

Emotional demands at work and risk of long-term sickness absence in 1.5 million employees in Denmark: a prospective cohort study on effect modifiers



Elisabeth Framke, Jeppe Karl Sørensen, Kristina Alexanderson, Kristin Farrants, Mika Kivimäki, Solja T Nyberg, Jacob Pedersen, Ida E H Madsen, Reiner Rugulies



Summary

Background High emotional demands at work can affect employees' health and there is a need to understand whether such an association might be modified by other working conditions. We aimed to examine emotional demands at work as a risk factor for long-term sickness absence and analyse whether influence, possibilities for development, role conflicts, and physical demands at work might modify this risk.

Methods We did a nationwide, population-based, prospective cohort study in Denmark and included employed individuals who were residing in Denmark in 2000, aged 30–59 years, who had complete data on age, sex, and migration background, with information on emotional demands and possible effect modifiers from job exposure matrices, and covariates and outcome (sickness absence) from population registers. Individuals with long-term sickness absence (≥ 6 weeks of consecutive sickness absence) between Jan 1, 1998, and Dec 31, 2000, and self-employed individuals were excluded. We assessed long-term sickness absence during a 10-year period from Jan 1, 2001, to Dec 31, 2010. Using Cox regression, we estimated hazard ratios (HRs) and 95% CIs and tested interaction as departure from additivity, estimating relative excess risk due to interaction (RERI). Multivariable adjusted models included sex, age, cohabitation, migration background, and income.

Findings 1521352 employed individuals were included and contributed data between Jan 1, 2000, and Dec 31, 2010. During 11919021 person-years (mean follow-up 7.8 years), we identified 480685 new cases of long-term sickness absence. High emotional demands were associated with increased risk of long-term sickness absence compared with low emotional demands, after adjusting for age, sex, cohabitation, migration background, income, and the four possible effect modifiers (adjusted HR 1.55 [95% CI 1.53–1.56]). The association between high emotional demands and risk of long-term sickness absence was stronger in a synergistic way when individuals were also exposed to low possibilities for development (RERI 0.35 [95% CI 0.22–0.47]; 28.9 additional cases per 1000 person-years) and high role conflicts (0.13 [0.11–0.15]; 22.0 additional cases per 1000 person-years). No synergy was observed for influence and physical demands at work.

Interpretation People in occupations with high emotional demands were at increased risk of long-term sickness absence. Our findings on synergistic interactions suggest that, in emotionally demanding occupations, increasing possibilities for development and reducing work-related role conflicts might reduce long-term sickness absence. Further interventional studies are needed to confirm or refute this hypothesis.

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Introduction

Emotional demands at work concern aspects of work that require sustained emotional effort from employees.^{1,2} High levels of emotional demands characterise some professions, such as health care, education, and social work.^{3,4} Clients in such professions often include individuals in difficult or distressing situations; for example, patients with severe illnesses, older patients in dementia units, or children living in socially disadvantaged circumstances. Public service work requires empathy and some emotional involvement with the clients,^{5,6} and the emotional demands of such work has

been linked with poor mental health.⁷ Emotional demands at work have also been associated with an increased risk of long-term sickness absence.^{4,8–10}

Concerns have been raised that these associations might be inflated by reporting bias in the assessment of emotional demands.⁴ One previous study reported a higher risk of long-term sickness absence in those with high levels of emotional demands at work when addressing this bias by comparing perceived and content-related measurements of emotional demands, adjusting estimates for baseline psychological state, and aggregating individual-level emotional demands to the

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National Research Centre for the Working Environment, Copenhagen, Denmark (E Framke PhD, J K Sørensen MSc, J Pedersen PhD, I E H Madsen PhD, Prof R Rugulies PhD); Division of Insurance Medicine, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden (Prof K Alexanderson PhD, K Farrants PhD); Department of Epidemiology and Public Health, University College London, London, UK (Prof M Kivimäki FMedSci); Department of Public Health, Clinicum, Faculty of Medicine, University of Helsinki, Helsinki, Finland (Prof M Kivimäki, S T Nyberg PhD); Finnish Institute of Occupational Health, Helsinki, Finland (Prof M Kivimäki); Department of Public Health and Department of Psychology, University of Copenhagen, Copenhagen, Denmark (Prof R Rugulies)

Correspondence to:
Dr Elisabeth Framke,
National Research Centre for the Working Environment,
Copenhagen DK-2100, Denmark
elf@nfa.dk

Research in context

Evidence before this study

Emotional demands at work concern aspects of work that require sustained emotional effort from employees and are associated with an increased risk of long-term sickness absence. In several occupations, such as health care, education, and social work, a high level of emotional demand is unavoidable. We searched PubMed and Web of Science on May 13, 2021, for articles published in English with titles or abstracts (on PubMed in the past 10 years) or titles (on Web of Science from Jan 1, 2011, to May 13, 2021) that included the search terms (“emotional demands” OR “emotion*”) AND (“sickness absence” OR “sick leave” OR “absenteeism”) AND (“influence” OR “decision authority” OR “decision latitude” OR “job control” OR “possibilities for development” OR “skill discretion” OR “developmental opportunities” OR “role conflicts” OR “physical demands” OR “physical workload” OR “ergonomic demands”). To our knowledge, this study is the first to examine whether influence, possibilities for development, role conflicts, and physical demands at work modify the risk of long-term sickness absence in relation to high emotional demands at work.

Added value of this study

In this population-based prospective cohort study, which included 1521352 employees in Denmark, we used national registers and job exposure matrices to investigate possible

effect modifiers for the association between emotional demands at work and long-term sickness absence during a mean follow-up of 7·8 years. Emotional demands at work were associated with a 1·5-fold increased risk of long-term sickness absence. This association was exacerbated when individuals were also exposed to low possibilities for development or high role conflicts at work. Low influence and high physical demands at work did not exacerbate the association.

Implications of all the available evidence

Employees in occupations with high emotional demands are at increased risk of long-term sickness absence. Our observational findings suggest that increasing possibilities for development and preventing or reducing high work-related role conflicts in emotionally demanding occupations might be a successful approach for reducing long-term sickness absence. The association between emotional demands at work and long-term sickness absence does not appear to be affected by low influence or high physical demands at work. Further interventional studies, including randomised controlled trials, are needed on these and other psychosocial factors at work that might modify the risk of long-term sickness absence in relation to high emotional demands, to evaluate the effectiveness of such interventions in real-life settings.

occupational level.⁴ However, few large-scale studies have examined the association between emotional demands at work and long-term sickness absence with non-self-reported data.

A further limitation of previous studies on emotional demands at work relates to understanding of effect modifiers. In several occupations, such as health care, education, and social work, a high level of emotional demand is often a part of the job and therefore it might be difficult to reduce exposure to emotional demands. Consequently, it is important to identify other work factors, which are amenable to change, that might modify the potential harmful effects of high emotional demands. Possible effect modifiers might include influence, possibilities for development, role conflicts, and physical demands at work. In the psychosocial work environment literature, the most widely used concept is the concept of job strain (demand–control model), which assumes that work is particularly hazardous if psychological demands are high and job control is low.¹¹ Psychological demands might partly overlap emotional demands, whereas job control is a composite variable consisting of decision authority (resembling influence at work) and skill discretion (resembling possibilities for development). When influence is low, individuals have fewer possibilities for handling emotional demands (eg, by prioritising or delegating certain work tasks). Low possibilities for development inhibit individuals from

learning and acquiring and using skills, and therefore deprive them of positive experiences that might partly compensate for the strain of high emotional demands. Furthermore, a high level of role conflicts adds an additional burden of complexity to work that might overload workers who also have to handle high emotional demands; and a high level of physical demand depletes workers of energy that might be needed for dealing with high emotional demands. However, we are not aware of any previous studies that have tested these hypotheses.

We aimed to test two hypotheses: first, whether people in occupations with high emotional demands at work are at increased risk of long-term sickness absence and second, whether high emotional demands are associated with risk of long-term sickness absence in a synergistic way in people in occupations where influence and possibilities for development are low and role conflicts and physical demands are high.

Methods

Study design and participants

We did a nationwide, population-based, prospective cohort study in Denmark and included employed individuals with information on emotional demands and effect modifiers from job exposure matrices, and on long-term sickness absence from national health registers. We used data from the Job Exposure Matrix Analyses of Psychosocial Factors and Healthy Ageing in Denmark

(JEMPAD) cohort—a nationwide, register-based cohort with information on employment, psychosocial factors at work, health, labour market attachment, and socio-demographics.¹² JEMPAD included all employed individuals (excluding self-employed individuals) who were residing in Denmark in 2000, aged 30–59 years, who had complete data on age, sex, and migration background. Individuals with long-term sickness absence (≥ 6 weeks of consecutive sickness absence) between Jan 1, 1998, and Dec 31, 2000, were excluded.

As JEMPAD did not include individual-level data on working conditions, we ascertained data on emotional demands, influence, possibilities for development, role conflicts, and physical demands at work with job exposure matrices that we created in the Danish Work Environment Cohort Study (DWECS).^{13,14} Outcome and covariates were ascertained with individual-level register-based data. All variables were ascertained at baseline in 2000. Outcome was ascertained from Jan 1, 2001, to Dec 31, 2010.

The study was approved by the Danish Data Protection Agency through the joint notification of the National Research Centre for the Working Environment (2015-57-0074). All data are stored in a protected server environment hosted by Statistics Denmark. In Denmark, studies that are based on questionnaire and register data only do not require approval from the National Committee on Health Research Ethics. In DWECS, informed consent was provided by the participants when filling in the questionnaire. In JEMPAD, which was register-based, informed consent was not required.

Procedures

We measured emotional demands at work at baseline in 2000 in the JEMPAD cohort with a job exposure matrix that we created in DWECS (appendix pp 2–5). DWECS is a survey on working conditions and health in a randomly selected sample of the workforce in Denmark from 1990 to 2010.^{13,14} Pooling data from the 2000 and 2005 waves of DWECS, we included the three items on emotional demands at work and constructed a scale by calculating the mean of the items (appendix pp 4–5). Using multilevel modelling, we constructed the job exposure matrix based on the mean values of emotional demands at work as the predicted level of emotional demands for the given occupational group (coded according to DISCO-88, the Danish version of the International Standard Classification of Occupations [ISCO]-88 system),¹⁵ sex, age, and DWECS year (2000 or 2005). Using the year 2000-specific job exposure matrix, we assigned the predicted level of emotional demands to all individuals in the JEMPAD study population at baseline in 2000, according to occupational group, sex, and age. We categorised individuals into four exposure groups on the basis of the quartiles of the distribution of the exposure. We defined individuals in the highest quartile as exposed to high emotional demands and individuals

in the three remaining quartiles as exposed to low emotional demands. More information on DWECS items, scale, and job exposure matrix construction is provided in the appendix (pp 2–5).

We measured influence, possibilities for development, and physical demands at work as effect modifiers in JEMPAD in 2000 with job exposure matrices, based on information from DWECS and constructed using the same approach as was used for the job exposure matrix on emotional demands. We constructed the job exposure matrix for role conflicts on the basis of one DWECS item that was dichotomised and then modelled as the predicted probability of role conflicts for the given occupational group, sex, age, and DWECS year. For each variable, we dichotomised individuals as either no exposure or as adversely exposed, meaning exposed to low influence (lowest quartile), low possibilities for development (lowest quartile), high role conflicts (highest quartile), and high physical demands (highest quartile; appendix p 3).

As measures for interaction on an additive scale¹⁶ were developed for risk factors rather than preventive factors, we defined low values of the two preventive factors (influence and possibilities for development) as risk factors.¹⁷ Thus, the stratum with the lowest risk became the reference category when considering two factors jointly¹⁷—ie, low emotional demands combined with high influence, high possibilities for development, low role conflicts, or low physical demands, respectively (double-unexposed groups). By contrast, the double-exposed groups were high emotional demands combined with low influence, low possibilities for development, high role conflicts, or high physical demands, respectively.

To assess long-term sickness absence, we linked JEMPAD to the Danish Register for Evaluation of Marginalization,¹⁸ which includes weekly information on all social transfer payments in Denmark since 1991. We defined long-term sickness absence as 6 weeks or longer of consecutive sickness absence. We assessed long-term sickness absence during a 10-year period from Jan 1, 2001, to Dec 31, 2010.

Potential confounders were measured in JEMPAD at baseline in 2000 and included sex, age, cohabitation, migration background, and income, retrieved from population-based registers,^{19,20} as these variables have shown associations with long-term sickness absence in previous studies.^{21–23} Cohabitation was measured as single versus married or cohabiting. For migration background, we used the classification of Statistics Denmark's population register, distinguishing between Danish origin (the whole population except immigrants and descendants of immigrants), immigrants (born abroad and none of the parents were either Danish citizens or born in Denmark), and descendants of immigrants (born in Denmark and none of the parents were either Danish citizens or born in Denmark). We

See Online for appendix

Participants (n=1 521 352)	
Sex	
Female	731 540 (48.1%)
Male	789 812 (51.9%)
Age, years	43.7 (8.4)
Cohabitation	
Yes	1 138 049 (74.8%)
No	379 795 (25.0%)
Missing	3 508 (0.2%)
Migration background	
Danish origin	1 453 371 (95.5%)
Immigrant	65 721 (4.3%)
Descendant of immigrants	2 260 (0.1%)
Household income, €	43 565 (37 998)
Household income category, €	
Low, <20 000	1 022 31 (6.7%)
Medium-low, 20 000–39 999	5 276 15 (34.7%)
Medium-high, 40 000–59 999	6 499 32 (47.7%)
High, ≥60 000	1 530 84 (10.1%)
Missing	88 490 (5.8%)
Data are n (%) or mean (SD).	
Table 1: Baseline characteristics in the year 2000	

measured income as the annual disposable household income in euros (after tax), categorised into deciles based on the distribution within the study population.

Statistical analysis

After confirming by visual inspection of survival plots that proportional hazard assumptions were not violated, we used Cox regression to estimate hazard ratios (HRs) and 95% CIs for the association between high emotional demands at work at baseline in 2000 and first episode of long-term sickness absence during follow-up from Jan 1, 2001, to Dec 31, 2010. We censored due to retirement (early, disability, or statutory), emigration, death, or end of study (Dec 31, 2010), whichever came first. We fitted three models. Estimates were adjusted for sex and age (model one), and further adjusted for cohabitation, migration background, and income (model two). In model three, we further adjusted for the four other working conditions: influence, possibilities for development, role conflicts, and physical demands at work. We also analysed the associations between low influence, low possibilities for development, high role conflicts, or high physical demands, respectively, and risk of future long-term sickness absence by fitting the three models.

To quantify if the association between high emotional demands and risk of long-term sickness absence was modified by influence, possibilities for development, role conflicts, or physical demands, we tested the interaction effects defined as departure from additivity as recommended in STROBE guidelines.²⁴ For each of the

four effect modifiers, we analysed the separate effects of emotional demands and the effect modifier and their joint effects, each relative to no exposure, and calculated the relative excess risk due to interaction (RERI).¹⁶ To inform decision makers about the number of additional cases for the combinations of emotional demands with each of the effect modifiers, we multiplied the estimated HR by the number of cases per 1000 person-years in the reference category and calculated the differences in number of cases in the reference group versus the exposure groups.

As proposed by Knol and VanderWeele,²⁵ we also present results for high emotional demands and risk of long-term sickness absence across strata of each of the four effect modifiers. In sensitivity analyses we repeated all analyses with follow-up until Dec 31, 2001 (ie, using a 1-year follow-up), similar to the follow-up duration in previous studies on long-term sickness absence in Denmark.^{4,26} We further analysed effect modification without adjusting for other working conditions and with dichotomising working conditions by median split instead of by the highest or lowest quartile.

All analyses were done using SAS version 9.4.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

1 680 214 individuals with complete data were identified from the JEMPAD cohort. 1 588 62 individuals had long-term sickness absence between Jan 1, 1998, and Dec 31, 2000, and were excluded. 1 521 352 employed individuals (789 812 [51.9%] men and 731 540 [48.1%] women) were included and contributed data between Jan 1, 2000, and Dec 31, 2010 (table 1). The mean age at baseline was 43.7 years (SD 8.4). During 11 919 021 person-years (mean follow-up 7.8 years) we identified 480 685 new cases of long-term sickness absence. We censored 147 863 individuals due to retirement, 27 915 due to emigration, and 13 151 due to death.

After adjustment for age and sex, high emotional demands were associated with an increased risk of long-term sickness absence compared with low emotional demands (HR 1.23 [95% CI 1.23–1.24]; table 2). After further adjustment for cohabitation, migration background, income, and the four other working conditions (effect modifiers), the estimate increased (1.55 [1.53–1.56]). Estimates were similar for men and women (appendix p 8).

The RERI was greater than 0 for possibilities for development (RERI 0.35 [95% CI 0.22 to 0.47], 28.9 additional cases per 1000 person-years) and role conflicts (0.13 [0.11 to 0.15], 22.0 additional cases per 1000 person-years) at work, indicating more than additive interaction (ie, synergism) in the double-exposed

groups. The RERI was less than 0 for influence (−0.25 [−0.28 to −0.23] and physical demands (−0.41 [−0.45 to −0.36]), indicating less than additive interaction (ie, antagonism) in the double-exposed groups (table 3).

When estimates were stratified by high and low values of the other four work environment factors, high emotional demands were associated with a higher risk of long-term sickness absence in all strata (appendix p 9).

In sensitivity analyses, the synergistic interaction between high emotional demands and low possibilities for development remained robust when follow-up was for 1 year instead of 10 years (appendix p 11) and when the estimates were not adjusted for other working conditions (appendix p 12). When working conditions were dichotomised by median split, the synergistic interaction between high emotional demands and low possibilities for development disappeared (appendix p 13). The synergistic interaction between high emotional demands and high role conflicts remained robust when working conditions were dichotomised by median split (appendix p 13), but not when follow-up was limited to 1 year (appendix p 11) and when estimates were not adjusted for other working conditions (appendix p 12).

Discussion

In this study based on a cohort of 1521352 employed individuals in Denmark, men and women working in emotionally demanding occupations were found to be at increased risk of long-term sickness absence compared with those in occupations with low emotional demands. Additive interaction analyses indicated synergism (ie, a higher than additive risk), for double exposure to high emotional demands and low possibilities for development (that remained robust in two of three sensitivity analyses) and double exposure to high emotional demands and high role conflicts (that remained robust in one of three sensitivity analyses). With regard to high emotional demands and low influence and high emotional demands and high physical demands, we identified antagonism (ie, a lower than additive risk associated with double exposure).

These findings support smaller-scale studies that have reported that high emotional demands at work are a risk factor for long-term sickness absence.⁴ As we used a job exposure matrix-based approach, our findings are unlikely to be affected by reporting bias. To our knowledge, with 1.5 million participants and more than 11.9 million person-years of follow-up, this study is by far the largest study so far on emotional demands and work absence. The next largest study was based on 26410 participants, with 1002 incident long-term sickness absence cases during 22466 person-years of follow-up.⁴

To our knowledge, this study is the first to examine whether influence, possibilities for development, role conflicts, and physical demands at work modify the higher risk of long-term sickness absence in relation to high emotional demands at work. Previous observational

	Person-years	Cases	Cases per 1000 person-years	Model one, HR (95% CI)	Model two, HR (95% CI)	Model three, HR (95% CI)
Emotional demands						
Low emotional demands	9 049 046	333 083	36.8	1 (ref)	1 (ref)	1 (ref)
High emotional demands	2 869 975	147 602	51.4	1.23 (1.23–1.24)	1.26 (1.26–1.27)	1.55 (1.53–1.56)
Influence						
High influence	9 080 914	335 304	36.9	1 (ref)	1 (ref)	1 (ref)
Low influence	2 838 107	145 381	51.2	1.27 (1.26–1.28)	1.18 (1.17–1.19)	1.02 (1.02–1.03)
Possibilities for development						
High possibilities for development	9 126 177	341 473	37.4	1 (ref)	1 (ref)	1 (ref)
Low possibilities for development	2 792 844	139 212	49.8	1.28 (1.27–1.28)	1.17 (1.16–1.17)	1.14 (1.13–1.15)
Role conflicts						
Low role conflicts	8 907 033	362 482	40.7	1 (ref)	1 (ref)	1 (ref)
High role conflicts	3 011 988	118 203	39.2	1.08 (1.07–1.09)	1.09 (1.09–1.10)	1.01 (1.00–1.02)
Physical demands						
Low physical demands	9 075 392	338 486	37.3	1 (ref)	1 (ref)	1 (ref)
High physical demands	2 843 628	142 199	50.0	1.55 (1.54–1.56)	1.41 (1.40–1.42)	1.36 (1.35–1.37)

Data are n unless otherwise stated. Model one: adjusted for sex and age. Model two: further adjusted for cohabitation, migration background, and income. Model three: further mutually adjusted for all work environment factors. HR=hazard ratio.

Table 2: Risk of long-term sickness absence during 10 years of follow-up by levels of emotional demands, influence, possibilities for development, role conflicts, and physical demands at work

studies have shown that leadership quality did not substantially buffer the adverse effect of high emotional demands on levels of antidepressant treatment²⁷ and sickness absence.⁸ However, work-related goal attainment seemed to moderate the negative effect of high emotional demands on employee wellbeing,²⁸ and finding work emotionally enriching and meaningful seemed to buffer the adverse effect of high emotional demands on exhaustion.²⁹

Our results indicate that high emotional demands at work might be particularly hazardous in the presence of low possibilities for development and high role conflicts. Low possibilities for development might inhibit employees from learning and acquiring and using new skills that could help with their handling of high emotional demands. Acquiring and using new skills might also increase job satisfaction and partly compensate for the strain of high emotional demands. Role conflicts might elicit negative emotions and add another type of emotional strain to a work situation already characterised by high emotional demands. Furthermore, role conflicts might arise from having too little time or resources to do the job properly, which might add further strain and exacerbate the negative effects of high emotional demands.

	Person-years	Cases	Cases per 1000 person-years	Adjusted HR (95% CI)*	Expected number of cases per 1000 person-years based on adjusted HR	Expected number of additional cases per 1000 person-years based on adjusted HR	RERI (95% CI)
Influence	..	..	..	..	..	..	-0.25 (-0.28 to -0.23)
Low emotional demands, high influence	6 686 851	216 461	32.3	1 (ref)	32.3	0	..
Low emotional demands, low influence	2 362 195	116 622	49.4	1.08 (1.07 to 1.09)	34.9	2.6	..
High emotional demands, high influence	2 394 063	118 843	49.6	1.60 (1.58 to 1.61)	51.7	19.4	..
High emotional demands, low influence	4 75 912	28 759	60.4	1.42 (1.40 to 1.44)	45.9	13.6	..
Possibilities for development	..	..	..	..	..	..	0.35 (0.22 to 0.47)
Low emotional demands, high possibilities for development	6 271 571	194 925	31.1	1 (ref)	31.1	0	..
Low emotional demands, low possibilities for development	2 777 474	138 158	49.7	1.13 (1.12 to 1.14)	35.1	4.0	..
High emotional demands, high possibilities for development	2 854 606	146 548	51.3	1.45 (1.44 to 1.46)	45.1	14.0	..
High emotional demands, low possibilities for development	1 53 369	10 54	68.6	1.93 (1.81 to 2.06)	60.0	28.9	..
Role conflicts	..	..	..	..	..	..	0.13 (0.11 to 0.15)
Low emotional demands, low role conflicts	7 325 420	273 109	37.3	1 (ref)	37.3	0	..
Low emotional demands, high role conflicts	1 723 625	59 974	34.8	0.98 (0.97 to 0.99)	36.6	-0.7	..
High emotional demands, low role conflicts	1 581 613	89 373	56.5	1.48 (1.46 to 1.49)	55.2	17.9	..
High emotional demands, high role conflicts	1 288 362	58 229	45.8	1.59 (1.57 to 1.61)	59.3	22.0	..
Physical demands	..	..	..	..	..	..	-0.41 (-0.45 to -0.36)
Low emotional demands, low physical demands	6 368 034	200 264	31.4	1 (ref)	31.4	0	..
Low emotional demands, high physical demands	2 681 011	132 819	49.5	1.41 (1.40 to 1.42)	44.3	12.9	..
High emotional demands, low physical demands	2 707 358	138 222	51.1	1.76 (1.74 to 1.78)	55.3	23.9	..
High emotional demands, high physical demands	1 62 617	9 380	57.7	1.76 (1.72 to 1.80)	55.3	23.9	..

Data are n unless otherwise stated. HR=hazard ratio. RERI=relative excess risk due to interaction. *Adjusted for sex, age, cohabitation, migration background, income, and the other three work environment factors.

Table 3: Risk of long-term sickness absence during 10 years of follow-up by levels of emotional demands at work, with effect modification by influence, possibilities for development, role conflicts, and physical demands at work

High emotional demands are part of the job in several occupations, such as teaching and health care, and reducing emotional demands might be difficult. Our findings suggest that workplace interventions in emotionally demanding occupations that aim to increase possibilities for development of the employees and to prevent or reduce role conflicts might be a successful approach for reducing long-term sickness absence.

For the combinations of high emotional demands and low influence, and high emotional demands and high

physical demands, the RERI was less than 0, indicating antagonism instead of synergism. However, it is important to note that both low influence (model two; table 2) and high physical demands (models two and three; table 2) were associated with an increased risk of long-term sickness absence compared with high influence and low physical demands, respectively. Thus, our analyses do not indicate that low influence and high physical demands are not of importance in risk of long-term sickness absence, but instead indicate that low

influence and high physical demands at work do not appear to exacerbate the association between high emotional demands and risk of long-term sickness absence.

The measures of influence and of possibilities for development in our study are similar to the concepts of decision authority and skill discretion, respectively, in the demand–control model.¹¹ Decision authority and skill discretion are usually combined into the variable of job control in the demand–control model. Our results showed that the interactions of emotional demands with influence and with possibilities for development, respectively, yielded different results, which might suggest that it could be fruitful in the demand–control model to analyse decision authority and skill discretion not only in combination but also separately.

The strengths of this study include the use of a large nationwide cohort of 1521352 employed individuals and the register-based outcome and covariates measurement. The job exposure matrix-based approach enabled us to measure emotional demands, influence, possibilities for development, role conflicts, and physical demands at work for all employees in the study population. Furthermore, the job exposure matrix-based approach reduced the risk of reporting bias as exposure was not measured at the individual-level but was estimated by the occupational groups of the participants.

This study has several limitations. First, the job exposure matrix-based approach means that we did not analyse directly the association between emotional demands, the effect modifiers, and the risk of long-term sickness absence, but analysed the association between working in occupations that on average had a certain level of exposure (with regard to emotional demands and the effect modifiers) and risk of long-term sickness absence. This method of analysis might lead to exposure misclassification, as some employees might have had low individual-level emotional demands while working in occupations with high average emotional demands and vice versa, which would most likely lead to underestimation of the observed associations.³⁰ Second, the Danish registers on sickness absence do not include information on diagnoses, which meant that we could only measure all-cause long-term sickness absence and not cause-specific long-term sickness absence. For example, it might be that the risk of long-term sickness absence in relation to emotional demands is higher for long-term sickness absence due to common mental disorders than for long-term sickness absence due to musculoskeletal disorders. Third, time of follow-up was long, with a mean of 7·8 years, and level of emotional demands might have changed during this time for some participants, which could have led to imprecise exposure measurement, as individuals could have changed job groups, and underestimation of the association. However, a sensitivity analysis with a 1-year follow-up produced estimates that were similar to the estimates of

the main analysis. Fourth, we did not incorporate possible period effects in emotional demands, to reflect changes in the labour market or in society. Effects were, however, constant over time, with proportional hazards throughout the complete follow-up period. Fifth, the analyses did not account statistically for clustering of data, as no such standard approach is available when estimating confidence limits for RERI. Sixth, the cohort included all employed individuals residing in Denmark who were aged 30–59 years in 2000. The results, therefore, apply to this age group and to employees in Denmark. As sickness absence systems differ between countries, generalisations to other countries should be made with caution. Seventh, our analyses were limited to incident long-term sickness absence among individuals who had no history of long-term sickness absence in the last 3 years before the start of follow-up, and the results might not apply to people who have recurrent long-term sickness absence.

In conclusion, in this large, job exposure matrix-based cohort study in Denmark, employees in occupations with high emotional demands had a higher risk of long-term sickness absence than those in occupations with low emotional demands over 7·8 years of follow-up. Additive interaction analyses indicated that the association between high emotional demands and risk of long-term sickness absence was exacerbated in a synergistic way by the presence of low possibilities for development and high role conflicts at work. In three sensitivity analyses, the synergism remained robust for low possibilities for development in two analyses and for role conflicts in one analysis. Contrary to our hypothesis, low influence and high physical demands at work did not exacerbate the association between high emotional demands and long-term sickness absence. Our findings raise the hypothesis that in emotionally demanding occupations, increasing possibilities for development at work and preventing or reducing high work-related role conflicts might reduce long-term sickness absence. Our results suggest that this hypothesis does not apply to low influence or high physical demands at work. Further interventional research, including randomised controlled trials, is needed on these effect modifiers and other psychosocial factors at work that might modify the high risk of long-term sickness absence in relation to high emotional demands, to evaluate the effectiveness of such interventions in real-life settings.

Contributors

EF, JKS, IEHM, and RR designed and planned the study. EF and JKS accessed and verified the data and did the statistical analyses. EF wrote the first draft of the report. All authors contributed to interpretation of data and revised the report. EF, JKS, IEHM, and RR jointly decided to submit the report and all other authors approved the decision.

All authors had full access to all the data in the study, approved the final version of the report, and agree to be accountable for all aspects of the work.

Declaration of interests

We declare no competing interests.

Data sharing

All data are stored in a protected server environment hosted by Statistics Denmark and can be accessed by researchers registered with Statistics Denmark. For further information, please contact Prof Reiner Rugulies (rer@nfa.dk).

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