

**Supplementary Material to Article:****Emotional demands at work and risk of disability pension: A nationwide cohort study in Denmark**

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## 1) Items of the work environment measures

**E-Table 1. Scales, items, and response options for the job exposure matrices**

<b>Scales</b>	<b>Items</b>	<b>Response options</b>
<b>Emotional demands</b> (ICC=0.22) (Cronbach's alpha=0.87) (Non-response=2.8%)	Does your work put you in emotionally disturbing situations?	Always; Often; Sometimes; Seldom; Never/hardly ever
	Is your work emotionally demanding?	To a very large extent; To a large extent; Somewhat; To a small extent; To a very small extent
	Do you get emotionally involved in your work?	To a very large extent; To a large extent; Somewhat; To a small extent; To a very small extent
<b>Influence</b> (ICC=0.20) (Cronbach's alpha=0.76) (Non-response=2.9%)	Do you have a large degree of influence concerning your work?	Always; Often; Sometimes; Seldom; Never/hardly ever
	Do you have a say in choosing who you work with?	Always; Often; Sometimes; Seldom; Never/hardly ever
	Can you influence the amount of work assigned to you?	Always; Often; Sometimes; Seldom; Never/hardly ever
	Do you have any influence on what you do at work?	Always; Often; Sometimes; Seldom; Never/hardly ever
<b>Possibilities for development</b> (ICC=0.25) (Cronbach's alpha=0.72) (Non-response=2.9%)	Does your work require you to take the initiative?	To a very large extent; To a large extent; Somewhat; To a small extent; To a very small extent
	Do you have the possibility of learning new things through your work?	To a very large extent; To a large extent; Somewhat; To a small extent; To a very small extent
	Can you use your skills or expertise in your work?	To a very large extent; To a large extent; Somewhat; To a small extent; To a very small extent
<b>Role conflicts</b> (AUC=0.68) (Cronbach's alpha=NA) (Non-response=3.9%)	Are contradictory demands placed on you at work?	No, not at all; From time to time; Yes, certainly
<b>Physical demands</b> (ICC=0.37) (Cronbach's alpha=0.80) (Non-response=5.0%)	Do you sit?	Almost all of the time; About ¾ of the time; About ½ of the time; About ¼ of the time; Rarely; Never

	Do you stand in the same spot?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you work with your back twisted or bent forwards without supporting with your hands and arms?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you twist or bent many times per hour?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Are your arms lifted to or above the shoulders?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you work with your neck twisted or bent forwards?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you work with your hand twisted or bent in the wrist?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you make the same finger-movements many times a minute (e.g. keying of text)?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you make the same arm-movements many times a minute (e.g. packing, mounting, machinework, carving)?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never
	Do you squat or kneel when working?	Almost all of the time; About $\frac{3}{4}$ of the time; About $\frac{1}{2}$ of the time; About $\frac{1}{4}$ of the time; Rarely; Never

ICC: Intraclass correlation. AUC: Area under the curve.

## 2) Construction of the job exposure matrices

The description of the construction of the job exposure matrices is a modified version of a description previously published (1). To ascertain emotional demands, influence, possibilities for development, role conflicts, and physical demands at work we constructed job exposure matrices (JEM) based on information from the Danish Work Environment Cohort Study (DWECS) and assigned these JEMs to individuals in the JEMPAD cohort. DWECS is a survey on working conditions and health conducted in a random sample of employed individuals in Denmark aged 18 to 64 years, first drawn in 1990 and followed-up every fifth year until 2010, with inclusion of additional individuals in each wave. We included DWECS data in the JEM construction by combining data from the 2000 and 2005 waves (2,3).

From DWECS, we included three items on emotional demands, four items on influence, three items on possibilities for development, one item on role conflicts and 10 items on physical demands at work (see e-Table 1). The psychometric properties of the scales for emotional demands, influence and possibilities for development were derived from the Copenhagen Psychosocial Questionnaire, version II (COPSOQ-II) and are comprehensively documented (4–8) whereas such a documentation is, to our knowledge, not available for the DWECS measures of role conflicts and physical demands.

We included DWECS respondents in the JEM construction, if they responded to at least half of the items within each scale. We calculated the scales as the mean score of the items on emotional demands, influence, and possibilities for development, respectively. Role conflicts was a single item measure that was dichotomized (Yes, certainly versus other response options). We constructed a sum score (ranging from 10 to 60) for physical work demands by scoring each item from 1 to 6 (higher scores indicate higher demands, sitting reversely coded) and adding up the scores. Higher scores indicated higher levels of emotional demands, influence, possibilities for development, role conflicts, and physical demands, respectively. The item non-response for each of the five work environment factors was ranging from 2.8% to 5.0% (see e-Table 1). There was a social gradient in item non-response. Item non-response was less than 1% in occupational groups with the highest socioeconomic status (legislators, senior officials, managers) and about 6% in occupational groups with the lowest socioeconomic status (elementary occupations, unskilled workers).

Each DWECS respondent was assigned an occupational group according to the DISCO-88 occupational classification system. DISCO-88 is the Danish version of the International Standard Classification of Occupations (ISCO) developed by the International Labour Organization (ILO) and was used from 1991 to 2009, when it was replaced with DISCO-08 (9,10). We used the four-digit level classification and required a minimum of five DWECS respondents within each occupational group. Occupational groups with less than five respondents were collapsed with other similar small occupational groups. The rationale for collapsing the groups was avoiding construction of JEMs based on too few individuals. Further, due to data protection regulations, it was not possible to conduct analyses based on less than five individuals. The DISCO-88 classification system includes 377 four-digit occupational groups. Each of the JEMs are based on 246 occupational groups with five or more DWECS respondents in each occupational group. Of the 377 occupational groups, we created JEM values on the four-digit level for 210 occupational groups. The remaining 167 four-digit level occupational groups (377 minus 210) were collapsed with other similar

occupational groups in the DISCO-88 classification system with less than five respondents. This procedure resulted in 36 collapsed occupational groups, of which 22 were collapsed on the third digit level, 12 on the second digit level and finally, two on the first digit level. The 36 collapsed occupational groups were equally distributed across the main occupational groups, except that the main groups 5 and 6 were not represented among the collapsed third digit level groups. Standard errors of the JEM values were somewhat higher for the 36 collapsed occupational groups as compared to the 210 four-digit level occupational groups indicating that four-digit level occupational groups are more homogenous, whereas the collapsed occupational groups were more varied.

Using the Glimmix procedure in SAS 9.4, we estimated the predicted level of emotional demands, influence, possibilities for development, and physical demands and using the Logistic procedure in SAS 9.4, we estimated the predicted probability of role conflicts given occupational group, sex, age, and year of data collection (2000, 2005). Thus, we constructed sex-, age-, and period specific JEMs.

To evaluate the extent to which the scores for the five working conditions were explained by job group, we calculated intra-class correlation coefficients (ICC) for the continuous variables of predicted levels of emotional demands, influence, possibilities for development, and physical demands. For the predicted probability of role conflicts (dichotomously defined) we estimated the area under the curve (AUC) (see e-Table 1). The ICCs ranged from 0.20 to 0.37 and the AUC was 0.68, indicating acceptable values for job exposure matrices concerning psychosocial working conditions, as compared to other matrices on the topic (11). E-table 2 shows correlation coefficients between the five job exposure matrices.

We linked the predicted level of emotional demands, influence, possibilities for development, and physical demands and the predicted probability of role conflicts, respectively, to the individuals in the JEMPAD cohort at baseline in 2000 using the year 2000 specific JEM.

Based on the predicted level of emotional demands, we categorized the individuals into four exposure groups (low; medium-low; medium-high; high) based on a quartile split of the distribution in the study population at baseline in 2000. Predicted levels of influence, possibilities for development, and physical demands and the predicted probability of role conflicts were analyzed as continuous variables.

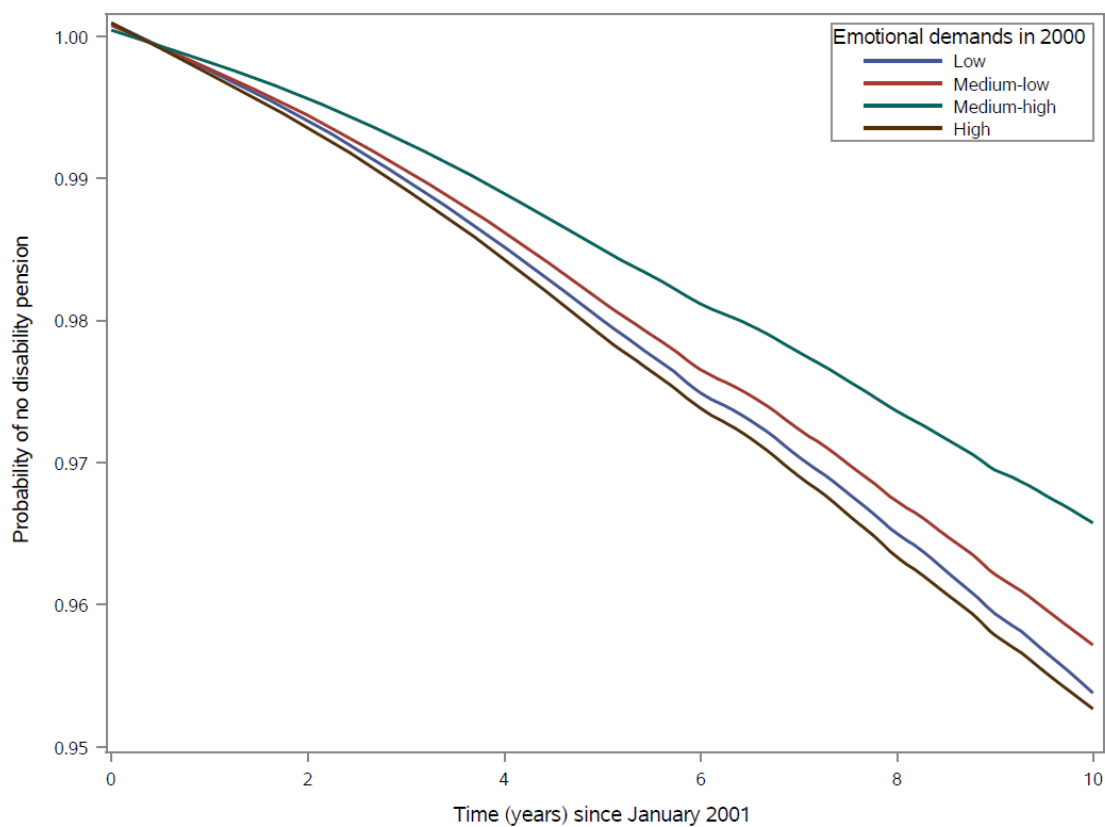
**E-Table 2. Correlation coefficients between the five job exposure matrices**

	Emotional demands	Influence	Possibilities for development	Role conflicts	Physical demands
Emotional demands	1.000				
Influence	0.356 p <0.001	1.000			
Possibilities for development	0.606 p <0.001	0.758 p <0.001	1.000		
Role conflicts	0.276 p <0.001	0.150 p <0.001	0.190 p <0.001	1.000	
Physical demands	-0.357 p <0.001	-0.560 p <0.0001	-0.588 p <0.001	0.016 p <0.001	1.000

## REFERENCES

1. Framke E, Sørensen JK, Alexanderson K, Farrants K, Kivimäki M, Nyberg ST, et al. 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. *Lancet Public Health*. 2021;6(10):e752–9.
2. Burr H, Bjerne JB, Kristensen TS, Tüchsen F, Bach E. Trends in the Danish work environment in 1990-2000 and their associations with labor-force changes. *Scand J Work Environ Health*. 2003;29(4):270–9.
3. Feveile H, Olsen O, Burr H, Bach E. Danish Work Environment Cohort Study 2005: From idea to sampling design. *Stat Transit*. 2007;8(3):441–58.
4. Pejtersen JH, Kristensen TS. The development of the psychosocial work environment in Denmark from 1997 to 2005. *Scand J Work Environ Health*. 2009;35(4):284–93.
5. Pejtersen JH, Kristensen TS, Borg V, Bjerne JB. The second version of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health*. 2010 Feb;38(3 Suppl):8–24.
6. Thorsen SV, Bjerne JB. Reliability of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health*. 2010 Feb;38(3 Suppl):25–32.
7. Rugulies R, Aust B, Pejtersen JH. Do psychosocial work environment factors measured with scales from the Copenhagen Psychosocial Questionnaire predict register-based sickness absence of 3 weeks or more in Denmark? *Scand J Public Health*. 2010;38(3):42–50.
8. Pejtersen JH, Bjerne JB, Hasle P. Determining minimally important score differences in scales of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health*. 2010 Feb;38(3 Suppl):33–41.
9. International Labour Organization (ILO). Bureau of Statistics, work unit of the Policy Integration Department [Internet]. 2004 [cited 2024 Mar 23]. Available from: <https://www.ilo.org/public/english/bureau/stat/isco/isco88/>
10. International Labour Organization (ILO). Bureau of Statistics, work unit of the Policy Integration Department [Internet]. 2010 [cited 2024 Mar 23]. Available from: <https://www.ilo.org/public/english/bureau/stat/isco/isco08/>
11. Madsen IEH, Gupta N, Budtz-Jørgensen E, Bonde JP, Framke E, Flachs EM, et al. Physical work demands and psychosocial working conditions as predictors of musculoskeletal pain: a cohort study comparing self-reported and job exposure matrix measurements. *Occup Environ Med*. 2018 Oct 1;75(10):752–8.

### 3) Kaplan-Meier survival plot showing probability of no disability pension according to levels of emotional demands



**E-Figure 1. Kaplan-Meier survival plot showing probability of no disability according to levels of emotional demands**

#### 4) Hazard ratios for all variables of the complete main model

**E-Table 3. Exposure to emotional demands and covariates in 2000 and risk of disability pension from 2001 to 2010**

Emotional Demands	N	Person-years	Cases	Cases per 10,000 person-years	Model 3 HR, 95% CI
<b>All</b>	1,670,825	15,649,743	67,923	43.4	
High emotional demands	417,663	3,930,006	18,989	48.3	1.73 (1.68-1.79)
Medium-high emotional demands	416,667	3,944,803	13,723	34.8	1.23 (1.20-1.27)
Medium-low emotional demands	419,311	3,894,792	16,942	43.5	1.20 (1.17-1.23)
Low emotional demands	417,184	3,880,141	18,269	47.1	Reference
Female sex	809,416	7,616,372	37,099	48.7	1.15 (1.13-1.18)
Male sex	861,409	8,033,371	30,824	38.4	Reference
Age (per one year increase)	1,670,825	15,649,743	67,923	43.4	1.06 (1.06-1.06)
Single, living alone	426,180	3,923,833	24,672	62.9	1.38 (1.35-1.40)
Cohabiting	1,241,021	11,695,380	43,176	36.9	Reference
Descendants of emigrants	2,457	22,906	93	40.6	1.77 (1.72-1.82)
Emigrants	73,054	646,358	5,749	88.9	1.10 (0.90-1.35)
Danish origin	1,595,314	14,980,478	62,081	41.4	Reference
Income 1 <sup>st</sup> decile	157,011	1,463,841	11,837	80.9	3.56 (3.42-3.72)
Income 2 <sup>nd</sup> decile	157,019	1,489,397	8,541	57.3	2.68 (2.57-2.80)
Income 3 <sup>rd</sup> decile	157,020	1,494,012	7,012	46.9	2.29 (2.19-2.39)
Income 4 <sup>th</sup> decile	157,008	1,492,574	6,155	41.2	2.00 (1.92-2.09)
Income 5 <sup>th</sup> decile	157,016	1,486,358	5,848	39.3	1.87 (1.79-1.95)
Income 6 <sup>th</sup> decile	157,015	1,476,497	5,620	38.1	1.73 (1.66-1.81)
Income 7 <sup>th</sup> decile	157,015	1,467,882	5,422	36.9	1.63 (1.56-1.70)
Income 8 <sup>th</sup> decile	157,017	1,458,724	5,047	34.6	1.50 (1.43-1.57)
Income 9 <sup>th</sup> decile	157,013	1,449,498	4,207	29.0	1.27 (1.21-1.34)
Income 10 <sup>th</sup> decile	157,015	1,430,158	3,177	22.2	Reference
Influence at work (per 1 unit increase)	1,670,825	15,649,743	67,923	43.4	0.99 (0.95-1.02)
Possibilities for development (per 1 unit increase)	1,670,825	15,649,743	67,923	43.4	0.55 (0.53-0.57)
Role conflicts (per 1 unit increase)	1,670,825	15,649,743	67,923	43.4	1.12 (0.92-1.35)
Physical demands (per 1 unit increase)	1,670,825	15,649,743	67,923	43.4	1.05 (1.04-1.05)

All variables are adjusted for each other.



### 5) Supplementary analysis: Adding a model with adjustment for previous long-term sickness absence

**E-Table 4. Exposure to emotional demands in 2000 and risk of disability pension from 2001 to 2010 with further adjustment for long-term sickness absence in the 24 months before baseline**

Emotional Demands	N	Person-years	Cases	Cases per 10,000 person-years	Model 3 HR, 95% CI	Model 4 HR, 95% CI
All	1,670,825	15,649,743	67,923	43.4		
High	417,663	3,930,006	18,989	48.3	1.73 (1.68-1.79)	1.74 (1.69-1.79)
Medium-high	416,667	3,944,803	13,723	34.8	1.23 (1.20-1.27)	1.23 (1.20-1.26)
Medium-low	419,311	3,894,792	16,942	43.5	1.20 (1.17-1.23)	1.20 (1.17-1.23)
Low	417,184	3,880,141	18,269	47.1	Reference	Reference

Model 3: Adjusted for sex, age, cohabitation, migration background, household disposable income after tax, physical workload, influence, possibilities for development, and role conflicts (same model 3 as in table 1 in the article). Model 4: Further adjusted for long-term sickness absence in the 24 months before baseline.

Note: Long-term sickness absence was defined as sickness absence with a duration of more than 30 days. Information was retrieved from the Danish Register for Evaluation of Marginalisation (DREAM).