data did not depend on the women’s age. This changed when pregnancy-related sick leave was included in the analyses because of the combined effect of being young and therefore more prone to be pregnant. Furthermore, this age dependency could not be found among the male employees. Because pregnancy-related sick leave was recoded from sickness benefit to maternity payment, sick leave among young women is underestimated, and caution is advised when analysing sick leave in this age group of females.

Male employees seemed to give more valid self-reported sick leave data than women (58;62;64). The massive female employee domination in the public sector and in our study population hampers firm conclusions about potential gender differences in the diagnostic accuracy of sick leave in our data.

*b)*

We did not adjust for potential confounders in the validation of self-reported sick leave data. The results may therefore be biased due to confounding from occupation. Sick leave length and spell duration is dependent of occupation (Paper I) (89), and the ability to correctly recollect the duration of sick leave decreases with its duration (58;61;64).
5.2.5 To conclude about generalisability

a) and b)

The exclusion of women (n=95) having pregnancy-related sick leave increased the internal validity of our study. However, in comparative register studies on sick leave where the DREAM register is considered for use, it is very important to consider the recoding of pregnancy-related sick leave into maternity benefits. This reduces the external validity which is limited in fertile-aged women.

The employer period has changed twice since 2006; as from 2 January 2012, the period is 30 days. In principle, the sick leave spell duration must exceed 30 days before it appears in the DREAM register. This limits its usage in scientific contexts. However, in light of the poor agreement found between self-reported and workplace-registered sick leave exceeding one week, the DREAM register is preferable to self-reports on sick leave spell durations exceeding 30 calendar days and workplace registers are preferable to self-reports on sick leave lengths exceeding one week.

5.3 Paper III

5.3.1 Design

We aimed at identifying whether sick leave patterns were early indicators of disability pension or/and long-term sick leave. From an epidemiological point of view, this makes the study a risk study. Roughly speaking, two study designs are appropriate for the identification of risk factors: observational, retrospective studies and prospective studies. We conducted the study as an observational follow-up study because the study population was large and because both outcome variables, i.e. disability pension and long-term sick leave, were register-based. In this way, loss to follow-up was not a limitation despite the fact that disability pension is a rare event.

5.3.2 Selection bias

The inclusion of participants to Study III was guided by the same principles as those described in Figure 2. We lost 622 responders to the work environment questionnaire distributed in 2005 by the exclusion of employees who were on maternity/paternity leave and those who were not employed throughout 2004. Women accounted for 96% of those who were excluded; the median age was 34.4 years (range 18-66 years). The mean number of unfavourable work factors was 4.8 (SD 2.4). Thus, apart from being younger the 622 excluded responders were similar to those included in the study. It makes little scientific sense to comment on the kind of sick leave pattern the excluded employees would have had, and any potential selection bias
and its possible direction made on this basis would seem speculative. However, it was possible to follow the excluded employees according to outcome. During the “wash-out” period, 134 (7.6%) of the 1,754 excluded employees experienced the event disability pension or long-term sick leave 285 (16.2%), one of the competing risks or emigrated from Denmark and did not return before 1 January 2006. During the follow-up period, 84 individuals (5.2%) were granted a disability pension; this proportion was not statistically significantly different from the proportion (112 individuals, 4.2%) of included employees (p=0.16) granted such pension. The proportion (515 individuals, 35.5%) of long-term absentees among those who were excluded was statistically significantly higher than the proportion (761 individuals, 32.2%) among the included employees (p=0.03).

The exclusion of respondents on maternity/paternity leave and those who were not employed throughout 2004 may imply that the RR of experiencing long-term sick leave was underestimated due to selection. However, the magnitude of this bias is impossible to determine because of uncertainty as to which sick leave pattern the excluded might have had.

Among the included study participants, selection bias introduced by non-response to the work environment questionnaire may have given rise to underestimated risk estimates of the exposure by mixed and long-term sick leave patterns. This presumption is supported by the fact that the differences between unadjusted and adjusted results presented among responders in Tables 7 and 8 were smaller than those we would have found if the unadjusted analyses had been performed for non-responders and responders as one group.

The one-year “wash-out” period may have caused underestimation of the RR of experiencing recurrence of long-term sick leave due to selection bias; approximately 40% of those who experienced long-term sick leave during the “wash-out” period had a mixed or a long-term sick leave pattern; the equivalent figure for those included in the final analyses was 20%.

5.3.3 Information bias

The exposure variable, i.e. sick leave patterns, was retrieved from a workplace register, and both outcomes were identified from a register whose data are known to be highly valid. The DREAM register has 100% coverage of granted disability pensions in Denmark (78). Long-term sick leave, defined as nine consecutive sickness benefit weeks, was validated on the same study population (Paper II) (53). Information bias was therefore limited.

We believe that the use of the pseudo values method (93;94) increased the credibility of the estimated associations. Even though a hazard ratio is the most common measure of association in the analysis of time-to-event data, a RR is, in general, easier to interpret than a hazard ratio. More specifically, the assumption about proportionality of hazards may not always be met; many studies do not describe if proportionality has been checked and whether
proportionality exists in fully adjusted models or merely in the unadjusted model. This may cause results to be imprecise and may possibly lead to misleading conclusions. Finally, if events have a prevalence above 10%, it becomes more difficult to make inferences from the hazard ratio because of non-equivalence with RR.

5.3.4 Confounding
A one-year “wash-out” period was chosen to study sick leave patterns as an early indicator of disability pension and/or long-term sick leave because we wanted to eliminate confounding due to long-term sick leave immediately before events occurred (70;71). However, the appropriateness of excluding long-term absentees from the latter risk population is two-edged. The argument put forward in Paper III was rooted in a desire to identify early markers of reduced workability that may be preventable and be a target for workplace interventions. However, as mentioned above, this exclusion introduced a possible selection bias as well. Analyses were performed by the use of a generalised linear regression model which allowed us to use the pseudo values method (93;94). The robustness of this model is not threatened as long as the number of events is sufficiently large, i.e. 25 events per parameter (93). In the analyses of the RR of being granted a disability pension, 112 events corresponded to approximately five parameters. Thus, the adjusted models (Table 7) which included up to nine parameters were possibly over-fitted. This was not the case in the analyses of the RR of experiencing long-term sick leave (Table 8), in which 30 parameters could have been used. The main reasons for not including gender as a potential confounder were the limited number of allowed parameters in the analyses of the risk of being granted a disability pension and the priority of identicalness of the adjustment procedure in both risk populations. Moreover, the massive female employee domination in the public sector and in our study population would have hampered firm conclusions about potential gender differences in the risk estimates if we had chosen to include gender as a risk factor. Thus, gender-caused residual confounding cannot be ruled out.

5.3.5 To conclude about generalisability
Over-fitting may have threatened the internal validity in the adjusted analyses of the risk of being granted a disability pension. Potential selection bias may have been introduced on three occasions: first, by the exclusion of employees on maternity/paternity leave or employees who did not work the entire year of 2004; second, by exclusion due to the occurrence of an event during the “wash-out” period; and third, by non-response to the questionnaire on the working environment. All three types of selection bias may have caused underestimated RR in both risk estimates in general and in the RR of experiencing long-term sick leave in particular. The results hence reflect rather conservative risk estimates of future reduced workability among
elder care employees having mixed or long-term sick leave spell patterns. These results may be generalised to comparable female-dominated occupational settings.
Chapter 6: Discussion of Main Results

The discussion is divided into three sections to address the hypotheses raised in light of the findings of other studies.

6.1 Findings of Paper I in relation to main hypotheses

Was an association between total sick leave length and a poor working environment more likely to be due to a frequent short-term sick leave pattern than to a non-frequent long-term sick leave pattern, and even more so in young employees than in older colleagues? And were long-term sick leave spells, on the other hand, more strongly associated with a poor general health than short spells? (Paper I)

Irrespective of the number of sick leave spells, unfavourable scores in work pace, demands for hiding emotions and being bullied, at least from time to time as well as quality of leadership were significantly associated with employees having >14 sick leave days compared with employees having <15 days. Furthermore, employees with the long-term sick leave spell pattern were more likely to have unfavourable work pace scores than employees with the non-frequent short-term sick leave pattern. Inversely, employees with unfavourable scores in role conflict and emotional demands had a higher probability of having a frequent spell pattern, i.e. 3-9 short-term spells and 2-13 mixed spells, respectively, than a non-frequent short-term spell pattern adjusted for sick leave length.

Commitment to the workplace was the only work factor that confirmed our hypothesis that young employees would be more frequently absent than their older colleagues in situations where both age categories evaluated the work factor scores as being unfavourable.

Finally, the long-term sick leave spell pattern increased the OR for a fair-poor general health more than did the frequent sick leave patterns.

6.1.1 Other study findings

It has been claimed and tested within the JD-R model that high job demands are more likely to cause long-term sick leave than short-term sick leave, irrespective of spell frequency (21). It has also been claimed that job demands and resources are uniquely and closely related to specific occupations (20). The NRCWE-conducted survey found that the 34% increased sick leave level among employees engaged in homecare compared to administrative employees was explained by differences mainly in demands (work pace, emotional demands, demands for hiding emotions, and physical work load), resources (influence, meaning of work commitment to the workplace, role conflict, and quality of leadership) and the proportion of employees being bullied and threatened by violence (42;46). These work factors emerged as the result of
statistical associations within a cross-sectional study design, and the results were possibly biased due to non-response by long-term absentees. Although the survey was conducted in 35 Danish municipal eldercare workplaces and thus encompassed a considerable proportion of the Danish eldercare sector, important work factors unique to this particular occupation may have been overlooked in our studies (Papers I and III) because we selected items from significant findings rather than from theory-based or qualitatively study-based items. In a review about workplace stress in nursing by McVicar (26), the most important work environment factors were found to be different aspects of work load, relationship with other clinical staff, leadership and management, emotional demands in the job, shift working and lack of reward. The ratio between healthcare personnel and patient has also been shown to affect levels of burnout but not sick leave (5). However, in a Danish setting among employees in human service work, high levels of burnout were associated with an increase in sick leave days compared with low burnout levels (101). In the latter study, burnout correlated closely with job satisfaction, quantitative demands, role conflict and emotional demands (101). Burnout is also an important element in the JD-R model where it is a direct consequence of sustained, high job demands (20), and it is thought to precede “involuntary sick leave”, i.e. sick leave length (21). Job resources, on the other hand, reduce the negative effect of job demands on burnout; this effect is denoted ‘the buffering effect’ and it may reduce “voluntary sick leave”, i.e. number of sick leave spells (21). Focusing on home care organisation of employees within the context of the JD-R model, Xanthopoulou and colleagues showed that high levels of job demands coincided with burnout only in the presence of low levels of job resources (102). The most important job demands were emotional demands and patient harassment. The resources showing the best buffering effect were autonomy, social support and opportunities for professional development (102). Rather than combining the associations of favourable/unfavourable demands and resources with the different sick leave patterns, we analysed each work environment factor separately. This could imply that the results presented in Paper I did not consistently support the hypotheses raised. However, a post-analysis of the linear effect of the number of work factors perceived as stressful showed a higher number of stressful work factors ($\beta=0.54$; 95% CI: 0.3-0.8) among those with 3-9 short-term sick spells than among those with 0-2 short-term spells after adjustment for age, gender and occupation. This is equivalent to an increase in OR from 1.1 (95% CI: 1.05-1.1) to 1.5 (95% CI: 1.2-1.7) when the number of stressful work factors rose from one to four. This is similar to the results of Elstad et al.; they reported that the OR rose from 1.3 to 1.5 when the number of items perceived as stressful rose from one to four among Nordic eldercare workers (32). However, these results were based on spells of any duration, whereas our results apply exclusively to short-term spells. Thus, in the post-analysis, our data also showed a combined effect of
unfavourable scores in both demands and resources on the OR of having frequent sick leave spells, i.e. sick leave length, because no adjustment was made for sick leave length.

Paper I explored whether the increased sick leave levels among young eldercare workers explained by Borg and colleagues (46) as the result of more role conflict and less commitment to the workplace were linked to the duration or the frequency of the spells rather than the overall sick leave length. We found no statistically significant effect modification in relation to role conflict. The associations between commitment to the workplace and quality of leadership, on the one hand, and sick leave patterns, on the other hand, were statistically significantly modified by age. We were able to identify no studies of healthcare employees whose age was explored as a potential effect modifier. Donders et al. conducted a study with objectives similar to those explored in Paper I regarding the working environment, sick leave patterns and age as a possible effect modifier, but the employees in their study were employed at a university (45). Among young employees, the OR for frequent sick leave spells decreased when they scored high on decision latitude, whereas the OR became insignificant among older colleagues. And high scores in demanding work factors resulted in an increased OR for prolonged sick leave among all age categories (45). These findings correspond nicely with the JD-R model. In the JD-R model, it is, however, tenure rather than age that is usually included in adjustment procedures and there is no argumentation for any effect modification (102).

6.2 Findings of Paper II in relation to main hypotheses

Were DREAM data on sickness benefits in accordance with workplace-registered sick leave spells? And was self-reported sick leave length based on one-year recollection less accurate than workplace-registered sick leave? (Paper II)

The study showed an excellent agreement between workplace-registered sick leave and DREAM-registered sickness benefit compensation. Except for pregnancy-related sick leave, the DREAM register identified workplace-registered spells exceeding 14 days with very high sensitivity and excellent specificity. To identify sick leave spells beyond eight weeks, the optimal cut-off point in the DREAM register was nine weeks. On average, DREAM data overestimated the workplace-specified duration of sickness spells by 1.4 weeks. The analyses of the self-reported sick leave lengths showed that the ability to recall accurately fell the higher the number of workplace-registered absence days. This was apparent even with sick leave lengths exceeding seven days.
6.2.1 Other study findings

The attraction that lies in using register data on sick leave rather than self-reports is outlined in Paper II. We investigated DREAM-registered sickness benefits and whether data on such benefits could be used as a valid approximation of at least 14-day workplace-registered sick leave spells among eldercare employees. Both sensitivity and specificity were high even if we required sick leave registration within the same week which was much stricter than the criterion of sick leave within the same year used in studies using self-reported sick leave. The request of detailed information on sick leave, i.e. diagnosis, reported in other studies considerably lowered the sensitivities in these studies (57;68).

Workplace-registered sick leave seems to be more reliable than self-reported sick leave. Recall periods of down to two months have been shown to produce discrepancies between workplace data and self-reported duration of absence in approximately 13% of the investigated cases. This percentage increased to approximately 50% when the recall period was extended to 12 months (61). In Paper II, the study population was able to recall absence length accurately in 662 cases (28.7%). Approximately 30% perfect agreement between self-report and workplace-registered data among female responders was also found in the Whitehall II study (58). For comparison, DREAM data were in perfect agreement with workplace data in 69.7% of the cases on which weeks were reimbursed and on the respondent being on sick leave. However, DREAM-registered sickness benefit weeks used for spell duration approximation should be interpreted with caution; we found that DREAM overestimated spell duration by a mean of 1.4 weeks.

One of the outcomes in Paper III is long-term sick leave, which was defined as eight consecutive sick leave weeks identified in DREAM. This outcome has been used in several publications where DREAM data have been used (103). In order to limit the possible misclassification due to the aforementioned overestimation, we studied which optimal cut-off point should be used to correctly discriminate between a sick leave spell duration of eight weeks or one that was longer as defined in the workplace register. Nine DREAM-registered sickness benefit weeks gave the highest sensitivity and specificity.

One of the key stakeholders in The arena in work disability prevention model is the legislative and insurance system (8). National legislation and the enforcement of enacted rules and regulations may be affected by numerous factors such as the state of the national economy and the government of the day (49;104-106). A demographic change throughout Europe and the growth of the aging work force call for a reform of current employment policies (49). Economic incentives may be used to engage the employer to take active part in the prevention of long-term sick leave, for example by extending the period where benefits are paid by the employer. The other side of the coin may be a less inclusive labour market which may arise if employers try to reduce the number of employees with known or anticipated reduced
workability (49). Structural changes like recession (105) and downsizing in workplaces (107) have been shown to affect employee workability and work stress perceptions.

The DREAM register is a longitudinal database that mirrors the structures in the social security system in force at the time in question; this must be taken into account when using DREAM data. As stated in Chapter 5.2.5; the employer period, i.e. the period during which the employer is responsible for the wage compensation while employees are sick-listed, has been altered twice and it is currently 30 days (108). We investigated whether the DREAM-registered sickness benefits were a valid approximation of at least 14-day workplace-registered sick leave spells among eldercare employees. These study results therefore cannot be replicated using DREAM-registered sickness benefit data from 1 April 2007 and onwards. We have no reason to believe that the conclusions in Paper II would change due to employer period alterations alone. Alterations in the procedures leading from the employer-registered sick leave spells to the municipality-registered sickness benefit pay-outs that eventually emerge in the DREAM register should, however, encourage reconsideration of the conclusions in Paper II. To my knowledge, these procedures have not been altered significantly since 2006.

6.3 Findings of Paper III in relation to main hypotheses

Was a frequent short-term sick leave pattern an early indicator of disability pension and long-term sick leave? (Paper III)

Employees exposed to a mixture of short and long or merely long-term sick leave spells had a significantly larger RR of being granted a disability pension than employees with a non-frequent short-term sick leave spell pattern. The risk of experiencing long-term sick leave was significantly increased for all sick leave patterns compared with a non-frequent short-term sick leave pattern. Although statistically insignificant after adjustment for total sick leave length, this result does not disprove that a frequent spell pattern is an indicator of future long-term sick leave, but sick leave length appears to be a better indicator of future reduced workability than spell frequency.

6.3.1 Other study findings

In Paper III, exposure to sick leave patterns defined as a mixture of short (1-7 days) and long (>7 days) spells or merely long spells increased the risk of being granted a disability pension. This is in accordance with previous studies which report that long-term sick leave spells lasting more than 14 days (79), 28 days (80) or 54 days (81) increased the risk of being granted a disability pension. Unfortunately, we could draw no firm conclusions about the independent risk of sick leave spell frequency due to the risk of over-fitting. However, the fact that the prevalence of employees whose sick leave exceeded 14 days (22%) was much higher among
employees with the mixed and solely long-term sick leave spell patterns than among employees with a frequent short-term sick leave pattern (3%) implies that the increased risk may be due to sick leave length rather than spell frequency. Two studies investigating the risk of future disability pension when having a frequent short-term spell pattern defined as at least two spells lasting 1-15 days (82) or at least three 1-3 day sick leave spells (70) both concluded against an independent risk when employees had frequent sick leave spells. However, Pedersen et al. (81) and Wallman et al. (72) found that sick leave patterns were commonly characterised by progression in both spell frequency and sick leave spell duration 4-16 years before disability pension. Several studies support this observation; they found that frequent sick leave spell patterns posed an independent risk of future long-term sick leave (82;83;109). These findings were further underpinned by the increased RR of future long-term sick leave when employees were exposed to frequent short-term, mixed, and long-term sick leave spells as reported in Paper III.

A poor working environment has previously been found to be an independent risk factor for disability pension among general working populations (75-78;110) and for more than eight sick leave weeks in general (103) and among Danish eldercare workers in particular (34). The risk for disability pension was not increased by the number of unfavourable work environment factors among the study participants included in Paper III, but the risk for long-term sick leave was. The study by Clausen et al. emphasised that tackling long-term sick leave in the eldercare sector may be contingent more on promotion of job resources than on reduction in job demands (34). This notion was suggested because job resources remained significant after mutual adjustment for all psychosocial work environment exposures, while demands became insignificant.

One of the unique job demands in the eldercare sector is that of often very close contact with the elderly. This demand is hardly likely to (and nor should it) be reduced in the future (26;102). Grounded in the JD-R model, job resources may have the ability to buffer the negative effects of sustained, high job demands on sick leave length (21). It seems reasonable to apply this theoretical perspective within the eldercare sector as well (102).
Chapter 7: Main Conclusions

The overall objective of this dissertation was to investigate whether workplace-registered frequent short-term sick leave spells could be used for early identification of eldercare employees experiencing a poor psychosocial working environment and being at risk of future work disability. A further purpose was to validate sick leave measures (Papers I and III).

The precision of recollection of sick leave length obtained by questionnaires declined the higher the number of workplace-registered sick leave days; even with sick leave lengths exceeding seven days. This finding is in accordance with results from similar studies. Workplace-registered sick leave data are therefore preferable to self-reports in general and notably so if sick leave measures are defined from both sick leave spell duration and sick leave frequency. If workplace-registered sick leave is unavailable, the recall period should be shorter than one year.

As expected, the number of sickness benefit weeks was overestimated in the DREAM register compared with the workplace register. A nine-week sickness benefit cut-off point in DREAM should therefore be used when defining long-term sick leave as eight consecutive sick leave weeks. This result can be generalised to municipal work settings because similar procedures are used in the registration of sick-listed employees and in the application for the tax-financed municipal refund to the employer. However, caution is a must because of the limited external validity in fertile-aged women. The study should be replicated in the private sector and in state institutions.

Workplace-registered short-term frequent sick leave spells were expected to be an indicator of a poor working environment. The results from Paper I, however, did not support this hypothesis. Role conflict and emotional demands were the only work factors associated with such a sick leave pattern, whereas sick leave length was consistently associated with unfavourable work factor scores. Moreover, in Paper III, sick leave length was found to be a better early risk marker of future permanent work disability than sick leave spell frequency. Likewise, the number of unfavourable work factor scores was found to increase the risk of future long-term sick leave. Thus, eldercare employees in general and employees above 40 years of age in particular who work in comparable occupational settings and who experience sick leave lengths above 14 calendar days may benefit from preventive actions towards future reduced workability that target work pace, demands for hiding emotions, bullying and quality of leadership. The possible mediating effect of age should be studied further because the working environment may affect inexperienced and experienced employees differently.
A frequent sick leave spell pattern, though, was found to increase the risk of future long-term sick leave (Paper III), which may be a first warning of a permanently reduced workability.
Chapter 8: Perspectives

During the preparation for the PhD protocol we discovered that basically all research on sick leave and the association with the psychosocial working environment used length of sick leave and frequency of spells as two separate sick leave measures. Hence, any independent association between length versus frequency and psychosocial work factors therefore remained unknown. Papers I-III and their respective conclusions were destined to ensure: 1) early identification of employees at risk of future reduced workability based on their sick leave pattern and 2) detection of work environment factors that should be targeted in workplace interventions addressing high-risk sick leave patterns.

However, no straightforward answers were produced as to which targets/thresholds should be set to identify those employees who have a frequent short-term sick leave pattern. Future research should focus on the definition of frequency, i.e. how many short-term spells constitute this pattern. Spell patterns rather than sick leave length and frequency of sick leave spells should be studied further as two separate measures. Short-term frequent sick leave spells seem to precede adverse events within occupational health; more knowledge about this phenomenon is required.

Preservation or supply of job resources within the eldercare sector may be a more sustainable answer to high job demands, high sick leave rates and staff shortage as hypothesised within the JD-R model, than previous strategies, i.e. demands for efficiency improvements expressed in downsizing, strict time recordings, lowering of core output quality, but this needs further confirmation. Future research should identify what are important and unique work environment factors within the eldercare sector by combining evidence from questionnaire-obtained data and from qualitative studies. It should be studied whether these sustained high job demands lead to long-term sick leave and whether this association is mediated by the identified unique job resources.

In continuation of Paper I, where all analyses were done at the level of the individual; multilevel analyses could be performed to determine how much of the variation in sick leave patterns (consistent with those in Paper I and III) that was attributable to individual factors and how much that was attributable to work-team aggregated work environment factors. Such knowledge would give employers and occupational healthcare professionals important information about the appropriate future intervention level, viz. individual or work-team, to reduce sick leave.
The results of Papers I and II have laid the ground for collaboration with a research team from the University of Groningen in The Netherlands on a project called “Cross-cultural validation of sickness absence prediction models”. Workplace-registered and self-reported sickness absence days or sick leave spells per year among the municipal eldercare employees are used to investigate prediction models of future high-level sickness absence or spell frequency.
Chapter 9: Summary in English

Introduction: The average sick leave rates among employees in the eldercare sector are higher than among employees in other occupations. Sick leave has considerable consequences not only at the societal and personal level, but also at the workplace level. It contributes to existing staff shortages in the healthcare sector and has been reported to adversely affect the efficiency of care and patient outcomes. Next to citizens with no labour experience in Denmark, eldercare employees also have the highest incidence of being granted a disability pension. Many studies seem to agree that sick leave length is an important risk factor for future disability pension. It is therefore important to identify healthcare workers at risk of sick leave at an early stage. The literature has raised the hypothesis that frequent short-term sick leave is associated with unfavourable work environment factors, whereas long-term sick leave is associated mainly with ill health and health-related reduced workability.

Drawing on existing scientific knowledge, we hypothesised that frequent, short-term sick leave spells were associated with an unfavourable self-reported psychosocial working environment (Paper I) and that such a sick leave pattern also was an early indicator of future long-term sick leave and disability pension (Article III). We also hypothesised that DREAM-registered sickness benefits were a valid approximation of workplace-registered sick leave (Article II).

Materials and methods: The final analyses were performed on 2534 (Paper I), 356 (Paper II) and 1978/1797 (Paper III) employees from the municipal eldercare sector in Aarhus. Multiple logistic regression models were used to study the association between the short-term sick leave spell pattern and unfavourable work environment scores. A receiver-operating characteristic curve (ROC curve) was used to study the performance of DREAM data on sickness benefit. Weekly cut-off points in DREAM were used to find the optimum discrimination of sick leave spell durations of > 8 weeks defined in the workplace register. The relative cumulative incidence (RR) of being granted a disability pension or experiencing long-term sick leave within 352 weeks was analysed in generalised linear regression models using the pseudo values method.

Results: Of 11 work environment factors role conflict (odds ratio (OR): 1.50 (95% confidence interval (CI): 1.2 -1.9)) and emotional demands (OR: 1.62 (95% CI: 1.1 -2.5)) were associated with frequent short-term sick leave spells independently of sick leave length. Work pace (OR: 1.41 (95% CI: 1.1 -1.7)), demands of hiding emotions (OR: 1.56 (95% CI: 1.2 -2.0)), quality of leadership (OR: 1.41 (95% CI: 1.1 -1.7)) and bullying (OR: 1.50 (95% CI: 1.1 -2.0)) were, however, associated with sick leave length rather than sick leave frequency. A
nine-week sickness benefit cut-off point in DREAM should be used when defining long-term sick leave as eight consecutive workplace-registered sick leave weeks, whereby an area under the ROC curve of 0.99 could be accomplished. Frequent short-term sick leave spells were not early risk factors for either future disability pension or eight consecutive sick leave weeks. Inversely, a sick leave length of at least 1-14 days significantly increased the risk of long-term sick leave (RR (1-14 days to >56 days): 1.40-1.92 (95 % CI: 1.09-2.84)) compared with those who had no sick leave at all.

**Conclusions:** DREAM-registered sickness benefits could be used to generate valid approximations of workplace-registered sick leave. Caution is, however, a must because of the limited external validity in fertile-aged women. Validation is advised if similar analyses are to be applied to sick leave data from state institutions or private companies. Sick leave length was consistently associated with unfavourable work factor scores. Moreover, sick leave length was found to be a better early risk marker of future permanent work disability than sick leave spell frequency. A frequent sick leave spell pattern, though, was found to increase the risk of future long-term sick leave, which may be a first warning of a permanently reduced workability.
Introduktion: Medarbejdere i den kommunale ældrepleje har i gennemsnit det højeste sygefravær sammenlignet med andre faggrupper i både den kommunale, statslige og private sektor. Sygefravær kan have alvorlige konsekvenser for den enkelte medarbejdere liv såvel som arbejdsspladsen kan påvirkes i form af mangel på arbejdskraft, kvaliteten af plejen kan reduceres samt andre forhold relateret til den ældre borger kan påvirkes negativt. Medarbejdere ansat i ældreplejen er overrepræsenterede blandt personer, der tilkendes førtidspension. Man ved, at sygefraværslængden er en vigtig risikofaktor for, om man kommer på førtidspension. Det er derfor vigtigt at kunne identificere medarbejdere i risiko for reduceret arbejdsevne på et så tidligt tidspunkt som muligt. I litteraturen er der fremsat en hypotese om at hyppige, korte sygefraværsperioder er associeret med et belastende arbejdsmiljø, hvorimod langvarige fraværsperioder primært skal ses som helbredsaflændige. Med afsæt i den eksisterende forskning fremsatte vi de for hypoteser om, at hyppige, korte sygefraværsperioder var associeret med et selv rapporteret dårligt psykosocialt arbejdsmiljø (Artikel I), og at et sådant sygefraværsområde ligeledes var en tidlig indikator for fremtidigt langvarigt sygefravær og førtidspension (Artikel III). Ligeledes fremsatte vi hypotese om, at DREAM-registrerede sygedagpengeudbetalinger var en valid approksimation for arbejdsgiverregistreret sygefravær (Artikel II).


Resultater: Ud af 11 arbejdsmiljøfaktorer var rolle konflikt (odds ratio (OR): 1,50 (95 % confidence interval (CI): 1,2-1,9)) og følelsesmæssige krav (OR: 1,62 (95 % CI: 1,1-2,5)) associeret med hyppige sygefraværsperioder uafhængigt af fraværslængden. Arbejdstempo (OR: 1,41 (95 % CI: 1,1-1,7)), krav om at skjule følelser (OR: 1,56 (95 % CI: 1,2-2,0)), ledelseskvalitet (OR: 1,41 (95 % CI: 1,1-1,7)) samt mobning (OR: 1,50 (95 % CI: 1,1-2,0)) var derimod associeret med fraværslængden snarere end fraværsfrekvensen. Ni ugers
sammenhængende sygedagpenge-udbetalinger registreret i DREAM gav den største overensstemmelse med otte ugers sammenhængende arbejdsgiverregistreret sygefravær, hvorved arealet under ROC kurven blev 0,99. Frekvente kortvarige sygefraværsperioder var ikke en tidlig risikofaktor for fremtidig førtidspensionering eller otte ugers sammenhængende sygefravær, hvorimod sygefraværet opgjort i tre længdekategorier øgede sandsynligheden sammenlignet med den lille gruppe som slet ikke havde fravær (RR(1-14 dage til >56 dage): 1,40-1,92 (95 % CI: 1,09-2,84)).

Reference List


(13) Stapelfeldt CM, Christiansen DH, Jensen OK, Nielsen CV, Petersen KD, Jensen C. Subgroup analyses on return to work in sick-listed employees with low back pain in a randomised trial comparing brief and multidisciplinary intervention. BMC Musculoskelet Disord 2011;12:112.


(19) Labriola M. Conceptual framework of sickness absence and return to work, focusing on both the individual and the contextual level. Work 2008;30(4):377-87.


(39) Borg V. Working in eldercare. 8-10-2009. Copenhagen, Denmark, National Research Centre for the Working Environment. Ref Type: Online Source.


(41) Kristensen TS. A questionnaire is more than a questionnaire. Scand J Public Health 2010 Feb;38(3 Suppl):149-55.


(52) The national labour market authority. DREAM. [28], 1-38. 2012. The national labour market authority, Copenhagen. Ref Type: Catalog.


(74) National Social Appeals Board D. Statistics about awarded anticipatory pensions. 29-6-2012. Ref Type: Online Source.


Appendixes

Paper I
Paper II
Paper III
Are environmental characteristics in the municipal eldercare, more closely associated with frequent short sick leave spells among employees than with total sick leave: a cross-sectional study

Christina Malmose Stapelfeldt1,2*, Claus Vinther Nielsen1,2, Niels Trolle Andersen3, Line Krane4, Nils Fleten4, Vilhelm Borg5 and Chris Jensen2,6

Abstract

Background: It has been suggested that frequent-, short-term sick leave is associated with work environment factors, whereas long-term sick leave is associated mainly with health factors. However, studies of the hypothesis of an association between a poor working environment and frequent short spells of sick leave are few and results are inconsistent. Therefore, we aimed to explore associations between self-reported psychosocial work factors and workplace-registered frequency and length of sick leave in the eldercare sector.

Methods: Employees from the municipal eldercare in Aarhus (N = 2,534) were included. In 2005, they responded to a work environment questionnaire. Sick leave records from 2005 were dichotomised into total sick leave days (0–14 and above 14 days) and into spell patterns (0–2 short, 3–9 short, and mixed spells and 1–3 long spells). Logistic regression models were used to analyse associations; adjusted for age, gender, occupation, and number of spells or sick leave length.

Results: The response rate was 76%; 96% of the respondents were women. Unfavourable mean scores in work pace, demands for hiding emotions, poor quality of leadership and bullying were best indicated by more than 14 sick leave days compared with 0–14 sick leave days. For work pace, the best indicator was a long-term sick leave pattern compared with a non-frequent short-term pattern. A frequent short-term sick leave pattern was a better indicator of emotional demands (1.62; 95% CI: 1.1-2.5) and role conflict (1.50; 95% CI: 1.2-1.9) than a short-term non-frequent pattern.

Age (= < 40 / >40 years) statistically significantly modified the association between the 1–3 long-term sick leave spell pattern and commitment to the workplace compared with the 3–9 frequent short-term pattern.

Conclusions: Total sick leave length and a long-term sick leave spell pattern were just as good or even better indicators of unfavourable work factor scores than a frequent short-term sick leave pattern. Scores in commitment to the workplace and quality of leadership varied with sick leave pattern and age. Thus, different sick leave measures seem to be associated with different work environment factors. Further studies on these associations may inform interventions to improve occupational health care.

Keywords: Cross-sectional, Home care services, Psychology, Social, Sick leave, Working environment
Background
The public sector in general and the municipal health care sector in particular is challenged by high sick leave rates among home-care personnel [1-3]. The sector also reports problems in recruiting and holding on to new employees. Demographic changes marked by a growing size of the population of elderly citizens, expectably in demand of personal care and home care, adds further to this vicious circle [4]. Several models have been developed in an attempt to capture positive and/or negative factors in the working environment explaining adverse effects among employees, i.e. sick leave, turn-over intentions and low engagement. Two models have gained general acceptance in the field of occupational health; effort-reward imbalance model [5], and the demand-control-(support) model [6]. However, these two models may be too static, i.e. the items used do not offer adequate descriptions of important work environment characteristics in all occupational settings [7]. A more recent model (the job demands-resources model) [8] proposes that every organisation has its own unique work environment characterised by demands and resources. It further claims that health may be affected by sustained high job demands and turnover intentions may be a consequence of sustained low job resources [7].

The National Research Centre for the Working Environment (NRCWE) conducted a national survey of the municipal eldercare in Denmark in 2004–2005 [9]; the survey reported a 34% higher level of sick leave among home-care personnel than among administrative employees within the eldercare sector [10]. Numerous demands and resources in the psycho-social and physical working environment along with lifestyle factors were found to be associated with high self-reported sick leave levels [10]. The survey also reported a significantly higher risk of having high (more than four weeks) and moderate (one to four weeks) levels of sick leave among young homecare employees (<40 years). This increased risk was partly explained by the experience of more role conflict, less commitment to the work place and less wellbeing [11].

It has been suggested that frequent short-term sick leave is associated with work environment factors, whereas long-term sick leave is associated mainly with ill health and reduced workability [12,13]. However, few studies have analysed if psychosocial work factors are more strongly associated with frequent short-term sick leave than with long-term sick leave [14]. In studies on health care workers, the total number of sick leave days per year was associated with high psychological demands, high physical workload [15] and low social support [16]. The number of sick leave spells was found to be related to physical and psychological work demands [16-19]. Elstad et al. reported proportionality in the association between the number of perceived stressful work characteristics and the number of spells [20]. Bullying is another factor that is associated with an increased risk of a new spell of sick leave [18]. High levels of decision authority, perceived meaningfulness of work, commitment to the workplace, quality of leadership and a good team climate may protect against sick leave [17,21,22]. The effect of social support on spells of sick leave varies between studies [16,19,23].

Generally, younger age is related to a higher frequency of spells [17,19,20,23,24], and older age is associated with fewer, but longer spells [17,18,24]. Moreover, age seems to modify the associations between work factors and different sick leave measures [25].

Apart from the effect of age, inconsistencies in the reported associations between work factors and sick leave are considerable. This was suggested to be due partly to the different measures of sick leave themselves [12,26]. Hence, most studies analyse length of sick leave and frequency of spells separately, and any independent association between length versus frequency and psychosocial work factors therefore remains unknown. However, in a study where nursing assistants were compared with doctors, the former had a higher risk of having incident sick leave spells of 1–3 days (adjusted for medium and long spells) and sick leave spells of 4–14 days (adjusted for short and long spells) than the latter [27].

The high levels of sick leave in the elderly care indicate that early detection of unfavourable changes in the working environment may be instrumental in maintaining the employees' wellbeing, productivity and viability within the institution or company. According to the literature, an association between total sick leave length and a poor working environment may be more likely to be due to a frequent short-term sick leave pattern than a non-frequent long-term sick leave pattern [12-14], and even more so in young employees than in older colleagues [11]. Long-term sick leave spells, on the other hand, seem to be more strongly associated with a poor general health than short spells. Whether these assumptions are valid within the elderly care sector has not yet been established.

This study draws on workplace-registered sick leave data to explore if sick leave patterns, i.e. the number of short-term sick leave spells or merely their duration, are associated with self-reported, unfavourable psychosocial work factors. If associations can be identified, the employers' sick leave register may be a fruitful source for initiating preventive work environment measures.

Aim
This study aims to explore associations between sick leave patterns and psychosocial work factors in elderly care and thereby enhance the potential for using the employers' sick leave register to launch interventions aimed
at improving the working environment and, hence, the employees’ wellbeing, productivity and viability.

**Methods**

A cross-sectional design was chosen because we wanted to use sick leave measures as an indicator of a poor working environment; not to study causal pathways.

We used workplace-registered sick leave data from municipal eldercare workers in Aarhus, Denmark. Questionnaire data on the working environment were collected by the NRCWE, Copenhagen in 2005.

**Study population**

Survey data on psychosocial work factors were merged with workplace-registered sick leave records from 2005. Sick leave from 2005 was chosen because all of the respondents had answered the questionnaire at some point between 18 February and 18 July 2005. Employees were included if they had been employed and had been working throughout 2005 and had received a questionnaire (N = 3,346) (Figure 1).

**Sick leave patterns**

Data on absence in 2005 were retrieved from the workplace records, which also contained stated reasons for each absence spell. Only spells related to sick leave were included. The dates of the first and the last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days. Overlapping, consecutive or duplicate sick leave spells were merged into a single spell.

First, sick leave was measured as the total number of sick leave days including all spells ended in 2005. We dichotomised this measure into 0–14 days and 15–581 days [10,11,25,28,29]. In 2005, the public insurance system reimbursed sickness benefits for sick leave spells lasting more than 14 days in conformity with the Danish Sickness Benefit Act [30].

Second, sick leave was categorised into patterns with short, long or a combination of short and long spells. We defined short spells as spells lasting zero to seven calendar days. This definition has also been used in other studies [24,31]. Long spells were defined as spells lasting eight calendar days or more.

Based on the above-mentioned measures, the sick leave patterns were:

Length of sick leave per year: 0–14 days and more than 14 days.

Spell patterns: 0–2 short spells, 3–9 short spells, 2–13 mixed spells and 1–3 long spells.

**Psychosocial work environment factors**

The Copenhagen Psychosocial Questionnaire (COPSOQ) [32] was used to collect information on perceived work-related demands and resources from the eldercare workers.

The environmental factors suggested to be the most important variables in explaining the self-reported high levels of sick leave among eldercare workers [10,11] were selected from the survey. These were: work pace, emotional demands, demands for hiding emotions, physical work load, influence, meaning of work, commitment to the workplace, role conflict and quality of leadership. These factors were scored on five-point Likert scales (Always, Often, Sometimes, Seldom, Never/hardly ever). The scores were transformed into 0–100 scores. The mean values of the different work environment scales were measured in a representative sample of working Danes in 2004/2005 [33]. In the present study, the selected work environment scales were dichotomised into favourable / unfavourable scores according to these mean scores. This was done for all scales except for physical work load which was dichotomised according to the mean value found in our data. Response categories on bullying and threats of violence were “at least once a month”, “from time to time” and “never”. They were dichotomised into “at least from time to time” and “never”. Response categories on general health were “Excellent”, “very good”, “good”, “fair” and “poor”. This variable was dichotomised into “excellent-good” and “fair-poor”. Reference scores were not available for bullying, threats of violence and general health.

**Socio-demographics and potential confounders**

Age (<40/>40 years) and gender were retrieved from the personnel files, whereas occupation (categorised in administration, manager, therapist/nurse, home care and
non-care) was retrieved from the questionnaire. We used the cut point of 40 years of age so direct comparisons with the results of the analyses carried out by NRCWE (10:11) were possible.

Statistical analyses
Univariable and multivariable logistic regression models were applied to find associations between total sick leave days/spell patterns and unfavourable scores in work factors and general health.

In the first analysis, using total sick leave days as the independent variable, we adjusted the model for age, gender, occupation and number of spells (continuous variable ranging from 0–13).

In the second analysis, using spell pattern as the independent variable (0–2 short-term sick leave spells was the reference), we adjusted the models for age, gender, occupation and total sick leave days categorised in four (0 days, 1–14 days, 15–56 days and >57 days). A Wald-test was performed to establish the overall difference in the odds of having unfavourable work factor scores between the sick leave patterns.

In the third analysis, using spell pattern as the independent variable, we again performed the same adjustments as mentioned in the second analysis. Based on the literature, we expected that unfavourable work factor scores and total sick leave length were more likely to be due to frequency of spells than duration, and that this association would be more pronounced among young employees than among their older colleagues. Long-term spells, on the other hand, were believed to be more strongly associated with poor general health than short-term spells. In this analysis, emphasis was on the odds of having unfavourable work factor scores / general health scores among eldercare workers with many short spells compared with few, but long spells (reference). We also sought to establish whether these associations were stronger among young employees than among older colleagues by including an interaction term between age and spell pattern.

The scale reliability coefficient (Cronbach’s alpha) of work factors used from the COPSOQ was calculated. To establish whether the work factor scores and general health scores were statistically significantly different between total sick leave categories and sick leave patterns, t-test, one-way ANOVA and chi2 was applied.

The significance level was set at \( p < 0.05 \). The results are shown as crude and adjusted figures.

STATATA version 12.1 was used as statistical software.

Approval (2012-41-1290) for using workplace-registered sick leave records and questionnaire data was obtained from the Danish Data Protection Agency: http://www.datatilsynet.dk/english/.

Results
The questionnaire was answered by 2,534 employees, which yielded a response rate of 76%. Non-responders were more likely to be young and male than responders (Table 1). Non-responders were also more likely to have a higher number of total sick leave days and fewer and longer spells of sick leave (Table 1).

The majority of the eldercare workers (75%) had less than 15 sick leave days in total. Twenty-one percent had no sick leave in the study period at all. A low frequency of short-term spells, defined by zero to two spells, was present among 54% of the employees (Table 1). Homecare (28%) and non-care (26%) personnel had the highest prevalence of having more than 14 sick leave days in total compared with managers (13%) who had the lowest prevalence (Table 2). This tendency was repeated in the spell patterns; the home care personnel had the lowest prevalence of 0–2 short-term spells as well as the highest prevalence of 3–9 short-term spells and mixed spells. The prevalence of having 1–3 long-term spells was similar among the occupational groups (Table 2).

Male workers (83%) were more likely to have 0–14 sick leave days in total than female workers (75%). Young employees were more likely to have more than 14 days of total sick leave (28%) and 3–9 short spells (26%) than older colleagues (24% and 18%; Table 2).

Work factor scores
The scale reliabilities were; emotional demands (\( \alpha = 0.81 \)), demands for hiding emotions (\( \alpha = 0.60 \)), influence (\( \alpha = 0.76 \)), meaning of work (\( \alpha = 0.70 \)), commitment to the workplace (\( \alpha = 0.73 \)), role conflict (\( \alpha = 0.68 \)), and quality of leadership (\( \alpha = 0.90 \)). Work pace was derived from a single question.

Compared with those who had less than 15 sick days, those who had more than 14 sick days were more likely to have high work demand scores, whereas those who had less than 15 sick days were more likely than the former to have high job resource factor scores (Table 3). The proportion of eldercare workers who reported their general health to be fair-poor was higher among those with more than 14 sick leave days (25%) than those with less than 15 sick leave days (9%).

The same trend as that described for total sick leave days was evident for the spell patterns; few and short-term spells had the most favourable mean work factor scores; and the scores turned more unfavourable the more frequent and/or the longer the duration of the spells (Table 3). The number of employees being bullied threatened or having a poor health increased as the frequency and the duration of the spell patterns rose.

Total sick leave days
We estimated the odds of having unfavourable work factor scores among eldercare workers with more than
14 sick leave days compared with 0–14 days (Table 4). In crude analyses, the odds ratios for all psychosocial work environment factors were statistically significantly different from one. Adjustments for age, gender, occupation and number of spells attenuated in all of the associations, but the odds remained statistically significant for having unfavourable scores in work pace 1.41 (95% CI: 1.1 - 1.7), demands for hiding emotions 1.56 (95% CI: 1.2 - 2.0), quality of leadership 1.41 (95% CI: 1.1 - 1.7) and being bullied from time to time 1.50 (95% CI: 1.1 - 2.0).

0–2 short-term spells compared with any other spell pattern

Crude analyses showed that the odds for having unfavourable work factor scores were significantly higher for employees with spell patterns featuring 3–9 short spells or 2–13 mixed spells than for employees with 0–2 short-term spells (Table 5). However, according to the crude analyses, employees having 1–3 long-term spells did not give statistically significantly more unfavourable scores to emotional demands, physical work load, influence, meaning of work or role conflict than employees with 0–2 short-term spells. After adjustment for age, gender, occupation and total sick leave days, employees having 3–9 short-term spells had significantly increased odds of unfavourable scores for role conflict 1.50 (95% CI: 1.2-1.9) than employees with 0–2 short-term spells. For the mixed spell pattern, the odds of having unfavourable work factor scores compared with 0–2 short-term spells were highest in emotional demands 1.62 (95% CI: 1.1-2.5) after adjustment. Work pace 2.24 (95% CI: 1.4-3.7) was more strongly associated with 1–3 long-term spells than with 3–9 short-term spells and 2–13 mixed spells.

The odds of having a fair-poor general health were most strongly associated with 1–3 long-term spells; even after adjustments, the odds ratio was statistically significantly different from one; 2.10 (95% CI: 1.1-3.9).

The Wald-test showed an overall statistically significant difference in the odds of having unfavourable scores in work pace, role conflict and general health between the sick leave patterns (Table 5).

Effect modification by age

Age significantly modified the association between a frequent short-term sick leave pattern and commitment to the workplace and between frequent short-term sick leave and quality of leadership (Table 6). For those below 40 years of age, the odds ratio of having unfavourable scores in commitment to the workplace was 1.33 (95% CI: 0.8 - 2.2) when having a frequent spell pattern compared with 1–3 long spells, whereas older colleagues had an odds ratio of 0.14 (95% CI: 0.03 - 0.6). Among younger

**Table 1 Age, gender and sick leave among responders (n = 2,534) and non-responders (n = 812) to the work environment questionnaire**

<table>
<thead>
<tr>
<th></th>
<th>Responders</th>
<th>Non-responders</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (min-max)</td>
<td>49.2 (19–68)</td>
<td>47.2 (18–68)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>2,433 (96)</td>
<td>751 (93)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total sick leave, n (%)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0-14 days</td>
<td>1,909 (75)</td>
<td>549 (68)</td>
<td></td>
</tr>
<tr>
<td>More than 14 days</td>
<td>625 (25)</td>
<td>263 (32)</td>
<td></td>
</tr>
<tr>
<td>Spell patterns, n (%)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0-2 short spells</td>
<td>1,378 (54)</td>
<td>380 (47)</td>
<td></td>
</tr>
<tr>
<td>3-9 short spells</td>
<td>490 (19)</td>
<td>162 (20)</td>
<td></td>
</tr>
<tr>
<td>2-13 mixed spells</td>
<td>515 (20)</td>
<td>183 (23)</td>
<td></td>
</tr>
<tr>
<td>1-3 long spells</td>
<td>151 (6)</td>
<td>87 (11)</td>
<td></td>
</tr>
<tr>
<td>Total number of spells, Median (min-max)</td>
<td>2 (0–13)</td>
<td>2 (0–11)</td>
<td>0.04</td>
</tr>
<tr>
<td>Total sick leave, median duration in days (min-max) *</td>
<td>3 (0–14)</td>
<td>3 (0–14)</td>
<td>0.5</td>
</tr>
<tr>
<td>0-14 days</td>
<td>35 (15–581)</td>
<td>45 (15–613)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>More than 14 days</td>
<td>2 (0–13)</td>
<td>2 (0–12)</td>
<td>0.97</td>
</tr>
<tr>
<td>Spell patterns, median duration in days (min-max) *</td>
<td>9 (3-31)</td>
<td>9 (3-31)</td>
<td>0.82</td>
</tr>
<tr>
<td>0-2 short spells</td>
<td>29 (9–421)</td>
<td>35 (10–321)</td>
<td>0.02</td>
</tr>
<tr>
<td>3-9 short spells</td>
<td>66 (8–581)</td>
<td>162 (8–613)</td>
<td>0.002</td>
</tr>
<tr>
<td>2-13 mixed spells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3 long spells</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* All sick leave spells ended in 2005 are included, therefore maximum duration exceeds 365 days.
employees, the odds ratio of having unfavourable scores in quality of leadership was 0.80 (95% CI: 0.5 - 1.3) among frequent absentees compared with those having 1–3 long spells. Among older employees, this odds ratio was 0.30 (95% CI: 0.1 - 0.7). No statistically significant effect modification was seen in relation to general health.

Discussion

Signs of a poor working environment reflected in unfavourable job demand and job resource scores were consistently, significantly associated with employees having more than 14 sick leave days compared with those having less than 15 days. For unfavourable scores in work pace, demands for hiding emotions and being bullied, at least from time to time, as well as quality of leadership, this association remained present among employees with more than 14 sick leave days after adjustment for the number of sick leave spells.

After adjustments for the effect of sick leave length, unfavourable scores in role conflict and emotional demands remained associated with a frequent spell pattern, i.e. 3–9 short-term spells and 2–13 mixed spells, respectively, compared with a non-frequent short-term spell pattern. The strongest association with the long-term spell pattern was seen among employees with unfavourable work pace scores.

Our results neither confirmed nor denied the hypothesis that a frequent short-term sick leave spell pattern was more strongly associated with an unfavourable working environment than a long-term sick leave spell pattern after adjustment for the effect of total sick leave length.

The hypothesis about general health was supported by our results; hence, a long-term sick leave spell pattern was more likely to be associated with poor general health than a short-term sick leave spell pattern.

Age significantly modified the association between sick leave patterns and work factors in the hypothesised direction for commitment to the workplace. Compared with a long-term sick leave pattern, a frequent short-term sick leave pattern decreased the odds ratio of having unfavourable work environment factors among older employees as opposed to among the young employees whose odds ratio of having unfavourable work environment factors increased.

Other studies

Sick leave length

In the perspective of the job demands-resources model; long-term sick leave, irrespectively of spell frequency, is more associated to high levels of demanding work factors than short-term sick leave [14]. In the survey

Table 2 Distribution of socio-demographics, categorised sick leave and number of spells in total sick leave and spell patterns

<table>
<thead>
<tr>
<th>Total sick leave</th>
<th>Spell patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–14 days</td>
</tr>
<tr>
<td></td>
<td>n (%) / mean (sd)</td>
</tr>
<tr>
<td>Age</td>
<td>N=1,909</td>
</tr>
<tr>
<td>=&lt; 40 years</td>
<td>332 (72)</td>
</tr>
<tr>
<td>&gt;40 years</td>
<td>1,577 (76)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1,825 (75)</td>
</tr>
<tr>
<td>Male</td>
<td>84 (83)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>50 (83)</td>
</tr>
<tr>
<td>Manager</td>
<td>177 (87)</td>
</tr>
<tr>
<td>Therapist/nurse</td>
<td>360 (82)</td>
</tr>
<tr>
<td>Home care</td>
<td>1,216 (72)</td>
</tr>
<tr>
<td>Non-care</td>
<td>106 (74)</td>
</tr>
<tr>
<td>Categorised sick leave</td>
<td></td>
</tr>
<tr>
<td>0 days</td>
<td>536 (100)</td>
</tr>
<tr>
<td>1–14 days</td>
<td>842 (61)</td>
</tr>
<tr>
<td>15–56 days</td>
<td>Not available</td>
</tr>
<tr>
<td>More than 57 days</td>
<td>Not available</td>
</tr>
<tr>
<td>Total number of spells</td>
<td>1.58 (1.5)</td>
</tr>
</tbody>
</table>
Table 3 Mean scores of psychosocial work factors stratified on dichotomised total sick leave days and spell patterns

<table>
<thead>
<tr>
<th></th>
<th>Reference mean scores (sd)</th>
<th>Responders having unfavourable scores</th>
<th>Total sick leave spell patterns</th>
<th>Spell patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>Mean (sd)</td>
<td>Mean (sd) **</td>
<td>Mean (sd) ***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>p-value</td>
<td>p-value</td>
</tr>
<tr>
<td>Demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work pace #</td>
<td>59.5 (19)</td>
<td>1,440 (57)</td>
<td>64.1 (21)</td>
<td>69.4 (21)</td>
</tr>
<tr>
<td>Emotional #</td>
<td>40.7 (24)</td>
<td>1,689 (67)</td>
<td>44.8 (19)</td>
<td>48.0 (19)</td>
</tr>
<tr>
<td>Hiding emotions #</td>
<td>50.6 (21)</td>
<td>503 (20)</td>
<td>39.6 (20)</td>
<td>43.4 (20)</td>
</tr>
<tr>
<td>Physical work load</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influence §</td>
<td>49.8 (21)</td>
<td>1,246 (50)</td>
<td>48.4 (20)</td>
<td>44.1 (22)</td>
</tr>
<tr>
<td>Meaning of work §</td>
<td>73.8 (16)</td>
<td>778 (31)</td>
<td>77.3 (14)</td>
<td>75.3 (15)</td>
</tr>
<tr>
<td>Commitment to the workplace §</td>
<td>60.9 (20)</td>
<td>1,539 (61)</td>
<td>57.7 (18)</td>
<td>54.1 (18)</td>
</tr>
<tr>
<td>Role conflict #</td>
<td>42 (17)</td>
<td>1,320 (53)</td>
<td>40.8 (16)</td>
<td>43.8 (16)</td>
</tr>
<tr>
<td>Quality of leadership §</td>
<td>55.3 (21)</td>
<td>1,069 (44)</td>
<td>57.6 (22)</td>
<td>51.9 (25)</td>
</tr>
<tr>
<td>Bullying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threats of violence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# (> reference mean scores) and § ( = < reference mean scores).
* t-test / **chi2.
*** one-way ANOVA / **** chi2.
conducted by NRCWE (10;11) the identified work factors associated with self-reported sick leave length may inform about the most relevant demands in the eldercare sector. Crude results from our analyses of the association between sick leave length and work factors were in accordance with those found by Borg et al. [10].

After adjustment for age, gender, occupation and number of spells, associations were attenuated. Work pace, demands for hiding emotions and bullying remained significant associated with sick leave length irrespectively of frequency of spells and may be unique demanding factors in this particular work setting. No previous studies analysing possible associations between sick leave length and work environment factors in the healthcare sector [15,16,23] have adjusted for the number of spells. However, high psychological demands and high work load [15] and job demands [16] defined by the job demand-control-support model by Karasek were associated with sick leave duration. The study by Schreuder et al. found that the demand-control ratio (high job demands and low control) was inversely associated with the number of sick leave days [23]. This is a surprising result but it may underline that the items in the demand-control-support model may not capture the uniqueness of the healthcare work environment [7].

Frequency of sick leave spells

A direct comparison between our study and studies also reporting short-term sick leave spells was possible. A high frequency of 1–7 days spells was associated with low levels of respect from a supervisor [23]. Also, a low decision latitude and a low predictability at work increased the risk of having a frequent 1–10 days spell pattern among women [17]; on the other hand, we saw a tendency towards demanding work factors being more likely to be associated with 3–9 short-term sick leave spells or mixed spells than 0–2 short-term spells. No such association was found for resources in the work environment.

High mean scores in emotional demands and role conflict were the only work factors that remained statistically significantly associated with having a frequent spell pattern after adjustment for total sick leave. This may imply that among employees in the eldercare sector, demanding work factors in general and emotional demands and role conflict in particular are more associated with frequency of sick leave spells than available resources at work. It contradicts the job demands-resources model which claims that frequent sick leave spells, regardless of the sick leave length, are likely to be more associated to low levels of motivational work factors than non-frequent spells [14]. Low levels of role conflict may however, be viewed upon as motivational; it is one of the scales about “interpersonal relations and leadership” in COPSOQ which also contains scales about motivational factors like feedback at work, and social support [32] referred to as job resources in the study of Schaufeli et al. [14].

Some studies have also used a set of variables to describe the working environment [19], or they have used the demand-control-support model by Karasek and Theorell and the effort-reward model by Siegrist [23]. They found that a high number of one-day spells was associated with low support, low influence and high physical load [19]. They also found that frequent 1–7 days absentees were more likely to display high levels

<table>
<thead>
<tr>
<th>Demand</th>
<th>More than 14 sick leave days OR (95% CI)</th>
<th>More than 14 sick leave days adjusted*, OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work pace</td>
<td>1.48 (1.2 - 1.8)</td>
<td>1.41 (1.1 - 1.7)</td>
</tr>
<tr>
<td>Emotional</td>
<td>1.19 (1.0 - 1.4)</td>
<td>1.08 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Hiding emotions</td>
<td>1.65 (1.3 - 2.0)</td>
<td>1.56 (1.2 - 2.0)</td>
</tr>
<tr>
<td>Physical work load</td>
<td>1.34 (1.1 - 1.6)</td>
<td>1.15 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Influence</td>
<td>1.36 (1.1 - 1.6)</td>
<td>1.13 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Meaning of work</td>
<td>1.32 (1.1 - 1.6)</td>
<td>1.14 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Commitment to the workplace</td>
<td>1.49 (1.2 - 1.8)</td>
<td>1.23 (1.0 - 1.5)</td>
</tr>
<tr>
<td>Role conflict</td>
<td>1.31 (1.1 - 1.6)</td>
<td>1.11 (0.9 - 1.4)</td>
</tr>
<tr>
<td>Quality of leadership</td>
<td>1.50 (1.2 - 1.8)</td>
<td>1.41 (1.1 - 1.7)</td>
</tr>
<tr>
<td>Bullying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>1.68 (1.3 - 2.2)</td>
<td>1.50 (1.1 - 2.0)</td>
</tr>
<tr>
<td>Threats of violence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least from time to time</td>
<td>1.21 (1.0 - 1.5)</td>
<td>1.03 (0.8 - 1.3)</td>
</tr>
</tbody>
</table>

* Adjusted for age, gender, occupation and number of spells.

The odds of having unfavourable psychosocial work factor scores with more than 14 sick leave days compared with 0-14 days.

Table 4 The odds of having unfavourable psychosocial work factor scores among eldercare workers.
Table 5 The odds of having unfavourable psychosocial work factor / general health scores among eldercare workers

<table>
<thead>
<tr>
<th>Demand</th>
<th>3-9 short spells OR (95% CI)</th>
<th>3-9 short spells OR (95% CI) *</th>
<th>2-13 mixed spells OR (95% CI)</th>
<th>2-13 mixed spells OR (95% CI) *</th>
<th>1-3 long spells OR (95% CI)</th>
<th>1-3 long spells OR (95% CI) *</th>
<th>p-value #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work pace</td>
<td>1.26 (1.0 - 1.6)</td>
<td>1.28 (1.0 - 1.6)</td>
<td>1.51 (1.2 - 1.9)</td>
<td>1.52 (1.0 - 2.2)</td>
<td>2.10 (1.4 - 3.0)</td>
<td>2.24 (1.4 - 3.7)</td>
<td>0.01</td>
</tr>
<tr>
<td>Emotional</td>
<td>1.32 (1.1 - 1.7)</td>
<td>1.32 (1.0 - 1.7)</td>
<td>1.40 (1.1 - 1.7)</td>
<td>1.62 (1.1 - 2.5)</td>
<td>1.27 (0.9 - 1.8)</td>
<td>1.37 (0.8 - 2.3)</td>
<td>0.07</td>
</tr>
<tr>
<td>.Hidden emotions</td>
<td>1.40 (1.1 - 1.8)</td>
<td>1.21 (0.9 - 1.6)</td>
<td>1.55 (1.2 - 1.20)</td>
<td>0.97 (0.6 - 1.5)</td>
<td>2.15 (1.5 - 3.1)</td>
<td>1.42 (0.8 - 2.4)</td>
<td>0.19</td>
</tr>
<tr>
<td>Physical work load</td>
<td>1.52 (1.2 - 1.9)</td>
<td>1.29 (1.0 - 1.7)</td>
<td>1.51 (1.2 - 1.9)</td>
<td>1.20 (0.8 - 1.8)</td>
<td>1.36 (0.9 - 2.0)</td>
<td>1.16 (0.7 - 1.9)</td>
<td>0.26</td>
</tr>
<tr>
<td>Influence</td>
<td>1.28 (1.0 - 1.6)</td>
<td>1.01 (0.8 - 1.3)</td>
<td>1.51 (1.2 - 1.8)</td>
<td>1.19 (0.8 - 1.7)</td>
<td>1.29 (0.9 - 1.8)</td>
<td>1.13 (0.7 - 1.8)</td>
<td>0.83</td>
</tr>
<tr>
<td>Meaning of work</td>
<td>1.33 (1.1 - 1.7)</td>
<td>1.11 (0.9 - 1.4)</td>
<td>1.43 (1.2 - 1.8)</td>
<td>1.03 (0.7 - 1.5)</td>
<td>1.14 (0.8 - 1.6)</td>
<td>0.81 (0.5 - 1.3)</td>
<td>0.54</td>
</tr>
<tr>
<td>Commitment to the workplace</td>
<td>1.46 (1.2 - 1.8)</td>
<td>1.17 (0.9 - 1.5)</td>
<td>1.67 (1.3 - 2.1)</td>
<td>1.28 (0.9 - 1.9)</td>
<td>1.50 (1.0 - 2.1)</td>
<td>1.19 (0.7 - 1.9)</td>
<td>0.52</td>
</tr>
<tr>
<td>Role conflict</td>
<td>1.54 (1.2 - 1.9)</td>
<td>1.50 (1.2 - 1.9)</td>
<td>1.43 (1.2 - 1.7)</td>
<td>1.25 (0.9 - 1.8)</td>
<td>1.25 (0.9 - 1.8)</td>
<td>1.05 (0.7 - 1.7)</td>
<td>0.01</td>
</tr>
<tr>
<td>Quality of leadership</td>
<td>1.27 (1.0 - 1.6)</td>
<td>1.17 (0.9 - 1.5)</td>
<td>1.56 (1.3 - 1.9)</td>
<td>1.38 (0.9 - 2.0)</td>
<td>1.56 (1.3 - 1.9)</td>
<td>1.77 (1.1 - 2.9)</td>
<td>0.11</td>
</tr>
<tr>
<td>Bullying</td>
<td>1.46 (1.1 - 2.0)</td>
<td>1.29 (0.9 - 1.8)</td>
<td>1.68 (1.3 - 2.2)</td>
<td>1.14 (0.7 - 2.0)</td>
<td>2.27 (1.5 - 3.5)</td>
<td>1.39 (0.7 - 2.6)</td>
<td>0.41</td>
</tr>
<tr>
<td>Threats of violence</td>
<td>1.45 (1.2 - 1.8)</td>
<td>1.17 (0.9 - 1.5)</td>
<td>1.34 (1.1 - 1.7)</td>
<td>1.19 (0.8 - 1.8)</td>
<td>1.37 (1.0 - 1.9)</td>
<td>1.28 (0.8 - 2.1)</td>
<td>0.55</td>
</tr>
<tr>
<td>General health</td>
<td>1.84 (1.3 - 2.5)</td>
<td>1.56 (1.1 - 2.3)</td>
<td>2.98 (2.2 - 4.0)</td>
<td>1.29 (0.7 - 2.2)</td>
<td>4.97 (3.3 - 7.4)</td>
<td>2.10 (1.1 - 3.9)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The odds of having unfavourable psychosocial work factor/general health scores with different sick leave patterns compared with 0-2 short spells.

* Adjusted for age, gender, occupation, total sick leave days # Wald-test for overall difference in work factor score between sick leave patterns.
of effort and to get low rewards in return, but also that low job demands and high control were associated with that sick leave pattern [23]. We analysed all work factors separately. However, a post-analysis of the linear effect of the number of work factors perceived as stressful showed that the number of stressful work factors was increased ($\beta = 0.54$; 95% CI: 0.3-0.8) among those with 3–9 short-term sick spells compared with those with 0–2 short-term spells after adjustment for age, gender and occupation. This is equivalent to an increase in odds ratio from 1.1 (95% CI: 1.05-1.1) to 1.5 (95% CI: 1.2-1.7) when the number of stressful work factors rose from one to four. This is similar to the results of Elstad et al.; they reported that the odds ratio rose from 1.5 to 2.0 (95% CI: 1.0-3.0) among Nordic eldercare workers [20]. However, these results were based on spells of any duration, whereas our results pertain exclusively to short-term spells.

We found that long-term sick leave spells were significantly associated with unfavourable scores in work pace, demands for hiding emotions, quality of leadership and being bullied. These findings correspond nicely with those of other studies; a higher probability of having long-term sick leave spells was associated with high psychological job demands [17], physical demands, mental demands and bullying [18], and quality of leadership [22]. Their definition of long-term sick leave spells (more than 10 days, more than 27 days and, finally, more than 8 weeks) was, however, different from the one used in the present study (more than 7 days). Redefining long-term sick leave spells to 15–56 days or more than 56 days in our data strengthened the associations, but the confidence intervals became much wider (results not shown).

This strengthening effect may seem surprising because sick leave spells of a long duration are viewed upon as health-related and not as a strategy deployed to cope with an unfavourable psychosocial work environment [12-14]. Employees in the eldercare sector have high levels of sickness presenteeism, i.e. going to work despite ill health [20]. Commitment to the elderly and their colleagues probably explains this phenomenon; exposed to further stress at work has been shown to increase the number of episodes of presenteeism; and the risk of future sick leave may well increase with more presenteeism episodes [20]. Our results possibly reflect the long-term effects of being exposed to unfavourable work factors and repeated presenteeism episodes causing prolonged sick leave.

We think of general health as an intermediate factor in the association between unfavourable work factor / general health scores and spell pattern. Long term sick leave is found to be predicted by the exposure of work demands in the study by Schaufeli et al. although it is recognised that health status may as well influence the long-term sick leave [14]. We therefore analysed self-rated general health as a

<table>
<thead>
<tr>
<th>Table 6 The modifying effect of age on associations between unfavourable psychosocial work factor / general health scores and spell pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-9 short spells</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>OR (95% CI) *</td>
</tr>
<tr>
<td><strong>Demand</strong></td>
</tr>
<tr>
<td>Work pace</td>
</tr>
<tr>
<td>Emotional</td>
</tr>
<tr>
<td>Hiding emotions</td>
</tr>
<tr>
<td>Physical work load</td>
</tr>
<tr>
<td>Influence</td>
</tr>
<tr>
<td>Meaning of work</td>
</tr>
<tr>
<td>Commitment to the workplace</td>
</tr>
<tr>
<td>Role conflict</td>
</tr>
<tr>
<td>Quality of leadership</td>
</tr>
<tr>
<td><strong>Bullying</strong></td>
</tr>
<tr>
<td>At least from time to time</td>
</tr>
<tr>
<td><strong>Threats of violence</strong></td>
</tr>
<tr>
<td>At least from time to time</td>
</tr>
<tr>
<td><strong>General health</strong></td>
</tr>
<tr>
<td>Fair-poor</td>
</tr>
</tbody>
</table>

The modifying effect of age on the association between unfavourable work factor / general health scores and 3-9 short spells compared with 1-3 long spells.

* Adjusted for age, gender, occupation, total sick leave days.
dependent variable. Expectedly, it was clearly associated more with a long-term sick leave spell pattern than with a short-term and mixed spell pattern (12;13). We also analysed whether general health modified the association between spell patterns and the working environment and it did not (results not shown). This implies that the use of sick leave patterns as an indicator of unfavourable work factors is equally good/bad, i.e. it is independent of the respondent's general health status.

**Interaction between age and spell patterns**

We found that a statistically significantly higher proportion of young employees (26%) than older employees (18%) had 3–9 short-term sick leave spells. This result is in accordance with results reported by other studies [17,19,20,23,24]. Our data, however, did not confirm the often made observation that the proportion of employees who have few, but long sick leave spells is higher among older than among young employees [17,18,24]. In our material, about 6% had 1–3 long-term spells both among young and older eldercare workers.

We identified no studies that analysed whether age acted as an effect modifier in the association between sick leave pattern and work factors among health care employees. One study by Donders et al. investigated the moderating effect of age between work-related characteristics and frequent sick leave and prolonged sick leave among employees at a Dutch university [25]. They found that among employees younger than 46 years the OR of having three or more sick leave spells was decreased when decision latitude was high. This was not significant among the older colleagues. Borg et al. concluded that the increased sick leave levels among young eldercare workers were explained mainly by more role conflict and less commitment to the work place [11]. We wanted to explore whether this observation was linked to the duration or the frequency of the spells rather than overall sick leave length. Our results showed that an unfavourable score in commitment to the workplace was associated with a frequent short-term sick leave spell pattern as opposed to a long-term pattern among young employees. The opposite effect was seen among older colleagues. We found no statistically significantly effect modification in relation to role conflict. Unfavourable scores in quality of leadership were associated more with a long-term sick leave spell pattern than with a frequent short-term spell pattern; and this association was significantly stronger among old than among young employees. In the study by Donders et al.; the OR for frequent sick leave decreased when young employees scored high on decision latitude, whereas the OR became insignificant among older colleagues. High scores in physical workload and conflict with superiors increased the OR for prolonged sick leave among all age categories [25].

One possible explanation for this difference in similar study populations may be rooted in differences between the data sources. Our sick leave data are register-based as opposed to the self-reported sick leave length used in previous studies. We have previously shown that the precision in self-reported sick leave among young (19–29 years of age) eldercare workers was lower than the precision of register data and that eldercare workers were poor at recalling their sick leave and mostly under-reported the actual length by more than seven days [34].

**Strengths and limitations**

We have contributed with new insight into how the frequency of sick leave spells interacts with sick leave length and how sick leave spells are associated with work factors and general health in the municipal eldercare sector.

It strengthened the validity of our results that the sick leave measures were constructed from register-based sick leave data. This reduced the risk of making trivial associations [35].

We excluded 779 employees because they were not employed throughout the entire year of 2005. By that we missed 40 responders to the questionnaire about the working environment. They were younger (median age 40.1 years) than the study population, and 85% were occupied in home care. This might have caused selection bias toward the null hypothesis because their mean work factor scores were neither more nor less favourable.

Non-responders (24%) were more likely to be young, having more than 14 sick leave days in total and having more long-term sick leave spells than responders. This might have weakened the association between sick leave length / long-term sick leave spell pattern and work factors due to selection bias. Also, a possible underestimation of the association between spell frequency and work factors adjusted for sick leave length cannot be ruled out.

Two of the work factor scales; demands for hiding emotions (α = 0.60) and role conflict (α = 0.68) showed lower alphas than the 0.7-threshold that is widely recognised [36]. In the development of first version of COPSOQ [32] the psychometric properties of demands for hiding emotions (α = 0.59) were also low. This scale is short and consist of two items, whereby the probability of getting an alpha lower than 0.7 is increased [32]. Role conflict, on the other hand consist of four items and showed a higher alpha (α = 0.72) in the original version [32] than in this present study. Using a valid yet unreliable scale as the dependent variable statistical power may decrease [37]. However, it has been shown that Cronbach's alpha may underestimate the true reliability when combined items in a scale have common causes rather than common effects. Higher intra class coefficients retest reliabilities for demands for hiding
emotions (0.75) and role conflict (0.74) were found than if reliabilities were expressed by alphas [37].

We studied demands and resources found in a representative sample of Danish eldercare employees’ to be associated with self-reported sick leave length (10;11). We have no evidence, though that these work factors uniquely describe demands and resources of the eldercare sector from a theoretical point of view. Future research should focus on whether information about sick leave patterns may be used to enhance interventions that aim at improving the work environment in this particular work setting.

Conclusions
Sick leave length was a better indicator of unfavourable scores in work pace, demands for hiding emotions, quality of leadership and bullying than a sick leave length below 15 days and a 0-2 short-term sick leave spell pattern, respectively. A frequent short-term sick leave spell pattern was a better indicator of unfavourable scores in emotional demands and role conflict than overall sick leave length. General health was strongly associated with the long-term sick leave pattern.

The present study could not confirm the hypothesis that an association between unfavourable work factor scores and total sick leave length was more likely to be due to the frequency of spells than their duration and that this association would be more pronounced among young employees than among their older colleagues. However, scores in commitment to the workplace and quality of leadership varied with sick leave pattern and age. These conclusions underpin that different sick leave measures may be associated with different work environment factors. Further studies on these associations may inform interventions to improve occupational health care.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
CMS conceived the study, carried out statistical analyses and drafted the manuscript. NTA supervised the statistical analyses. All authors participated in the design of the study, helped to draft the manuscript and interpreted the results. All authors have read and approved the final manuscript.

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Reference


Validation of sick leave measures: self-reported sick leave and sickness benefit data from a Danish national register compared to multiple workplace-registered sick leave spells in a Danish municipality

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Abstract

Background: Previous validation studies of sick leave measures have focused on self-reports. Register-based sick leave data are considered to be valid; however methodological problems may be associated with such data. A Danish national register on sickness benefit (DREAM) has been widely used in sick leave research. On the basis of sick leave records from 3,554 and 2,311 eldercare workers in 14 different workplaces, the aim of this study was to: 1) validate registered sickness benefit data from DREAM against workplace-registered sick leave spells of at least 15 days; 2) validate self-reported sick leave days during one year against workplace-registered sick leave.

Methods: Agreement between workplace-registered sick leave and DREAM-registered sickness benefit was reported as sensitivities, specificities and positive predictive values. A receiver-operating characteristic curve and a Bland-Altman plot were used to study the concordance with sick leave duration of the first spell. By means of an analysis of agreement between self-reported and workplace-registered sick leave sensitivity and specificity was calculated. Ninety-five percent confidence intervals (95% CI) were used.

Results: The probability that registered DREAM data on sickness benefit agrees with workplace-registered sick leave of at least 15 days was 96.7% (95% CI: 95.6-97.6). Specificity was close to 100% (95% CI: 98.3-100). The registered DREAM data on sickness benefit overestimated the duration of sick leave spells by an average of 1.4 (SD: 3.9) weeks. Separate analysis on pregnancy-related sick leave revealed a maximum sensitivity of 20% (95% CI: 4.3-48.1). The sensitivity of self-reporting at least one or at least 56 sick leave day/s was 94.5 (95% CI: 93.4 – 95.5) % and 58.5 (95% CI: 51.1 – 65.6) % respectively. The corresponding specificities were 85.3 (95% CI: 81.4 – 88.6) % and 98.9 (95% CI: 98.3 – 99.3) %.

Conclusions: The DREAM register offered valid measures of sick leave spells of at least 15 days among eldercare employees. Pregnancy-related sick leave should be excluded in studies planning to use DREAM data on sickness benefit. Self-reported sick leave became more imprecise when number of absence days increased, but the sensitivity and specificity were acceptable for lengths not exceeding one week.

Keywords: Agreement, Eldercare sector, Public transfer payment, Register data, Self-report, Sensitivity, Sick leave, Specificity, Validation, Workplace record
Background
The past couple of decades have seen growing concern over sick leave in working populations in Western societies as a public health problem. Sick leave has a multifactorial aetiology [1-3]. Several scientific approaches have therefore been used which may explain the variety of approaches used to measure sick leave within an epidemiological framework: frequency of sick leave spells per individual, the total length of absence during a specified period, incidence rate, cumulative incidence and duration of absence spells [4]. However, in light of the large number of studies on sick leave, it is remarkably that only few validation studies have been performed.

Among the four traditional sources (employer’s personnel files, insurance-based data, national social security registers and self-reported data) from which sick leave data are traditionally retrieved, register-based sick leave data is an option available only in few countries. Even where registers are available, self-reported sick leave data are usually more easily acquired than data from other sources. Company-based data retrieved from employers’ personnel files is considered a golden standard, mainly because these data are also used for calculating earnings [5-8].

To identify sick leave measure validation studies, a systematic literature search was performed in PubMed. The search terms “Sick leave”, “absenteeism”, “preseenteism”, “work”, “registries”, “self report”, “questionnaires”, “reproducibility of results”, “validity/validation”, “sensitivity and specificity”, “predictive value of tests”, and “accuracy” were combined in the search. Twelve validation studies were selected. The validity of sick leave data reported in questionnaires or in interviews was studied and analysed against data retrieved from employers’ personnel files [5,6,8-13], insurance companies [9,14-16] and a national social security register [17]. None of the studies validated insurance-based data either from companies or from national social security registers against employers’ personnel files.

The validation studies found discrepancies between self-reported length of absence and insurer-reported compensation payments. The inconsistencies spoke against self-report and were associated with work status, cause of absence as well as personal characteristics [14,15].

A study from the Netherlands found poor agreement between workplace-registered sick leave data and data collected in a questionnaire [11]. The ability of this questionnaire to detect frequency of sick leave spells was reported to have a sensitivity of 55% and specificity of 83%. The remaining nine studies concluded that self-reports yielded acceptable validity [5,6,8-10,12,13,16,17]. The total length of absence was the most widely used measure of sick leave [5,6,8-10,12,13,16], but also prevalence [5,12,17], frequency of spells [5], incidence and duration of sick leave spells [16] were used.

Recall periods ranged from 2 weeks to 4 years and were discussed in several papers [6,9,10,17]. These studies were largely unanimous that shorter recall periods could increase the precision of self-reported sick leave. In two papers, the optimum recall period was recommended to be no longer than 2–3 months to obtain valid measures of absence lengths [6,10].

The Whitehall II study and a Swedish replication of Whitehall II found a worse recollection the longer the absence length [8,13] which indicates that valid self-reporting may be limited to absence of short duration. Finally, relatively high sensitivities were found in studies where data on absence length, frequency and prevalence of absence were provided as pre-specified categorical questionnaire options [5,17].

In Denmark opportunities for register-based research are unique [18]. Data on social public transfer payments, like sickness benefits are registered on a weekly basis in a national register called DREAM [19]. Employers’ sickness benefit paid in excess of two weeks is refundable from the municipality according to the Danish Sickness Benefit Act [20]. DREAM data on sickness benefit has been used for follow-up studies, where return to work (RTW) [21-27], sick leave defined as absence >2–3 weeks [28-32] and long-term sick leave defined as absence >8 weeks [29,31-40] have been used as endpoints. Study populations have also been defined from the DREAM register [24-26,29,41,42]. One attempt has been made to validate the DREAM register [43]. In this study a random sample of 5,221 Danish citizens were asked about which kind of income they received in a particular week in 2001. According to the DREAM register 82 persons were receiving sickness benefit and of those 38 responded this kind of income; yielding a positive predictive value of 31.7%. The article concluded the DREAM register to be a feasible tool for social and economic research in Denmark. DREAM data on sickness benefit has so far not been validated against workplace-registered sick leave.

Aim
1) To validate registered sickness benefit data from DREAM against workplace-registered sick leave spells of at least 15 days. 2) To validate self-reported sick leave days during one year against workplace-registered sick leave.

Methods
Study population
The study is a cross-sectional study of municipal elder care workers in Aarhus (the second largest city in Denmark). To validate DREAM data a total of 3,554
individuals employed throughout 2006 were identified in the employer’s computerized personnel files. Details on the study population are given in Table 1. Their median age was 47.5 years. The majority were women (95%) who were primarily working as home care workers, assistant nurses and nurses. The male employees worked mainly as home care workers, assistant nurses, maintenance workers, and in the administration. Nineteen percent worked full-time, i.e. 37 hours per week, 70% worked between 36 and 30 hours per week, 7% worked between 29 and 20 hours per week and the remaining 1% worked less than 20 hours per week.

All subjects in this study were covered by the Danish national health insurance, which provides sickness benefit to those who are unable to work due to disease or injury.

Agreement between self-reported sick leave and workplace-registered data was studied in 2,311 respondents to the “Working in eldercare” survey [44] in 2005. The response rate was 73% and 2,139 of these respondents were also included in the validation of DREAM data from 2006.

Beside questions about the working environment and health the employees were also asked: “How many sick leave days have you had within the last 12 months?”. The two study populations did not differ regarding gender, age, profession or hours worked per week.

**Measures of sick leave**

When an employee needed sick leave, he/she reported absence to his or her immediate superior. An absence form was printed out by the superior, in which the first date of the absence spell was written. This form was handed to the employee, who wrote the last date of the absence spell when he/she returned to work and signed it together with the immediate superior. The dates on the form were entered to a computerised duty roster (from which earnings are calculated) by the immediate superior or a secretary. In each of the 14 municipal eldercare workplaces in Aarhus a number of immediate superiors were responsible for entering absence dates. Simultaneously these absence dates were transferred to the company’s absence records along with a categorization of the absence spell (sick leave, care leave, child’s first sick day etc.). These raw data on absence were retrieved from the workplace records, but only spells related to sick leave were included in the present study. The dates of the first and last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days. Overlapping, consecutive, or duplicate sick leave spells were merged into a single spell.

Sick leave spells entitled to municipal refunding according to the Danish Sickness Benefit Act include the following four categories: 1) spells lasting more than 14 days; 2) spells related to pregnancy; 3) spells due to sick leave in a “flexi job”, i.e. modified job due to permanently reduced workability; or 4) recurrent or anticipated spells due to chronic disease. Spells in categories 2) - 4) shorter than or equal to 14 days were exempted from the employer period and refundable from the first day of absence. For every refundable sick leave spell, we identified the week number in which the spells were seen.

### Table 1 Description of elder care workers employed throughout 2006 in the municipality of Aarhus (N = 3,554)

| Age in years, median (interquartile range) | 47.5 (39-54) |
| Gender (% female) | 95.3 | 3,387 |
| Workplace, local centres: |  |
| Frederiksbjerg | 9.2 | 326 |
| Hasle-Gellerup-Toftergården | 7.5 | 267 |
| Holme og Skåde | 7.4 | 264 |
| Hørgården og Vejlby | 8.1 | 289 |
| Skelager/Bjømshøj | 4.2 | 148 |
| Trøjborg og Abildgården | 5.6 | 199 |
| Viby og Rosenvang | 6.6 | 235 |
| North | 7.1 | 251 |
| Northwest | 7.5 | 267 |
| South | 8.2 | 291 |
| Southwest | 5.5 | 197 |
| West | 9.1 | 324 |
| City | 7.2 | 255 |
| Others | 6.8 | 241 |
| Profession: |  |
| administration | 5.4 | 190 |
| activity | 6.3 | 222 |
| kitchen and café staff | 1.1 | 39 |
| cleaning | 5.5 | 195 |
| social and health care assistant level I and II | 68.0 | 2419 |
| nurse | 10.4 | 369 |
| maintenance | 0.6 | 21 |
| not defined | 1.9 | 66 |
| remaining staff | 0.9 | 33 |
| Hours worked per week: |  |
| 37 | 20.8 | 738 |
| 31-36 | 40.4 | 1,434 |
| 21-30 | 34.6 | 1,229 |
| ≤20 | 1.7 | 59 |
| missing | 2.7 | 94 |
From workplace absence to sickness benefit compensation

When a workplace-registered absence spell was assumed by the employer to be entitled to tax-financed compensation according to the Danish Sickness Benefit Act, a notification was sent from the human resource department in the municipality of Aarhus to an external private IT-company. This private partner provided data-handling services for the municipality and was responsible for notifying the social services in the sick-listed employee’s municipality of domicile, which grants sick leave compensation benefits. From the social services a form was sent to the sick-listed employee. Within a week detailed information about the particular absence spell, treatment, workplace, current work tasks, education and prospects about the return to work process had to be returned to the social services. This information was exchanged with a social worker from the municipal job centre, engaged in the process of resumption of work. If/when the absence spell was discontinued the social services was notified by the social worker. Data on tax-paid sickness benefit compensation granted in the municipality of domicile are pooled in a central database. This information is further processed and collected in a national register of sickness benefits and maternity payments, which becomes part of the DREAM register.

Measures of sickness benefit

The DREAM register is administered by The Ministry of Employment [19]. The name is a Danish acronym (Den Registerbaserede Evaluering Af Marginaliseringsomfanget) which translates into “The evaluation of marginalized groups of individuals based on registered social public transfer payments”. The DREAM register includes all Danish citizens with a CPR number who have received social public transfer payments at some point since mid-July 1991. Each person is registered once a week with a code representing the type of reimbursement received that particular week (currently 109 codes are available). Codes are ordered hierarchically; low-ranked codes are overwritten by high-ranked codes, e.g. sickness benefit codes (Table 2). The weekly recordings cover reimbursements of 1 to 5 days of actual workdays lost. By January 2006, data on more than 3.5 million citizens of a total Danish population of 5.4 million had been entered into the DREAM register.

The weeks of 2006 were isolated in the DREAM register and the 3,554 employees were identified by their CPR number. The weeks in 2006 coded 891, 892, 894 or 895 were identified.

Table 2 DREAM codes related to sickness benefit reimbursement

<table>
<thead>
<tr>
<th>DREAM-code</th>
<th>Various types of sickness benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>891</td>
<td>Sickness benefit</td>
</tr>
<tr>
<td>892</td>
<td>Sickness benefit while being on part time sick leave</td>
</tr>
<tr>
<td>893</td>
<td>Sickness benefit while being unemployed (this code is of no relevance in this study)</td>
</tr>
<tr>
<td>894</td>
<td>Sickness benefit while being re-trained</td>
</tr>
<tr>
<td>895</td>
<td>Sickness benefit while being employed under special condition “flexi job”</td>
</tr>
</tbody>
</table>

Statistical analyses

Agreement about prevalence of sick leave, aim 1

We used workplace registered sick leave as the reference standard in the comparison of employers’ personnel files and DREAM data on sickness benefit. Whether refundable sick leave and sickness benefit was registered in the employer’s personnel files and DREAM respectively, was addressed in each week of 2006 and cross tabulated. Hence 52 2×2 tables were constructed and sensitivity, specificity and positive predictive value (PPV) of DREAM data were calculated. Logistic regression was applied to obtain single sensitivity probabilities, i.e. the probability of having received sickness benefit registered in DREAM when the workplace data said so. For this analysis, individuals were included as cluster variables to adjust for 48 repeated measurements from each study member. Week 1, 2, 51 and 52 were excluded to avoid possible imprecision due to sick leave carried forward from the previous year and prolonged into the forthcoming year. Gender, dichotomised age (< 41 years), workplace (14 geographically defined categories) and profession (administration, activity, kitchen and café staff, cleaning, social and health care personnel level I and II, nurse and maintenance) were included as explanatory variables.

Concordance with sick leave spell durations, aim 1

A receiver-operating characteristic curve (ROC-curve) was used to study the performance of DREAM data on sickness benefit. Weekly cut-off points in DREAM were used to find the optimum discrimination of sick leave spell durations of >8 weeks defined in the workplace register.

The mean duration of the first workplace-registered sick leave spell was calculated as well as for the corresponding number of weeks of sickness benefit reimbursement registered in DREAM. Differences between and averages of these durations formed a Bland-Altman plot and was used to illustrate the relationship between the two durations. The assumptions behind a paired t-test were also appraised from this plot (Wilcoxon’s signed rank test is the non-parametric test equivalent). Included in the analyses were the first spells of sick leave retrieved from the employers’ personnel files and the first registration of
sickness benefit in DREAM, whenever agreement about starting week had been established.

Employees who had pregnancy-related sick leave according to the employers’ personnel files at some point in 2006 (95 women) constituted a special group. All analyses were performed both with and without this group and separately for the group as such.

**Concordance between self-reported and workplace-registered sick leave length, aim 2**

Raw data on absence were retrieved from the workplace records, but only spells related to sick leave were included. All sick leave spells 12 months prior to the response date were identified. If a spell encompassed the response date or the date 365 days prior to that, the spell was “shortened” to ensure the duration did not exceed these dates. All sick leave spells were summarised into total length in calendar days. These were compared to the self-reported sick leave days from the questionnaire.

Mean annual length and differences in days were stratified on gender, age, profession and working hours per week. To enhance the comparability to other studies we used some of the same sick leave measures used in a Swedish study [13]. Both measures of sick leave were categorised into: 1) 0 days, 2) 0>days=<7, 3) 7>days=<14, 4) 14>days<28, 5) 28>=days<56 and 56 days or more. An expanded 2x2 table was constructed and sensitivity and specificity were calculated.

Concordance of agreement was minimal, viz. 93% (95% CI: 92,9–93,5) of DREAM data showed a very poor performance of DREAM data on sickness benefit with the highest sensitivity reaching only 20% (95% CI: 4–50).

**Pregnancy-related sick leave excluded** Logistic regression analyses were initially performed without pregnancy-related sick leave. The models were adjusted for 48 repeated individual measurements and showed an overall probability of 96.7% (95% CI: 95.6-97.6) for DREAM data being in concordance with the workplace-derived data on refundable sick leave registered in the employers’ personnel files (sensitivity).

The sensitivity of DREAM data was not statistically significantly different for young female employee compared to older (odds ratio (OR) 0.68; 95% CI: 0.4 - 1.3) or for old and young men (OR 0.9; 95% CI: 0.2 - 5.0). Gender did not affect the sensitivity either: OR was 0.79 (95% CI: 0.5 - 1.3) for men. None of the professions or workplaces either increased or decreased the likelihood of agreement (results not shown).

The DREAM register and the employers’ personnel files for week 3 to week 50 were in agreement that 2,616 of 3,459 employees (75.6%; 95% CI: 74–77) were not sick-listed / not receiving sickness benefit and that 789 employees (22.8%; 95% CI: 21–24) were sick-listed and had received sickness benefit, an overall observed agreement of 98.4% (95% CI 98.0-98.8). Twenty-two employees 0.6% (95% CI: 0.4 - 1) were sick-listed according to workplace files, but did not receive sickness benefit according to DREAM. Finally, 32 employees (0.93%; 95% CI: 0.6 – 1.3) were reimbursed according to DREAM, but that figure could not be verified in the employers’ personnel files.

For those 789 employees where both the DREAM register and employers’ personnel files had recorded sick leave, agreement was complete in terms of registered weeks in 557 cases (70.6%; 95% CI: 67–74) and in terms of the number of weeks in 5 cases (0.6%; 95% CI: 0.2 – 2). However, disagreement about which weeks was observed in 173 cases (21.9%; 95% CI: 19–25) where DREAM had registered more weeks than the workplaces and 54 cases (6.8%; 95% CI: 5–9) where the number of workplace-registered sick leave exceeded the weeks of reimbursements in DREAM.

**Women with pregnancy-related sick leave included** The logistic regression models were also calculated including pregnancy-related sick leave. An overall probability of 87.0% (95% CI: 84.2 – 89.4) of DREAM data being in concordance with the workplace-derived data on refundable sick leave was found. DREAM data was statistically significantly less sensitive among younger than older women with an OR of 0.1 (95% CI: 0.06 - 0.2).
Still, sensitivity did not depend on gender; the OR was found to be 1.38 (95% CI: 0.9 - 2.1) for men.

**Duration of sick leave spells**

The following results are based on analyses that include the first sick leave spell of 356 employees without pregnancy-related sick leave. The ROC-curve (Figure 2) illustrates that a nine-week optimum cut-off point in the DREAM register was required to discriminate between a sick leave spell duration of eight weeks or more defined in the workplace register. The area under the curve (AUC) was 98.77% (95% CI: 97.8-99.7). This implies that a cut-off point of nine weeks in the DREAM register will correctly identify approximately 99% of workplace-registered sick leave durations of eight weeks or more.

The agreement between the two registers in terms of the duration of the first sick leave spell is also illustrated in Figure 3. The mean difference between DREAM data on sickness benefit and the employers’ personnel files was –1.4 (SD: 3.9) weeks, i.e. DREAM data overestimated sickness leave by an average of 1.4 weeks compared with the workplace register. According to the Bland-Altman plot, the difference was not evenly distributed around the y-line = 0 as DREAM data overestimated the workplace-registered sick leave in most cases. Furthermore, the difference was not independent of the average value; thus, clustering of dots illustrates that the shorter average duration, the less difference between the two registers. The average difference between the two registers was statistically significantly different from zero (p < 0.001).

**Aim 2**

**Total annual sick leave length**

The self-reported mean annual length of sick leave was lower than workplace-registered sick leave. For women the mean difference between workplace-registered and self-reported sick leave was 4.3 (95% CI: 3.4-5.2) days and for men 4.8 (95% CI: 0.4-9.2) days. The youngest age group (19–29 years) recalled their absence with the lowest precision with a mean difference of 7.2 (95% CI: 3.1-11.2) days compared to the age group of 40–49 years with a mean difference of 3.9 (95% CI: 2.7-5.1) days. Totally, 1,063 individuals underestimated their sick leave, 662 individuals recalled precisely and 586 individuals overestimated their sick leave.

When workplace-registered and self-reported sick leave lengths were categorised as shown in Table 3; 518 individuals underestimated their sick leave, 1,502 recalled their sick leave accurately and 251 eldercare workers overestimated their sick leave. The highest agreement was found in the categories 0, 0–7 and >56 days, where the responders were able to accurately recall annual lengths in 85.3 (95% CI: 81.4 – 88.6)% 78.1 (95% CI: 75.3 – 80.8) % and 58.5 (95% CI: 51.1 – 65.6) % of the cases, respectively. In total, of those having a least one sick leave day according to the workplace register (n = 1,910), 1,805 individuals also reported so.
Figure 2 The accuracy of DREAM to identify workplace-defined sick leave spells of > 8 weeks. ROC curve showing the sensitivity and specificity corresponding to different choices of cut-off points in DREAM for sick leave spell durations of eight weeks or more defined in the workplace register.

Figure 3 Bland-Altman plot of workplace-registered sick leave spells and DREAM-registered reimbursement periods. The average duration of workplace-registered sick leave spells and DREAM-registered reimbursement periods plotted against the difference between these two measures.
themselves, which was equivalent to a sensitivity of 94.5 (95% CI: 93.4–95.5) %. Among the eldercare workers who did not have any sick leave days (n = 401) 342 individuals reported so giving a specificity of 85.3 (95% CI: 81.4–88.6) %. The sensitivity of recalling having had >=28 or >=56 sick leave days was 64.7 (95% CI: 59.4–69.7) % and 58.5 (95% CI: 51.1–65.6) %, respectively. The corresponding specificities were 98.3 (95% CI: 97.6–98.8) % and 98.9 (95% CI: 98.3–99.3) %.

Discussion
Our study showed an excellent agreement between workplace registered sick leave and DREAM registered sickness benefit compensation. Except for pregnancy-related sick leave, the DREAM register identified workplace-registered spells exceeding 14 days with very high sensitivity and excellent specificity. To identify sick leave spells beyond eight weeks, the optimal cut-off point in the DREAM register was nine weeks. On average, DREAM data overestimated the workplace-specified duration of sickness spells by 1.4 weeks. The ability to recall accurately declined the higher number of workplace-registered absence days. This was apparent even with short lengths; only 47.5 (95% CI: 42.3–52.7) % and 37.1 (95% CI: 31.4–43.1) % recalled accurately that they had had 7–14 days or 15–28 days of sick leave, respectively.

Other validity studies
To our knowledge, no previous study has attempted to validate a national social security register against workplace-registered sick leave so comparison with other studies is not possible.

Studies providing self-reported data on total absence length, frequency and prevalence as pre-specified categorical options reported relatively high sensitivities (range 79–91% with workplace registers as reference standard) [5,13,17]. The sensitivity of 91% was found when responses were categorised in having had at least one day of absence within one year, but the specificity was low (74%) [13]. Regarding absence of more than 28 days within one year the sensitivity was 67% and the specificity was 98%. We were able to reproduce the results reported in the study by Voss et al. in our study. In the validation of DREAM data on sickness benefit, both sensitivity and specificity were high although we adopted a much stricter requirement of sick leave registration within the same week than the criterion of sick leave within the same year used in studies using self-reported sick leave. Other studies requesting more information on sick leave reported lower sensitivities. Thus, a decline in sensitivity from 79% to 64% [17] and from 79% to 13% [5] were seen when additional information about diagnosis was required.

In this study, we analysed the validity of DREAM registered sick leave spell duration. A frequent topic addressed in validation studies is the respondent’s ability to precisely recall sick leave duration within a specified timeframe. Recall periods of down to two months have been shown to produce discrepancies between workplace data and self-reported duration of absence in approximately 13% of the cases. This percentage increased to approximately 50% when the recall period was extended to 12 months [6]. In our study population the ability to recall absence lengths accurately was found in
662 cases (28.7%). Approximately 30% perfect agreement between self-report and workplace registered data among female responders was also found in the Whitehall II study [8]. For comparison, DREAM data was in perfect agreement with workplace data in 69.7% of the cases on which weeks were reimbursed and on the respondent being on sick leave. However, DREAM data overestimated the spell duration by a mean of 1.4 weeks. Overestimation was less pronounced at shorter spells. Due to the registration procedure in the DREAM register, an expected and systematic overestimation can explain some of the variation seen in our study because one week in the DREAM register covers reimbursement of 1 to 5 days of actual workdays lost.

The agreement between DREAM data on sickness benefit and workplace data did not depend on the women's age. This changed when pregnancy-related sick leave was included in the analyses because of the combined effect of being young and therefore more prone to be pregnant. Furthermore, the age dependency could not be found among the male employees. Because pregnancy-related sick leave is recoded from sickness benefit to maternity payment, sick leave among young women is underestimated and caution is advised when analysing sick leave in this age group of females.

Male employees seemed to give more valid self-reported data than women [8,9,13]. The massive female employee dominance in the public sector and in our study population hampers firm conclusions about potential gender differences in terms of diagnostic accuracy of sick leave in our data. Prior validation studies have established that the ability to correctly recollect the duration of absence decreases with the duration of the absence [6,8,13]. This was also the case regarding our self-reported data. A longer absence length was associated with increased discrepancies between workplace-registered and self-reported sick leave. Under- or over reporting was evident for 1,063 and 586 individuals, respectively. When using categorisation of sick leave duration the number of responders who underestimated their sick leave declined to 518. Still the ability to recall sick leave length accurately decreased with increased lengths of absence.

**Methodological considerations**

The present study included an entire population of eldercare workers in Aarhus, employed throughout 2004 and 2005 or 2006. In the validation of DREAM data nobody was lost to follow-up, thus selection bias was not an issue. In the validation of the self-reported sick leave, a total of 3,147 eldercare workers were employed throughout 2004 and 2005, but only 2,311 (73%) responded. Responders and non-responders had a mean workplace registered annual absence length of 2.5 (SD: 5.0) weeks and 4.2 (SD: 8.0) weeks, respectively (results not shown). We expect those with increased absence lengths to recall with less precision compared to those with shorter lengths. Therefore, some selection bias may have been present and caused overestimated results regarding agreement - in line with findings of Burdorf et al. [5]. This is a major disadvantage of self-reports as compared with register data.

The large number of participants yielded a high power reflected in precise measurements and tests. Yet, the population was strongly dominated by women and the power to reveal gender difference was therefore questionable.

There was a lower agreement between DREAM data and workplace data in the measures obtained at the beginning and towards the end of 2006 than during the remaining part of the year. This can be explained by different registration procedures. We do not expect excluding these weeks to have caused information bias because having sick leave in these particular weeks would appear at random.

The registrations in both the DREAM register and the employers’ personnel files are based on manual entry and human error might explain the disagreement between the two registers on 1.55% of the employees. This validation study was based on data from one municipality. Even if manual entry of sick leave data was done by a number of different administrative employees working on different geographical settings and workplaces within the same municipality, the procedure was most likely systematised in a way that differs from that used in other companies. Future research projects should repeat the validation study using data from workplaces from the private sector and state institutions. The municipal health care workers account for approximately 20% of the total municipal workforce of 500,000 persons in Denmark [45].

**Possible implication of the DREAM data validation**

Until 2011, we found 22 studies that used data retrieved from DREAM for sick leave research. Studies defined the study population from the DREAM register as those who had received sickness benefit for at least two to three weeks before baseline [24-26,29,41,42]. The DREAM register correctly registered sickness benefit reimbursements in 96.7% of those weeks that were also verifiable in the employers’ personnel files in our study. In general some bias should be expected because the DREAM register does not register sick leave as such but sickness benefit and other disability benefits. However, we believe that the agreement between sickness benefit and sick leave in our study is reasonable and that it supports the use of DREAM data as a selection tool to identify sick leave periods with little or no selection bias.
DREAM data used for follow-up studies [29,31-40] defined long-term sick leave as absence >8 weeks. When a cut-off point of nine DREAM-registered weeks of sickness benefit was chosen, the ability to discriminate workplace-registered spells of >8 weeks was optimal. However, from our point of view, this misclassification was non-differentiated which would tend to bias the results toward the null hypothesis.

In comparative register studies on sickness absence where the DREAM register is considered for use; it will be of great importance to recognise the recoding of pregnancy related sickness absence into maternity benefits, because it is reducing the validity in fertile-aged women.

Reliability of self-reported sickness absence declines with increasing length of absence and for studying absence beyond the period paid by the employer, national registers seems preferable to self-reported data if reliable personnel files are not available.

Conclusion
DREAM data on sickness benefit is a valid measure of sick leave spells lasting at least 15 days among Danish municipal eldercare workers. Self-reported annual sickness absence shows good agreement for total lengths not exceeding 1 week. DREAM offers valid, objective measurements and imprecision due to recall errors is thus avoided. Self-reported sick leave becomes more imprecise when number of absence days increases, but the sensitivity and specificity are acceptable for lengths not exceeding one week. However, the duration of sick leave spells from the DREAM-register should be interpreted cautiously. DREAM data is not valid in relation to pregnancy-related sick leave.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
CMS conceived the study, carried out statistical analyses and drafted the manuscript. NTA and NF carried out and / or supervised the statistical analyses. All authors participated in the design of the study, helped to draft the manuscript. NTA and NF carried out statistical analyses. All authors have read and approved the final manuscript.

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References


Paper III
Title page

Title

Sick leave patterns as predictors of disability pension or long-term sick leave: A 6.75-year follow-up study in municipal eldercare workers.

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Abstract

Background: The public health care sector is challenged by high sick leave rates among home-care personnel. This group also has a high probability of being granted a disability pension. We studied whether a workplace-registered frequent short-term sick leave spell pattern was an early indicator of future disability pension or future long-term sick leave among eldercare workers. Methods: 2,774 employees’ sick leave days were categorised: 0-2 and 3-17 short (1-7 days) spells, 2-13 mixed short and long (8+ days) spells, and long spells only. Disability pension and long-term sick leave were subsequently identified in a National register. The cumulative incidence proportion as a function of follow-up weeks was estimated using the Kaplan-Meier curve. The relative cumulative incidence (RR) of experiencing one of these events within 352 weeks was analysed in a generalised linear regression model using the pseudo values method adjusted for age, occupation and unfavourable work factors. Results: A frequent short-term sick leave pattern was not a significant early indicator of being granted a disability pension; the RR was 1.62 (95% CI: 0.84-3.12). Inversely, mixed or long-term sick leave patterns were both associated with a significantly increased RR compared with a non-frequent short-term pattern. The risk of long-term sick leave was significantly increased (1.35-1.64 (95% CI: 1.12-2.03) for all sick leave patterns beyond 0-2 short spells. Conclusions: Sick leave length was a better indicator of future workability than spell frequency. Preventive actions should target employees engaged in home-care having sick leave spells exceeding seven days, irrespective of spell frequency.
Article summary

Article Focus

- Workplace-registered sick leave patterns were identified, which permitted studying the independent effect of frequency and length of sick leave and whether these spell patterns could be used as early indicators of future reduced workability among municipal eldercare workers.

Key Messages

- Although statistically insignificant after adjustment by total sick leave length, the results do not disprove that a frequent sick leave spell pattern is an indicator of future reduced workability.
- Sick leave length was, however a better indicator of future disability pension and long-term sick leave than sick leave spell frequency.
- Preventive actions should be targeted eldercare employees having sick leave spells exceeding seven days, irrespective of spell frequency.

Strengths and Limitations

- Information bias were limited in this study, due to the use of workplace-registered sick leave records and the obtainment of outcome measures from a valid national register on social benefits.
- A new statistical approach (*pseudo values method*) in the analyses of time to event data was applied by which relative cumulative incidence was achieved.
- Selection bias may have been introduced and caused underestimated results.
Introduction

Approximately 7-10% of working age inhabitants are receiving disability pension in the Nordic countries,[1], and several studies seem to agree that sick leave length is an important risk factor for future disability pension,[2-4].

The public sector in general and the health care sector in particular is challenged by high sick leave rates among home-care personnel,[5,6]; next to citizens without any labour experience, this group also has the highest probability of being granted a disability pension,[7]. Employees in the eldercare sector also have high levels of sickness presenteeism, i.e. they go to work despite ill health,[8]. Commitment to the elderly and their colleagues probably partly explains this phenomenon. Exposure to an unfavourable working environment has been shown to increase the number of presenteeism episodes; and the risk of future sick leave may well increase with more presenteeism episodes,[8]. Studies of general work populations have shown that work environment factors are independent risk factors for being granted a disability pension,[9-12]. Thus, it may be of particular importance to take work environment factors into consideration in studies investigating the risk of being granted a disability pension among eldercare employees.

Several factors associated with disability pension were identified by Allebeck et al.[13]; thus, duration of sick leave, low socio-economic status, high age and single men were factors consistently associated with an increased risk of receiving disability pension. However, studies vary much in terms of reported sick leave length, definition of sick leave spell patterns and methods of quantifying how these factors may affect risk. Thus, long-term sick leave spells with a duration defined as more than 14 days,[14], 28 days,[15], and 54 days,[16], respectively, increased the risk of being granted a disability pension. However, studies exploring whether short-term sick leave spells constitute a risk of being granted a disability pension differ much in their conclusions,[3,17]. Frequent sick leave spells have been found to
predict recurrence of a frequent sick leave spell pattern,[18] and future long-term sick leave,[17,18]. It is therefore relevant to study whether a pattern of frequent short-term sick leave spells may be a predictor of disability pension because such a pattern may indicate the existence of unfavourable work environment factors and may herald reduced functioning at an early stage,[19]. A progression in frequency and duration of sick leave spells has been described as a common sick leave track preceding disability pension,[2,16].

Early detection of particular sick leave patterns predicting long-term sick leave or/disability pension could facilitate employers’ and healthcare professionals’ initiation of preventive strategies to maintain the employees’ workability. This is of special interest in the public sector in general and in the municipal eldercare sector in particular due to the high disability rates in this sector.

**Objective**

The aim was to study whether a workplace-registered frequent short-term sick leave spell pattern was an early indicator of future disability pension or future long-term sick leave among municipal eldercare workers.

**Material and methods**

**Study design and participants**

In an observational follow-up study, we included elder care workers (N=2,774) employed in the municipality of Aarhus (the second largest city in Denmark) throughout 2004. The potential follow-up period was 6.75 years. The employer’s sick leave register was merged with the national register containing data on social public transfer payments (DREAM).[20].
Exposure variable: Sick leave patterns

Data on absence in 2004 were retrieved from the workplace records, and spells related to sick leave were included. The dates of the first and the last day of each sick leave spell were available for each individual. A sick leave spell was counted in calendar days regardless of whether all of these days were work days or not. Overlapping, consecutive or duplicate sick leave spells were merged into a single spell.

The sick leave data were categorised into patterns with short, long or a combination of short and long spells. We defined short spells as spells lasting one to seven calendar days. This definition has also been used in other studies,[21,22]. Long spells were defined as spells lasting eight calendar days or more. This definition was used in a previous study conducted on the same population,[23].

Based on the above-mentioned measures, the sick leave patterns were defined as patterns with: 0-2 short spells, 3-17 short spells, 2-13 mixed spells and 1-5 long spells.

Outcome variables: Disability pension and long-term sick leave

Outcome variables were retrieved from the DREAM register,[20]. A person in Denmark is registered once a week with a code representing the type of social transfer payment (sick leave benefits, disability pension, etc.) received that particular week.

Disability pension

Disability pension is granted if a person’s capacity for work is reduced to such an extent that it makes self-support impossible, even in a flexible working arrangement. Disability pension is available to people aged 18 to 65,[24]. While it is possible to return to work or work part time while receiving disability benefit, these options are rarely used, and disability benefit in reality means permanent exit from the labour market.
**Long-term sick leave**

Long-term sick leave as outcome was defined as a consecutive period of nine weeks on sick leave. In a previous study of the municipal eldercare workers, we compared DREAM-registered sickness benefits with workplace-registered long-term sick leave.[25] A nine-week optimum cut-off point in the DREAM register was required to discriminate between a sick leave spell duration of eight weeks or more defined in the workplace register. Empirical evidence indicates that long-term absentees and in particular more than eight-weeks absentees in general have a substantially increased risk of not returning to work,[26] because the municipal authority responsible for the sickness benefit payout is legally bound to discuss occupational and/or vocational rehabilitation with the absentees upon this period.[27]

**Potential confounders**

**Workplace-registered variables**

Age and occupation were dichotomised into (=40/>40 years) and (care/non-care), respectively. The care category was defined by employees engaged in the care of the elderly, and the non-care category comprised employees from the administration, kitchen personnel, cleaners, staff engaged in maintenance, therapists, nurses and managers. Total sick leave days in 2004 were categorised into four groups (0 days, 1-14 days, 15-56 days and >57 days) in order to study the long-term effects of being exposed to a frequent short-term sick leave spell pattern adjusted for the effect of the total sick leave length.

**Questionnaire-obtained variables**

Questionnaire data on the working environment were collected by the National Research Centre for the Working Environment (NRCWE) in the municipal eldercare sector in Aarhus from February to July in 2005. Work factors associated with self-reported high levels of sick leave among eldercare workers,[28,29] were selected from the survey. These were: work
pace, emotional demands, demands for hiding emotions, physical work load, influence, meaning of work, commitment to the workplace, role conflict and quality of leadership. They were scored on five-point Likert scales (Always, Often, Sometimes, Seldom, Never/hardly ever) and transformed into 0-100 scores, dichotomised into favourable / unfavourable according to the mean values of the different work environment scales measured in a representative sample of working Danes in 2004/2005,[30]. This was done for all scales except for physical work load which was dichotomised according to the mean value found in our data. Response categories for bullying and threats of violence were “at least once a month”, “from time to time” and “never”. They were dichotomised into “at least from time to time” and “never”. Reference scores were not available for bullying and threats of violence. The number of individual unfavourable work factors was counted (range 0-11).

**Statistical analyses**

The cumulative incidence proportion (CIP) as a function of the number of follow-up weeks was estimated using the Kaplan-Meier curve. The relative cumulative incidence of being granted a disability pension or experiencing long-term sick leave within 352 weeks was analyzed in a generalised linear regression model using the pseudo values method,[31,32]. Entry date was defined as the 1st of January 2006 and the end of follow-up was week 39 in the year of 2012. The year of 2005 was used as a “wash-out” period,[3,4]. The sick leave patterns were based on sick leave spells that started or/and ended in 2004; spells prolonged into 2005 were excluded. According to the Danish Sickness Benefit Act, sickness benefits are not reimbursed beyond 52 weeks which, in principle, is defined as the maximum duration of a sick leave spell,[27]. A one-year “wash-out” period was therefore sufficient to eliminate the potential confounding effects of long-term sick leave immediately before follow-up started.
The outcome variable *disability pension* consisted of two measures: an event indicator (yes or no) and the time allowed to code the disability benefit in the DREAM register,[9] or end of follow-up / competing risks (*early retirement benefit, retirement pension or death*) / censored observations (*emigration*), whichever came first.

Likewise, the outcome variable *long-term sick leave* also consisted of two measures: an event indicator (yes or no) and time to nine consecutive DREAM-registered sick leave benefit weeks,[25] or end of follow-up / competing risks (*early retirement benefit, retirement pension, disability pension or death*) / censored observations (*emigration*), whichever came first.

A Wald test was performed to establish the overall difference in the relative cumulative incidence of being granted a disability pension or experiencing long-term sick leave between the sick leave patterns.

Due to few events, over-fitting may be present in the models analysing the risk of being granted a disability pension when adjusting for the *number of unfavourable work factors* and the *total number of sick leave days*. However, priority was given to the identicalness of the adjustment procedure in both risk populations.

The significance level was set at p<0.05. The results are shown as crude and adjusted relative cumulative incidences, i.e. risks (RR) and corresponding 95% confidence intervals (95% CI).

STATA version 12.1 was used as statistical software.

Approval (2012-41-1290) for using workplace-registered sick leave records, DREAM-registered sickness and disability benefit data and questionnaire data was obtained from the Danish Data Protection Agency: http://www.datatilsynet.dk/english/.
Results

Descriptive statistics

During the "wash-out" period, 133 (4.8%) of the 2,774 employees experienced the event disability pension or long-term sick leave 379 (13.7%), experienced one of the competing risks or emigrated from Denmark and did not return before 1 January 2006. This left a total of 2,639 employees (two employees experienced events or competing risks within the first week) with a total time at risk of 789,468 weeks until disability pension was granted (n=112), until competing risks (n=668) were experienced or until the subjects were right-censored (n=1,859). A total of 2,367 employees (28 employees experienced an event or a competing risk within the first week) with a total time at risk of 582,095 weeks until long-term sick leave (n=761), until competing risks (n=455) were experienced or until the subjects were right-censored (n=1,151). (Figure 1 and 2).

Table 1 shows descriptive statistics of the employees stratified according to event and exposure variables. Frequent short-term sick leave spells were more prevalent among young employees than among older colleagues in both risk populations, whereas non-frequent short-term and long-term sick leave spells were more common among old employees than among younger colleagues. Mixed sick leave spells were distributed equally across the age categories.

The proportion of employees having frequent short-term and mixed sick leave patterns was higher in the care group than in the non-care group. The prevalence of long-term sick leave was the same for both occupational groups.

The majority of employees (approximately 75%) had less than 15 sick leave days in 2004. Among the remaining 25%, the majority had a mixture of short and long spells. The mean number of unfavourable work factors was similar across the spell patterns (Table 1).
Disability pension

The unadjusted RR of being granted a disability pension among responders (n=1,978) was 1.84 (95% CI: 1.04-3.28) for employees exposed to a frequent short-term sick leave spell pattern, 2.58 (95% CI: 1.54-4.32) for employees exposed to a mixed or a long-term sick leave spell pattern, and 3.33 (95% CI: 1.56-7.12), for employees with a non-frequent-long-term sick leave spell pattern (Table 2).

Adjustment by age, occupation and number of unfavourable work factors did not alter the results except for the frequent short-term sick leave spell pattern, which became statistically insignificant. The overall difference in RR between the sick leave patterns remained statistically significantly different from one (Table 2).

The RR from the exposure of any of the sick leave patterns was not statistically significantly different from one when total sick leave was added to the model.

Long-term sick leave

The unadjusted RR of experiencing long-term sick leave among responders (n=1,797) was statistically significantly increased for all sick leave patterns compared with a non-frequent short-term spell pattern (Table 3). Adjustment by age, occupation and number of unfavourable work factors attenuated the relative cumulative incidences. The overall difference between the sick leave patterns remained statistically significantly different from one (p<0.0001). Being engaged in homecare (RR=1.37; 95% CI: 1.15-1.62) and experiencing a one-point increase in unfavourable work factors (RR=1.03; 95% CI: 1.01-1.06) independently increased the risk with respect to long-term sick leave (Table 3). Further adjustment by total sick leave did not affect the risk estimates in relation to age, occupation and unfavourable work factors. The relative cumulative incidence associated with being exposed to a frequent short-term, a mixed and a long-term sick leave spell pattern compared
with a non-frequent spell pattern was attenuated and became non-significant when adjusting for total sick leave length (Table 3).

**Discussion**

Municipal eldercare workers were followed for 6.75 years via a national register containing data on disability pensions and sickness benefits to determine if specific workplace-registered sick leave patterns in general and frequent short-term spells in particular were early predictors of being granted disability pension or/and long-term sick leave. Employees exposed to a mixture of short and long or merely long-term sick leave spells had a significantly increased RR of being granted a disability pension than employees with a non-frequent short-term sick leave spell pattern.

The risk of experiencing long-term sick leave was significantly increased for all sick leave patterns compared with a non-frequent short-term sick leave pattern. Although statistically insignificant after adjustment by total sick leave length, the result does not disprove that a frequent spell pattern is an indicator of future long-term sick leave, but sick leave length appears to be a better indicator of future reduced workability than spell frequency.

Previous studies have found that long-term sick leave spells lasting more than 14 days,[14], 28 days,[15] or 54 days,[16] increased the risk of being granted a disability pension. In this study, exposure to sick leave patterns defined as a mixture of short (1-7 days) and long (>7 days) spells or merely long spells increased the risk of being granted a disability pension. The prevalence of employees with sick leave lengths of more than 14 days (22%) was much higher in these sick leave patterns than among employees with a frequent short-term sick leave pattern (3%). This implies that the increased risk may be due to sick leave length rather than spell frequency. Unfortunately, we could draw no firm conclusions about the
independent risk of sick leave spell frequency because adjustment by sick leave length threatened the robustness of the model due to over-fitting. Hultin et al. found no increased risk of being granted a disability pension in a general population of employed persons exposed to a frequent short spell pattern defined as at least two spells lasting 1-15 days,[17]. Nor did Kivimäki et al. whose increased hazard ratio of disability pensions among female municipal employees exposed to at least three short-term (1-3 days) sick leave spells became non-significant after adjustment for long-term spells and total sick leave,[3]. However, Wallman et al.[2] and Pedersen et al.[16] found that sick leave patterns were commonly characterized by progression in both frequency and duration of sick leave spells during 16 years before disability pension. Fortunately, disability pension is a rare event, which means that prospective risk studies need either long follow-up periods or large study populations. The follow-up periods of Hultin et al. and Kivimäki et al. ranged from 2,[17] to 3.6 years,[3]; and in our study, we followed the employees for 6.75 years. These follow-up periods may be too short to detect an association between spell frequency and disability pension. Another explanation could be that spell frequency may be associated with other factors than health and that these factors may pose an independent risk for disability pension. Future studies should look into this hypothesis.

We did find an increased RR of future long-term sick leave when employees were exposed to frequent short-term, mixed, and long-term sick leave spells. This finding supports the results in studies of sick leave track records which report that such track records lead to disability pension and that frequent sick leave spell patterns pose an independent risk of future long-term sick leave,[17,18,33].

A poor working environment has previously been found to be an independent risk factor for disability pension among general working populations,[9-12] even though it should be assumed that risk is mediated by poor health. Among the eldercare workers in this study,
unfavourable work factors did not increase the risk for being granted a disability pension. This result may, however, reflect underestimation of the real figures because of non-response (25%) to the work environment questionnaire. We have previously shown that non-responders had more long-term sick leave than responders,[25] and that the risk of experiencing long-term sick leave was increased among workers who were exposed to unfavourable work factors.

A poor psychosocial working environment in itself does not cause permanently reduced workability, but it may lead to health conditions that will result in a disability pension. Thus, we did not adjust for self-reported general health in the previous analyses because it may be part of the causal pathway between sick leave pattern and disability pension. When using self-reported general health instead of sick leave patterns as the independent variable, the RR of being granted a disability pension was 4.76 (95 % CI: 2.70 - 8.14) when exposed to a fair-to-poor self-reported general health compared with a good-to-excellent health. This corresponds with findings reported in other studies,[34,35].

This study has several strengths. First, the exposure variable, i.e. sick leave patterns, was retrieved from a workplace register; second, both outcomes were identified from a national register whose data are generally believed to enjoy high validity,[36]. The DREAM register has 100% coverage of granted disability pensions in Denmark,[12]. Long-term sick leave, defined as nine consecutive sickness benefit weeks, was validated on the same study population,[25]. Information bias were therefore limited.

A third strength is the use of the pseudo values method,[31,32]. Even though a hazard ratio is the most common measure of association in the analysis of time-to-event data, a relative risk is, in general, easier to interpret than a hazard ratio. More specifically, the assumption about proportionality of hazards may not always be met; many studies do not describe if
proportionality has been checked and whether proportionality exists in fully adjusted models or merely in the unadjusted model. This may cause results to be imprecise and may possibly lead to misleading conclusions. Finally, events exceeding a prevalence of 10% make inferences from the hazard ratio more difficult because of non-equivalence with relative risk.

One important limitation was the possible selection bias introduced by non-response to the work environment questionnaire. This presumably gave rise to underestimated risk estimates of the exposure by mixed and long-term sick leave patterns. This presumption is supported by the smaller differences between unadjusted and adjusted results presented among responders in Table 2 and 3 than the differences we would have found if the analyses had been performed for non-responders and responders as one separate group.

We chose a one-year “wash-out” period to study sick leave patterns as an early indicator of disability pension and/or long-term sick leave because we wanted to eliminate confounding due to long-term sick leave immediately before events occurred,[3,4]. However, this approach may have caused underestimation of the RR of experiencing recurrence of long-term sick leave due to selection bias; approximately 40% of those who experienced long-term sick leave during the “wash-out” period had a mixed or a long-term sick leave pattern; the equivalent figure for those included in the final analyses was 20% (results not shown).

**Conclusion**

Workplace-registered frequent short-term, mixed, and long-term sick leave patterns were early indicators of future long-term sick leave. Sick leave length was, however, a better indicator of future reduced workability than sick leave spell frequency. Preventive actions should be targeted employees engaged in home-care having sick leave spells exceeding seven days, irrespective of spell frequency.
Author contributions

Christina M. Stapelfeldt conceived the study, carried out statistical analyses and drafted the manuscript. Niles T. Andersen supervised the statistical analyses. All authors participated in the design of the study, helped to draft the manuscript and interpreted the results. All authors have read, commented and approved the final manuscript.

Declaration of Conflicting Interest’

The authors declare that they have no competing interest’.
Reference List


Table 1: Description of the study participants included in the risk analyses of being granted disability pension (N=2,639) or experiencing long-term sick leave (N=2,367), respectively.

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</tr>
<tr>
<td>&lt;= 40 years</td>
<td>241 (43)</td>
<td>180 (32)</td>
<td>124 (22)</td>
<td>15 (3)</td>
<td>224 (44)</td>
<td>171 (34)</td>
<td>100 (20)</td>
<td>11 (2)</td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td>1,147 (55)</td>
<td>379 (18)</td>
<td>438 (21)</td>
<td>115 (6)</td>
<td>1,071 (58)</td>
<td>342 (18)</td>
<td>354 (19)</td>
<td>94 (5)</td>
</tr>
<tr>
<td>Occupation, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>None-care</td>
<td>520 (65)</td>
<td>125 (16)</td>
<td>115 (14)</td>
<td>42 (5)</td>
<td>487 (66)</td>
<td>116 (16)</td>
<td>96 (13)</td>
<td>38 (5)</td>
</tr>
<tr>
<td>Home care</td>
<td>868 (47)</td>
<td>434 (24)</td>
<td>447 (24)</td>
<td>88 (5)</td>
<td>808 (50)</td>
<td>397 (24)</td>
<td>358 (22)</td>
<td>67 (4)</td>
</tr>
<tr>
<td>Categorised total sick leave, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 days</td>
<td>494 (100)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>471 (100)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1-14 days</td>
<td>894 (60)</td>
<td>473 (32)</td>
<td>72 (5)</td>
<td>40 (3)</td>
<td>824 (61)</td>
<td>438 (32)</td>
<td>60 (4)</td>
<td>38 (3)</td>
</tr>
<tr>
<td>15-56 days</td>
<td>0 (0)</td>
<td>86 (17)</td>
<td>365 (73)</td>
<td>48 (10)</td>
<td>0 (0)</td>
<td>75 (18)</td>
<td>302 (72)</td>
<td>41 (10)</td>
</tr>
<tr>
<td>&gt; 56 days</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>125 (75)</td>
<td>42 (25)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>92 (78)</td>
<td>26 (22)</td>
</tr>
<tr>
<td>Number of unfavourable psycho-social work environmental factors, mean (sd) *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.52 (2.5)</td>
<td>4.96 (2.5)</td>
<td>5.34 (2.6)</td>
<td>5.24 (2.5)</td>
<td>4.46 (2.5)</td>
<td>4.93 (2.4)</td>
<td>5.33 (2.5)</td>
<td>4.89 (2.5)</td>
</tr>
<tr>
<td>Event, n (%)</td>
<td>38 (3)</td>
<td>23 (4)</td>
<td>42 (7)</td>
<td>9 (7)</td>
<td>325 (25)</td>
<td>188 (37)</td>
<td>208 (46)</td>
<td>40 (38)</td>
</tr>
<tr>
<td>Competing risk, n (%)</td>
<td>402 (29)</td>
<td>91 (16)</td>
<td>129 (23)</td>
<td>46 (35)</td>
<td>302 (23)</td>
<td>57 (11)</td>
<td>69 (15)</td>
<td>27 (25)</td>
</tr>
<tr>
<td>Censoring observations, n (%)</td>
<td>948 (68)</td>
<td>445 (80)</td>
<td>391 (70)</td>
<td>75 (58)</td>
<td>668 (52)</td>
<td>268 (52)</td>
<td>177 (39)</td>
<td>38 (36)</td>
</tr>
</tbody>
</table>

* 661 and 570, respectively did not receive/respond to the work environment questionnaire
Table 2: The relative cumulative incidence (RR) of being granted disability pension within 352 weeks for employees exposed to a frequent short-term, mixed or long-term sick leave pattern compared with a non-frequent sick leave pattern.

<table>
<thead>
<tr>
<th>pseudo-values</th>
<th>Unadjusted (n=661)</th>
<th>Unadjusted (n=1,978)</th>
<th>Adjusted * (n=1,978)</th>
<th>Adjusted ** (n=1,978)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall difference between the spell patterns</td>
<td></td>
<td></td>
<td>p=0.008</td>
<td>p=0.0008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=0.004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=0.78</td>
</tr>
</tbody>
</table>

**Sick leave pattern**

<table>
<thead>
<tr>
<th>Sick leave pattern</th>
<th>RR (95% CI)</th>
<th>RR (95% CI)</th>
<th>RR (95% CI)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 short sick leave spells</td>
<td>1.00 (1.00-1.00)</td>
<td>1.00 (1.00-1.00)</td>
<td>1.00 (1.00-1.00)</td>
<td>1.00 (1.00-1.00)</td>
</tr>
<tr>
<td>3-17 short sick leave spells</td>
<td>0.78 (0.25-2.39)</td>
<td>1.84 (1.04-3.28)</td>
<td>1.62 (0.84-3.12)</td>
<td>1.29 (0.67-2.48)</td>
</tr>
<tr>
<td>3-13 mixed sick leave spells</td>
<td>3.09 (1.44-6.63)</td>
<td>2.58 (1.54-4.32)</td>
<td>2.41 (1.39-4.17)</td>
<td>0.90 (0.12-6.54)</td>
</tr>
<tr>
<td>1-5 long sick leave spells</td>
<td>0.84 (0.11-6.31)</td>
<td>3.33 (1.56-7.12)</td>
<td>3.46 (1.34-8.93)</td>
<td>1.20 (0.15-9.56)</td>
</tr>
</tbody>
</table>

**Age**

| Age | | | |
|====|----|----------------|----------------|
| <= 40 years | | | |
| > 40 years | 1.42 (0.60-3.37) | 1.29 (0.44-3.76) | |

**Occupation**

<table>
<thead>
<tr>
<th>Occupation</th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homecare personnel</td>
<td>1.39 (0.71-2.70)</td>
<td>1.55 (0.67-3.57)</td>
<td></td>
</tr>
</tbody>
</table>

**Unfavourable work factor**

<table>
<thead>
<tr>
<th>Unfavourable work factor</th>
<th></th>
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<tbody>
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</tbody>
</table>

**Total sick leave**

<table>
<thead>
<tr>
<th>Total sick leave</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>0 days</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>1-14 days</td>
<td>1.67 (0.46-6.08)</td>
<td>2.88 (0.36-22.75)</td>
<td></td>
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<tr>
<td>15-56 days</td>
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<tr>
<td>more than 56 days</td>
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</tbody>
</table>

**Notes:**

* Adjusted for age, occupation and unfavourable work factors.

** Adjusted for age, occupation, unfavourable work factors and total sick leave.
Table 3: The relative cumulative incidence (RR) of experiencing long-term sick leave within 352 weeks for employees exposed to a frequent short-term, mixed, or long-term sick leave pattern compared with a non-frequent sick leave pattern.

<table>
<thead>
<tr>
<th>pseudo-values</th>
<th>Unadjusted (n=570)</th>
<th>Unadjusted (n=1,797)</th>
<th>Adjusted (^a) (n=1,797)</th>
<th>Adjusted (^b) (n=1,797)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>Overall difference between the spell patterns</td>
<td>p&lt;0.0001</td>
<td>p&lt;0.0001</td>
<td>p&lt;0.0001</td>
<td>p=0.19</td>
</tr>
<tr>
<td>Sick leave pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 short sick leave spells</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3-17 short sick leave spells</td>
<td>1.50 (1.13-1.98)</td>
<td>1.44 (1.21-1.71)</td>
<td>1.35 (1.12-1.62)</td>
<td>1.20 (0.99-1.46)</td>
</tr>
<tr>
<td>3-13 mixed sick leave spells</td>
<td>2.00 (1.53-2.62)</td>
<td>1.78 (1.51-2.08)</td>
<td>1.64 (1.40-1.94)</td>
<td>1.31 (0.99-1.72)</td>
</tr>
<tr>
<td>1-5 long sick leave spells</td>
<td>1.24 (0.68-2.26)</td>
<td>1.61 (1.20-2.15)</td>
<td>1.52 (1.13-2.03)</td>
<td>1.23 (0.87-1.74)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;= 40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 40 years</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Occupation</td>
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</tr>
<tr>
<td>Non-care</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homecare personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable work factor scores</td>
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<tr>
<td>Total sick leave</td>
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</tr>
<tr>
<td>0 days</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>1-14 days</td>
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</tr>
<tr>
<td>15-56 days</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>more than 56 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a (age, occupation and unfavourable work factors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b (age, occupation, unfavourable work factors and total sick leave)</td>
<td></td>
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</tr>
</tbody>
</table>
**Figure legends**

**Figure 1**: The cumulative incidence (--- 95% CI) of being granted disability pension within 352 weeks among eldercare workers, according to their sick leave pattern.

**Figure 2**: The cumulative incidence (--- 95% CI) of experiencing long-term sick leave within 352 weeks among eldercare workers, according to their sick leave pattern.
Figure 1.

Cumulative incidence of disability pension by spell length and weeks until disability pension, censoring or competing risk.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cumulative Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 short spells</td>
<td></td>
</tr>
<tr>
<td>3-17 short spells</td>
<td></td>
</tr>
<tr>
<td>2-13 mixed spells</td>
<td></td>
</tr>
<tr>
<td>1-5 long spells</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.

Cumulative incidence of long-term sick leave by spell length and weeks until long-term sick leave, censoring or competing risk.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cumulative Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 short spells</td>
<td></td>
</tr>
<tr>
<td>3-17 short spells</td>
<td></td>
</tr>
<tr>
<td>2-13 mixed spells</td>
<td></td>
</tr>
<tr>
<td>1-5 long spells</td>
<td></td>
</tr>
</tbody>
</table>

Weeks until disability pension, censoring or competing risk

Weeks until long-term sick leave, censoring or competing risk
Ph.d.-afhandlingen kan rekvireres ved henvendelse til:

MarselisborgCentret
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Tlf. 7841 4440
Mail: Inger.Hornbech@stab.rm.dk
www.marselisborgcentret.dk