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Abstract

Background: Previous literature has established associations between psychosocial working conditions and sickness absence (SA), but only a few studies have examined associations among younger employees and even fewer have examined SA of any length. This study aimed to investigate associations between psychosocial working conditions and SA spells of any length among younger employees in Denmark.

Method: A nationwide sample of 301,185 younger employees was followed in registers for on average 2.6 years. On occupational level, we assessed job insecurity, quantitative demands, decision authority, job strain, emotional demands, and work-related physical violence using job exposure matrices. Adjusted rate ratios of SA spells of any length (≥1 day) were estimated for women and men separately with Poisson models.

Results: Among women, employment in occupations with high quantitative demands, low decision authority, high job strain, high emotional demands, or high work-related physical violence was associated with high rates of SA. High emotional demands showed the strongest association with a rate ratio of 1.44 (95% CI: 1.41-1.47). Among men, the patterns were somewhat different with low decision authority showing the strongest association (1.34 [1.31-1.37]) and high quantitative demands, high job strain, and high emotional demands associated with lower rates of SA among men.

Conclusion: In a large nationwide cohort of younger employees, we found that several psychosocial working conditions were associated with SA spells of any length. Patterns resemble those of previous studies examining long-term SA in the whole working population, suggesting that these may be generalizable to SA of any length among younger employees.

Introduction

Sickness absence (SA) is a major public health concern and an established measure of health (1, 2). SA is associated with an increased risk of labour market exclusion (3) and is of great importance for both those directly affected and their employers. Across the European countries, average rates of SA vary between 3% and 6% of the working time and it is estimated that the cost of SA accounts for about 2.5% of GDP (4).

Many different factors may affect the risk of SA including environmental factors such as psychosocial working conditions. Previous studies linking psychosocial working conditions with SA have shown associations for a range of factors including job control (5-11), psychological and emotional demands (5, 9-12), job strain (8, 13), workplace violence (10, 14), and job insecurity (15).

However, previous research has mainly focused on the whole working population (5-10, 12-16) and only a few studies have examined SA in younger employees (11). Additionally, many previous studies have focused on the risk of long-term SA (5, 8, 10, 12-14) and fewer studies have focused on all length of SA (6, 7, 9, 11). This is an important gap in the existing knowledge for the following reasons: 1) Younger employees have different SA patterns compared to older employees with shorter spells of SA being more common (17, 18). Age may be an important effect modifier of the association between work environment factors and SA (11, 19), and consequently results from previous studies on older populations may be less generalizable to younger populations. 2) In recent years, policymakers in many European countries have implemented reforms aimed at delaying retirement and extending working lives (20). A study of young employees in Denmark found that accumulated exposure to low job control was associated with a higher risk of disability pension (21). With increasing retirement age, younger people in particular may be exposed to occupational exposures for longer. 3) Higher rates of SA among young employees may be a risk marker of more permanent exclusion from the labour market (3, 22). Early temporary or even permanent exclusion from the labour market may not only

affect the individual but may also has societal consequences in terms of lost productivity and payment of social benefits. Hence, identification of work-related risk factors for SA in younger employees may be considered particularly prudent and knowledge of potentially modifiable risk factors may be used to prevent SA among younger employees at the beginning of their working careers.

Therefore, this study aimed to investigate associations between psychosocial working conditions and SA among younger employees in Denmark. We did this using a register-based cohort of 301,185 young employees who entered the Danish labour market between 2010 and 2018. SA was registered on daily basis with registers and psychosocial working conditions were estimated on occupational level using job exposure matrices (JEMs) on job insecurity, quantitative demands, decision authority, job strain, emotional demands, and work-related physical violence. These six psychosocial working conditions have previously been shown to be associated with SA (5-15) and we know from previous validation that these factors can reasonably be estimated on an occupational level (23). To prevent post hoc decision-making, we published a study protocol containing detailed descriptions of the hypothesis, design, and methods (24) before data linkage.

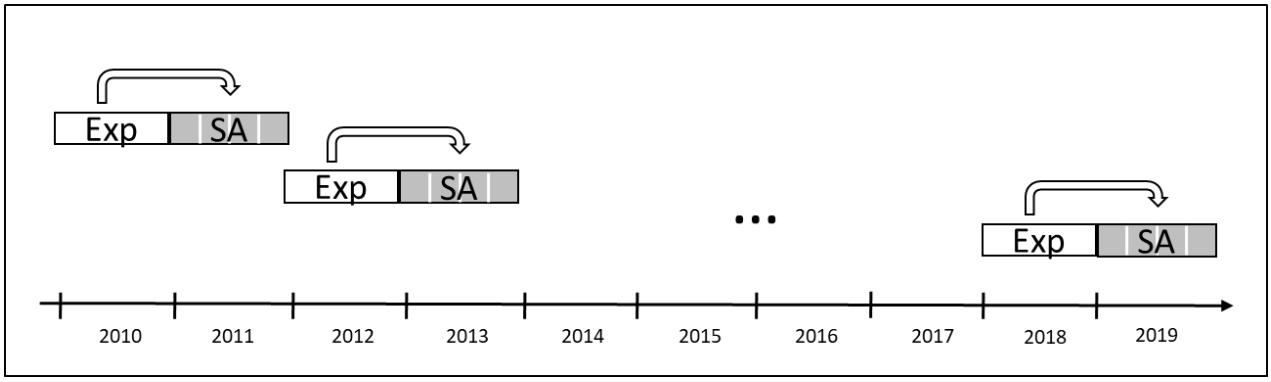
Methods

Study design

In this study, we updated the Danish Work Life Course Cohort study (DaWCo) with all younger employees (aged 15 to 30) who entered the Danish labour market for the first time between 2010 and 2018. Details of DaWCo have been published elsewhere (25). Briefly, DaWCo is an open nationwide cohort following individuals from labour market entry until end of follow-up (year 2019) in administrative Danish registers. In DaWCo working conditions are measured on occupational level using job exposure matrices (JEMs), a common method to quantify occupational exposure based on job title when individual measurement from e.g. surveys are not possible (26). SA was measured with data from the Danish Register of Work Absence (RoWA), which is a combination of two registers;

Statistics Denmark's 'Absence and Employment'-register and 'Periods of Absence'-register (27). RoWa includes information on the daily registered absence for all public employees, all private employees in large companies (>250 employees), and a yearly representative sample of private employees from middle-sized companies (10-250 employees). A prospective design ensured exposure and covariates were measured the year before (**figure 1**).

Figure 1 Study design. Exp (assessed working conditions), SA (sickness absence)



Population

In total, 579,114 individuals aged 15 to 30 entered the Danish labour market for the first time between 2010 and 2018. We were able to follow 301,778 (52 %) employees at some point during follow-up in RoWA. We excluded individuals who emigrated (n=397) or received a disability pension (n=150) before or in the baseline year (first available year in RoWA). We further excluded 46 individuals with missing information on sex. Thus, the final study population consisted of 301,185 individuals (160,104 women and 141,081 men) with 771,976 person-years at risk. The mean follow-up time was 2.6 years (interquartile range [IQR] 1.0 to 3.7).

Assessment of psychosocial working conditions

Psychosocial working conditions on job insecurity, quantitative demands, decision authority, job strain, emotional demands, and work-related physical violence was estimated with JEMs. The construction and validation of the JEMs are presented in detail elsewhere (23) and in **Supplementary material Appendix 1**. In short, the JEMs are constructed based on self-reported exposure data from the

Working Environment and Health in Denmark study (WEHD) (28). WEHD is a national questionnaire-based survey on working conditions and health conducted among a representative sample of employees working in Denmark aged 18 to 64 (28). The estimated values from the JEMs were assigned to each individual in the DaWCo based on yearly job title (DISCO-08), sex, and age. We categorised the estimated values of the six psychosocial working conditions into groups based on quartiles of the yearly distribution for women and men separately. **Supplementary material Appendix 1, table S2** presents the 10 job groups with the highest average level or risk of the six psychosocial working conditions.

Assessment of SA

We registered all spells of SA repeatedly from 1. January 2011 until end of follow-up 31 December 2019, but disregarded SA due to caring for a sick child and SA related to injuries. To account for potential seasonal variation in rates of SA spells, we quantified the number of SA spells of any length (≥1 day) in three-month windows based on the start date of the SA spell (January-March, April-June, July-September, and October-December).

In Denmark, employers are obligated by law to pay salary for the first 30 days if an employee becomes unable to work due to illness or injury. After the 30th day the municipality pays SA benefits (29).

Assessment of covariates

We included a range of register-based covariates. **Supplementary material appendix 2 table S3** present an overview of categorisations and source. We included the following sociodemographic covariates: age, migration background (no migration background, immigrant, or descendent of immigrants), and cohabitation. We included information on sector of employment (public or private) to account for the uneven distribution of private employees in RoWA. To account for the cohort design we included calendar year, year of labour market entry, year since labour market entry, and years with employment. To account for socioeconomic position, we included personal disposable income.

Furthermore, we included information on the number of health services used and information on hospital-diagnosed chronic or mental disorders prior to labour market entry. Additionally, we included information on physical work demands measured on occupational level using a JEM (23). Lastly, as previous SA might affect current exposure and risk of future SA (30), we included information on any SA spells the year before exposure, any long-term SA spells (>30 days) the year before exposure, and an indicator of more than ten days of SA in the year before exposure.

For supplementary analyses we defined four stratification variables: educational attainment, industry, sector and age. We categorised educational attainment into three groups as primary and lower (≤10 years of education), upper secondary and short cycle tertiary (11-15 years), and bachelor or higher (≥15 years). We categorised industries into 10 groups (Wholesale and retail trade, Human health and social work, Accommodation and food service activities, Education, Travel agent, cleaning and other operational services, Public administration and defence compulsory social security, Manufacturing, Construction, Other industries, and Unknown). We categorised sector of employment into public or private sector and used three age groups (15-19, 20-24, and ≥25).

Statistical analyses

First, we calculated the rate of SA spells of any length (≥1 day) per person-year to assess the crude association for job insecurity, quantitative demands, decision authority, job strain, emotional demands, and work-related physical violence. Second, using a multilevel Poisson regression model, we estimated the rate ratio (RR) and 95% confidence interval (CI) quantifying the association between the six psychosocial working conditions and the number of SA spells during follow-up. The multilevel approach accounts for the repeated measurement of SA and covariates on an individual level and working conditions on an occupational level (31). All analyses were conducted separately for women and men. Periods of non-employment during follow-up where considered as time not at risk. We treated migration, disability pension, and death as absorbing states, and individuals for whom these

occurred were only considered at risk until the time of the first occurrence. We included a scale parameter to account for over dispersion and used the logarithm of the time at risk as an offset variable to account for unequal follow-up time as suggested in the literature (32). We present a minimally and a fully adjusted model. The minimally adjusted model included covariates related to the JEM (age) and the cohort design (calendar year, year of labour market entry, years since labour market entry, and years with employment). The fully adjusted model further included sociodemographic covariates (migration background, cohabitation, and sector of employment), socioeconomic position (disposable personal income), health (health services use, existing chronic and mental disorders), physical work demands, and information on previous SA.

All covariates except sex, migration background, year of labour market entry, and existing chronic and mental disorders were included as time-varying variables.

Supplementary analyses

In supplementary analyses, we estimated fully adjusted rates of SA spells of >7 days and of SA spells of >30 days for each of the six psychosocial working conditions. We conducted four fully adjusted stratified analyses for SA spells of any length by educational attainment, industry, sector of employment, and age group. During follow-up some of the young employees included in the cohort was employed while they were under education or training. To ensure higher generalisability between individuals we conducted a supplementary analyses excluding years with employment while under education.

Lastly, we conducted a quantitative bias analysis to estimate the extent of misclassification of exposure derived from the use of JEMs to assessed psychosocial working conditions. This analysis produces a bias corrected estimate under the assumption of exposure measured without misclassification. A comparison of the bias-adjusted estimates against the observed estimates provides an idea of the magnitude and direction of the expected bias due to misclassification of exposure. The analyses was

conducted using the method and spreadsheet developed by Lash, Fox, & Fink (33). The quantitative bias analysis is described and presented in detail in **supplementary material appendix 3**.

Results

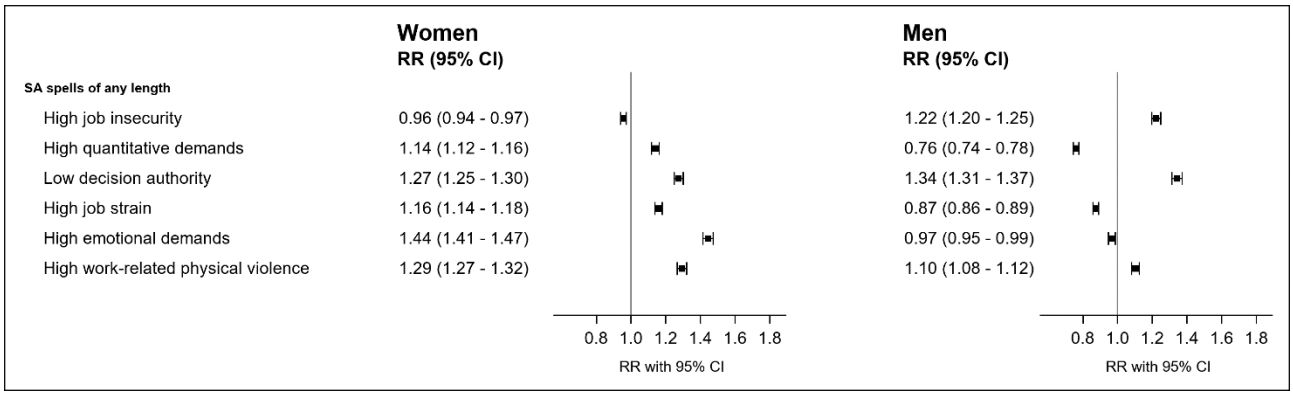
Table 1 shows the time-invariant characteristics of the participants. The mean age at labour market entry was 18 (SD: 3.7, IQR: 16 to 20) for women and 19 (SD: 4.0, IQR: 16 to 20) for men. The majority had no migration background (women: 75.3%, men: 72.9%). Having suffered from chronic somatic diseases prior to labour market entry was higher among men (8.0%) than women (5.7%). Few participants had multiple chronic diseases (0.2% and 0.3%) and of those the vast majority had asthma (90%). Any mental disorders prior to labour market entry were around 7% for both women and men. **Figure S1 to S6 in supplementary material appendix 4** illustrates trends over time since labour market entry for the time-variant covariates. In the first year of employment most participants were employed in "Wholesale and retail trade" and during follow up employment in "Human health and social work" became more prevalent among women and employment in "Construction" and "Public administration" became more prevalent among men (**supplementary material appendix 4, figure S3**).

Psychosocial working conditions and rates of SA spells

Table 2 presents number of SA spells and minimally and fully adjusted RR (95% CI) for SA spells of any length for each of the six psychosocial working conditions. Among women, during 426,068 person-years, we identified 693,677 spells of SA of any length (≥ 1 day) (1.6 spells per person-years). Among men, during 345,908 person-years, we identified 446,584 spells of SA (1.3 spells per person-years) (**table 2**). The mean length of SA was 3.1 (IQR: 1.0 to 2.5) among women and 2.8 (IQR: 1.0 to 2.5) among men. **Figure 1** presents fully adjusted RR for SA spells of any length among employees in jobs with high levels of the six psychosocial working conditions compared to employees in job with low levels of exposure. Among women, the fully adjusted model showed higher rates of SA spells of any

length among employees who worked in jobs with high quantitative demands (RR: 1.12 [95% CI: 1.10-1.14]), low decision authority (1.23 [1.21-1.25]), high job strain (1.12 [1.10-1.14]), high emotional demands (1.44 [1.41-1.46]), and high work-related physical violence (1.28 [1.26-1.31]). We found slightly lower rates of SA among employees working in jobs with high job insecurity (0.95 [0.94-0.97]) (**figure 2**). Among men, we found a different pattern, with higher rates of SA spells associated with high job insecurity (1.22 [1.20-1.25]), low decision authority (1.31 [1.28-1.34]), and high work-related physical violence (1.10 [1.08-1.13]) and lower rates of SA associated with high quantitative demands (0.76 [0.75-0.78]), high job strain (0.88 [0.86-0.89]), and high emotional demands (0.96 [0.94-0.98]) (**figure 2**). Adjustment for previous SA had overall a small effect on the associations (**Supplementary material appendix 5, table S6**).

Figure 2 Fully adjusted rate ratio (RR) (95% CI) for the associations between psychosocial working conditions and sickness absence (SA) of any length (≥1 day) among women (n = 160,104) and men (n = 141,081). RR adjusted for age, migration background, cohabitation, sector of employment, labour market entry, years since labour market entry, years with employment, disposable income, health services use, exiting chronic and mental disorders, physical work demands, and previous SA the year before exposure



Supplementary analyses

Overall we found similar associations between the six psychosocial working conditions and SA spells of any length, SA spells of >7 days and SA spells of >30 days (**Supplementary material appendix 6, figure S7**). The most pronounced difference was among men, where we found that high emotional demands were associated with slightly higher rates of SA spells of >30 days with a RR of 1.11 (1.00-1.24) compared to a RR of 0.97 (0.95-0.99) for SA spells of any length.

In the stratified analysis, we found overall similar association between the six psychosocial working conditions and rates of SA across education level (**Supplementary material appendix 6, table S8**). However, among women with a bachelor degree or higher educational attainment associations was strongest for low decision authority (1.57 [1.47-1.67]). Moreover, employment in occupations with high job insecurity was only associated with SA among employees with low educational attainment (1.07 [1.05-1.09]). We found stronger associations between the six psychosocial working and SA among employees employed in industries with a high degree of contact with patient or client and among employees in the public sector (**Supplementary material appendix 6, table S9 and S10**). Similar associations was found across age groups and when we excluded years with non-regular employment and years while under education (**Supplementary material appendix 6, table S11 and 12**). Quantitative bias analyses showed that when we accounted for potential misclassification of exposure bias adjusted RR for most of the psychosocial working condition deviated further from unity. (**Supplementary material appendix 3, table S4**).

Discussion

Summary and interpretation of main findings

In a Danish nationwide sample of 301,212 younger employees followed for 771,976 person-years, we found that five out of six psychosocial working conditions were associated with higher rates of SA spells of any length (≥1 day) among women and three out of six psychosocial working conditions among men. The five conditions were high quantitative demands, low decision authority, high job strain, high emotional demands, and high work-related physical violence among women and high job insecurity, low decision authority, and high work-related physical violence among men. Lower rates of SA was found among women employed in occupations with high job insecurity and among men employed in occupations high quantitative demands, high job strain, high emotional demands. Overall, the patterns were similar across educational attainment and age, but deviated across industry and sector

of employment. In supplementary analysis we found similar associations with SA spells >7 days and SA spells of >30 days compared to SA spells of any length. This suggest that results from previous studies on long-term SA may to some extent be generalizable to SA spells of any length.

Contrary to our hypotheses, we found lower rates of SA among men employed in occupations with high quantitative demands and high job strain compared to employment in occupations with low levels, respectively. Previously, job groups variance explained by the applied JEMs have been published (23) and for quantitative demands the Intraclass Correlation Coefficient (ICC) was overall lower among men (0.10) compared to women (0.14). Showing that a lower degree of variance in quantitative demands was explained by job groups among men compared to women. Furthermore, the applied JEM on quantitative demands has previously been found associated with a lower risk of musculoskeletal pain on the occupational level but not the individual level (23). Together, this suggest, that the applied JEM for quantitative demands may be less valid among men. Consequently, results should be interpreted with caution. We found that high levels of emotional demands were associated with higher rates of SA spells among men working in industries with a high level of contact with patients or students (e.g. human health, social work or education). This may explain the lower SA rates among men employed in occupations with high emotional demands, as fewer men were employed in industries with patient or student contact.

Comparison with previous studies

Only few studies have investigated the associations between psychosocial working conditions and SA among younger employees. A Swedish twin study found that JEM assessed job demands was associated with a higher risk of SA of 1-30 days and SA of 31-365 days among younger employees aged 18-35 (11). A Finish study of employees within the public sector found higher but insignificantly risk of SA (10-365 days) due to any diagnose for high demands and low job control (19). Despite some

methodological differences between the two mentioned studies and the present study, the findings corresponds.

Furthermore, this study adds to existing literature by showing similar association across SA spells of any length, SA spells of >7 days, and SA spells of >30 days among younger employees. SA of different lengths have previously been investigated as mutually exclusive outcomes (5, 9) and in a recent study of Danish hospital employees, Mathisen et al. (2022) found a wide range of psychosocial working conditions associated with sickness absence of 1-3 days, 4-28 days and >28 day with overall similar association across the three separate SA outcomes (9). This finding is in line with the findings from the present study.

In the present study we refrained from analysing short- and long-term SA as mutually exclusive outcomes because this approach to some degree could cause biased associations due to selection bias (34). This approach involves estimating associations between exposure and spells of short-term SA in a population were spells of SA are unable to become long-term. Estimates based on such population may not be easily generalized to working population were the eventual length of a SA spell is not known before the end of the spell. However, as both approaches have shown similar associations across different length of SA we believe this strength the suggestion that results from previous studies on long-term SA to some extent can be generalizable to SA spells of any length among younger employees.

The present study was conducted on a register-based cohort without self-reported data on the psychosocial work environment, and consequently, the findings from this study do not account for the personal experience of the working environment. Even though previous studies have linked psychosocial working conditions with SA, the majority of these studies have been conducted on either the entire working population or a working middle-aged population (8, 13). Higher rates of SA among younger employees may be an early sign of temporary or even permanent exclusion from the labour market (3, 22) which not only affects the younger employee but may also lead to lost productivity and

increasing payment of social benefits. Hence, more knowledge on how psychosocial working conditions measured on an individual level are associated with SA among younger employees, still remain an important topic for further research.

Strength and limitations

This study has several strengths. Combining a large register-based cohort of more than 300,000 younger employees with JEM on working conditions provided us with a unique opportunity to focus on the association between working conditions and SA spells of any length among younger employees and to conduct relevant stratified analyses. Furthermore, we published a detailed study protocol before we carried out the analyses (24), which ensured that the analytical strategy were not affected by post-hoc decisions. Age-group stratified analyses and analyses excluding years with employment while under education was not specified in the protocol.

This study also has some limitations. Even though the JEM approach might limit reporting bias, JEMs may introduce misclassification of exposure (26). Employees in jobs with high level of adverse psychosocial working conditions may not actually be exposed and conversely, employees in jobs with low level may not actually be non-exposed. However, quantitative bias analyses showed that the estimated association might be a conservative suggestion of the true associations. We did not investigate all aspects of the psychosocial work environment, as we did not include working conditions such as social support which also been found associated with SA (5). Job title aggregated measurement of social support have previously shown low validity(35) and it reasonable to assume that the level of social support may depend less on job title and may vary more across work units. The included JEMs was constructed based on a nationwide sample of Danish employees age 18 to 64. JEMs based on younger employees may have provided different results. However, age stratified analyses showed no indication of the JEMs not being suitable among younger employees.

In the analysis we adjusted for a range of potential confounders. However, we were limited to data available in registers and hence we were not able to adjust for individual risk factors for SA such as health behaviours (36). In the fully adjusted analyses, we included information on previous SA which might increase the risk of over-adjustment as previous SA could be a consequence of previous adverse working conditions. Stepwise adjustment revealed that previous SA for most working conditions had a small attenuating effect on the associations which means that in case of over-adjustment the presented estimates might be slightly conservative. Moreover, we held back from adjusting the main analysis for education as we expected this to cause a substantial over-adjustment as the JEMs was assessed based on job title which is highly correlated with education. To account for socioeconomic differences we adjusted for disposable income, but some residual confounding from socioeconomic positions may still be present.

Conclusion

In a large nationwide cohort of younger employees, we found that several psychosocial working conditions were associated with SA spells of any length. Associations differed among women and men, with employment in occupations with high levels of emotional demands showing the strongest association among women, and employment in occupations with low levels of decision authority showing the strongest association among men. Our findings resembles those of previous studies examining long-term SA in the whole working population, suggesting that these may be generalizable to SA of any length among younger employees.

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