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Biased reporting of working conditions may inflate associations with depression. We examined the risk of depression among employees of small work units with homogenous working conditions experiencing low and high levels of psychological demands and decision latitude. We observed no strong associations. Control over own work or reduced work demands as a means to prevent depression is therefore not supported.

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A two-year follow-up study of risk of depression according to work-unit measures of psychological demands and decision latitude

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Objectives The aim of this study was to examine if high psychological demands and low decision latitude at work increase the risk of depression.

Methods In 2007, 4237 non-depressed Danish public employees within 378 different work units were enrolled in the study. Mean levels of psychological demands and decision latitude were computed for each work unit to obtain exposure measures that were robust to reporting bias. In 2009, 3046 (72%) participated at follow-up, and those reporting high levels of depressive, burnout or stress symptoms went through a psychiatric interview by which 58 cases of new onset depression were diagnosed. Odds ratios (OR) of depression for different levels of work unit mean psychological demands and decision latitude were estimated by logistic regression taking established risk factors into account.

Results The OR for depression according to psychological demands was 1.07 [95% confidence interval (95% CI) 0.42–2.49] for every unit of change on a 5-point scale. The corresponding OR for decision latitude was 1.85 (95% CI 0.55–6.26). No interactive effects of psychological demands and decision latitude were observed.

Conclusion These findings suggest that low decision latitude may predict depression, but confidence intervals are wide and findings are also compatible with no increased risk.

Key terms epidemiology; mental health; occupational health; stress; work environment.

Depression is a mental disorder characterized by depressed mood, loss of interest, and decreased energy accompanied by other symptoms such as loss of self-esteem (1) and is currently the leading burden of disease assessed by disability-adjusted life years in middle and high-income countries (2).

Several prospective studies have indicated that the risk of depression is influenced by psychosocial working conditions, most frequently characterized by Karasek & Theorell's job strain model based upon perceived psychological demands and decision latitude (3–5). Psychological demands cover role conflicts,

workload, and time pressure, whereas decision latitude covers the degree of the employee's work activity control and the ability to utilize specific skills at work. The model predicts that mental strain is the result of the interaction of high psychological demands and low decision latitude (6).

Most previous studies have depended on self-reported exposure information and are thus subject to reporting bias, because depressed mood may affect the individual's perception and reporting of the work environment. This is relevant even in follow-up studies, because depression often has a long insidious preclinical

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stage (4, 7, 8). Personality, temperament, and attitude to work may also be important causes of reporting bias. The majority of the previous studies have focused on the individual's perception of the psychosocial working environment (3–5). Such experiences are expected to be important elements of the causal pathway between job strain and depression (4, 9) but may not provide an unbiased description of the work environment (10).

Non-self-reported measures of psychosocial working conditions are probably the only option to circumvent the serious problem of reporting bias (7, 8, 11). Measures such as registry information on hospital overcrowding, reorganization, and workload (12–14), expert assessment (10, 15), employer assessment (16), job title (17), and averaging across work units (8, 18, 19) or workplaces (20) are different approaches to this problem.

To identify preventable, environmental, and psychosocial risk factors affecting the majority of the workforce, measures of agreed-upon exposure are needed (21). This may be obtained by aggregated measures among workers with similar psychosocial working conditions (8).

Work-unit aggregated measures of psychosocial work characteristics have several advantages. First, the inherent and uncontrollable ties between individual self reports of exposure and outcome are broken and reporting bias is circumvented (7, 8, 11). Second, these measures are independent of a specific, individual workers' appraisal of his or her working conditions but reflects an average workers' psychological processing that is not accounted for by registry information on organizational conditions or external assessment of work tasks (22). Third, such estimates of exposure can be provided also for non-respondents from measured work units (23). A disadvantage is that work-unit aggregation will reduce exposure contrast as well as statistical power (24). The method has also been discussed controversially (25).

In the present study, we used work unit mean scores of self-reported demands and decision latitude to avoid reporting bias as a potential explanation of a positive association with depression. Participants in the work unit who were diagnosed with depression at baseline were excluded from the calculation of the mean scores as this could influence their assessment of the psychosocial work environment. We also excluded participants diagnosed with depression at follow-up because they could have preclinical depressive symptoms that could influence their assessment of working conditions. By including only non-depressed participants throughout the study, we avoid any reporting bias caused by depression.

The objective of this follow-up study was to examine if high psychological demands and low decision latitude increase the risk of depression.

Methods

Design

This follow-up study is based on the Danish PRISME cohort established in 2007 and re-examined in 2009 (8). The main purpose of the PRISME study is to examine to what extent psychological work factors affect the risk of depression, burnout and stress symptoms. The study examines the relation between decision latitude and psychological demands measured in 2007 and depression during follow-up from 2007–2009. Cases of depression were identified by a two-step procedure: Firstly, we identified participants reporting mental symptoms (depressive, stress, or burn-out symptoms) in a questionnaire. Secondly, these participants were invited to participate in a standardized psychiatric interview identifying cases of depression based on criteria from the ICD-10 classification of mental and behavioral disorders: diagnostic criteria for research (ICD-10-DCR).

Population

In 2007, the Danish PRISME cohort of 10 036 public employees from 502 small work units in Aarhus, Denmark, was recruited for the baseline study, and 4489 employees (44.7%) from 474 work units participated by filling in a postal questionnaire concerning working conditions and health. At baseline, we identified 100 participants with depression (as defined later). In 2009, all participants from 2007 were approached again, and a total of 3224 completed the questionnaire. We identified 78 cases of depression, of which 63 were non-depressed at baseline.

Participants with mild, moderate, and severe depression present at baseline (N=100) were excluded from the study. We also excluded five participants from five work units, for which we could not identify the work unit leader as well as participants from work units with less than three responders who were non-depressed at both baseline and follow-up (147 workers from 90 work units) to avoid very unstable work unit measures of exposure. The average participation rate in the included work units was 71% ranging from 17–100%. A total of 4237 participants from 378 work units were eligible for follow-up. In 2009, 3046 of these workers from 376 work units participated and thus comprised our final study population. Further details of design and baseline population have recently been reported in more detail (8).

Measures of psychosocial working conditions

Psychosocial working conditions were measured in 2007 according to Karasek' & Theorell's job strain model (6) with scales from the Copenhagen Psychosocial

Questionnaire (26). Psychological demands, decision authority, and skill discretion were each measured by four items on a scale from “always” (1) to “never” (5). For each scale, a mean value of the four items was calculated. Decision latitude was computed as the mean value of decision authority and skill discretion. The items are listed in figure 1.

Mean values of decision latitude and psychological demands were calculated for each of the 376 work units after the exclusion of participants with depression at baseline or at follow-up. The mean values were assigned to all employees in a particular work unit.

Measures of mental symptoms

Depressive symptoms were measured with the Common Mental Disorder Questionnaire (CMDQ), which is a brief case-finding instrument (27). The questionnaire has shown a high external validity when using the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) standardized psychiatric interview as the gold standard (27). We used the six-question subscale for depression from the CMDQ. The questions referred to the last 4 weeks and were measured on a 5-point response scale from “not at all” to “extremely”. Questions were phrased eg, as: “During the last four weeks how much were you bothered by feelings of worthlessness.” Stress symptoms were measured with four questions from the short version of the Perceived Stress Scale (28). Burn-out scores

were measured with six questions from the Copenhagen Burn-Out Inventory (29). All symptom questions concerned the last four weeks and were measured on point scales from “not at all” or “never” (1) to “extremely”, “very often”, or “always” (5).

At baseline, we selected participants with (i) a score ≥ 3 on ≥ 3 of the 6 depressive symptom questions, (ii) the highest average score (≥ 2.5) on the perceived stress questions, and (iii) the highest burn-out score (≥ 4) for the standardized psychiatric interview.

At follow-up, we chose selection criteria for the standardized psychiatric interviews based on tabulation of the frequency of ICD-10-DCR depression by different cut-off levels of depressive, stress, and burn-out scores in the 2007 data to identify the largest possible number of depressive cases with the lowest number of interviews (a high positive predictive value). We selected participants with a high symptom score on ≥ 2 of the 3 mental symptom scales at follow-up (depression, stress, or burn-out). A high score on the depression scale was defined as a score of ≥ 3.0 on ≥ 2 items; a high stress score was defined as a mean score of ≥ 2.5 ; and a high burn-out score was defined as a mean score of ≥ 2.5 .

Diagnosis of depression

Diagnoses of depression were obtained by the SCAN interview (version 2.1 part I) (30) according to the ICD-10-DCR criteria for research. The sections regarding depressive (6, 7, and 8) and bipolar (10) disorders were used. The interviews referred to the previous three months. The interviews were conducted by ten students of medicine or psychology trained at a one-week course conducted by a WHO certified trainer (OM). Inter-rater reliability on item level was found to be satisfactory ($\kappa=0.71$).

Participants diagnosed with depression

In 2007, we invited 715 workers to participate in the SCAN interview; 552 participated and 100 (2.2% of all participants at baseline) were diagnosed with depression. In 2009, we invited 671 workers to participate in the SCAN interview; 426 participated and a total of 78 were diagnosed with depression (2.4% of all participants at follow-up). Of these, 15 participants were excluded because they were also diagnosed with depression at baseline. Furthermore, five participants were excluded because they were employed in a work unit with < 3 non-depressed employees or had no identifiable leader as described previously. These exclusions left 58 cases of depression for the analyses. In 2007, 40, 43, and 17 participants fulfilled the ICD-10-DCR diagnostic criteria for a mild, moderate, and severe depressive episode,

Psychological demands

- Is your workload unevenly distributed so it piles up?
- How often do you not have time to complete all your work tasks?
- Do you get behind in your work?
- Do you have enough time for your work tasks?

Decision latitude (decision authority)

- Do you have a large degree of influence concerning your work?
- Do you have a say in choosing with whom you work?
- Can you influence the amount of work assigned to you?
- Do you have any influence on what you do at work?

Decision latitude (skill discretion)

- Does your work require you to take the initiative?
- Do you have the possibility of learning new things through your work?
- Can you use your skills or expertise in your work?
- Does your work give you the opportunity to develop your skills?

Figure 1. Items measuring the level of psychological demands and decision latitude.

respectively, and 15, 32, and 11 fulfilled the criteria in 2009. No participants fulfilled the criteria for bipolar disorder in either 2007 or 2009.

Measures of potential confounders

The following potential confounders were measured based on data from the baseline questionnaire: gender, age (≤ 34 , 35–44, 45–54, ≥ 55 years), previous episodes of depression (yes, no), family history of depression (yes, no), income (continuous), education beyond primary or high school (< 3 , 3–4, > 4 years), full-time work (< 30 , ≥ 30 hours per week), alcohol consumption (≤ 14 , > 14 grams per week), living alone (yes, no), neuroticism (0–2, 3–6 on the neuroticism scale of the Eysenck Personality Questionnaire Revised-Abbreviated version) (31), depressive symptoms (rating of ≥ 3 on < 2 , ≥ 2 questions from the CMDQ) (27), body mass index (< 18.5 , 18.5–25, > 25 kg/m²), and smoking (never, < 20 years, ≥ 20 years). Traumatic life events (32) during the last six months were measured at follow-up. A traumatic life event was defined as serious illness, serious injury, being assaulted, death of a relative or friend, marital problems, or serious illness, serious injury or assault of a close relative. The selection of these potential confounders was based upon a review of the literature (33–37).

Participation

Responders and non-responders at baseline were compared in a previous study (23). Work-unit average levels of psychological demands and decision latitude were assigned to responders and non-responders of every work unit. Outcome data on prescription of antidepressant medication were available through linkage to national registers. Non-participants (4.1%) were more often prescribed antidepressant medication than participants (3.4%). We found no clear indications that the low baseline participation had distorted our estimates of the associations between psychological demands, decision latitude and depression. The relative hazard ratios for use of antidepressant medication in the high psychological demands groups were 1.17 [95% confidence interval (95% CI) 0.90–1.53] for the participant population compared to the source population. The relative hazard ratios were 1.36 (95% CI 0.89–2.08) for decision latitude.

Participation at follow up was associated with older age, educational, income, alcohol consumption, and work-unit average decision latitude (table 1).

Statistical analysis

Odds ratios (OR) of depression were analyzed by logistic regression with robust clusters based on the work unit of the participants which included all the selected

potential confounders (38). Analyses were performed using both continuous-scale exposure information and exposure divided into tertiles forming a low-, medium-, and high-exposure group. The data were analyzed for interaction between psychological demands and decision latitude. The interaction term was calculated based on both continuous and dichotomous data. The cut-off level for the dichotomization was the median level (psycho-

Table 1. Baseline characteristics at follow-up. [BMI=body mass index; CMDQ=common mental disorder questionnaire; DKr=Danish krone; OR=odds ratio; 95% CI=95% confidence interval]

Characteristic	Participant at follow-up (N=3046)	%	Non-participant at follow-up (N=1232)	%	OR	95% CI
Psychological demands						
Low	1010	33.2	410	33.3	1	
Medium	1002	32.9	383	31.1	1.06	0.90–1.25
High	1034	34.0	439	35.6	0.96	0.81–1.12
Decision latitude						
High	1045	34.3	369	30.0	1	
Medium	957	31.4	421	34.2	0.80	0.68–0.95
Low	1044	34.3	442	35.9	0.83	0.71–0.98
Women	2392	78.9	959	79.6	0.96	0.81–1.13
Age						
<35 years	602	19.9	336	27.9	1	
35–44 years	728	24.0	316	26.2	1.29	1.07–1.55
45–54 years	1096	36.2	369	30.6	1.66	1.39–1.98
≥ 55 years	605	20.0	184	15.3	1.84	1.48–2.27
Previous depression	382	13.0	177	15.1	1.20	0.99–1.45
Family history of depression	806	27.0	312	26.4	1.00	0.86–1.17
Education beyond primary or high school						
<3 years	509	16.9	308	25.7	1	
3–4 years	2147	71.1	782	65.2	1.66	1.41–1.96
>4 years	365	12.1	110	9.2	2.01	1.55–2.59
Household income >500 000 DKr	1482	50.9	499	43.5	1.35	1.17–1.54
Alcohol consumption >14 grams/week	725	24.2	237	20.0	1.28	1.08–1.51
Living alone	564	18.6	239	19.9	0.92	0.78–1.09
Full-time work	2581	91.8	1011	91.7	1.00	0.78–1.29
Neuroticism personality trait ^a	450	14.9	204	16.9	0.86	0.71–1.03
CMDQ depressive symptoms ^b	272	9.0	118	9.9	0.90	0.72–1.13
Smoking						
Never smoked	1446	52.6	524	49.0	1	
0–19 years	633	23.0	270	25.2	0.85	0.71–1.01
≥ 20 years	672	24.4	276	25.8	0.88	0.74–1.05
BMI (kg/m²)						
<18.5	53	1.8	21	18.4	0.99	0.59–1.65
18.5–25	1918	63.9	751	63.4	1	
>25	1030	34.3	413	34.9	0.98	0.85–1.13

^a Dichotomized score based on neuroticism scale from Eysenck Personality Questionnaire Revised (31).

^b A screening instrument designed for case finding (27).

logical demands, 2.8, and decision latitude, 2.5). Linearity of the relation between the exposure variables and depression was examined by logistic regression models including quadratic and cubic terms and by locally weighted scatter plot smoothing (39). The associations were further explored using regression analysis with restricted cubic splines due to the non-linear relation between the two. We used four knots defined by the percentiles 5, 35, 65, and 95. The spline analyses were adjusted for previous depression, traumatic life events, depressive symptoms, and neuroticism. We determined these covariates by log likelihood testing and stepwise exclusion of non-significant terms ($P>0.05$), starting with the least significant potential confounder. All analyses were conducted using the STATA 11 statistical software (StataCorp LP, College Station, TX, USA).

Results

Nurses (30%), social workers (18%), teachers (11%), managers (7%), and medical doctors (6%) were the most prevalent professions among the participants. Members of work units with high psychological demands had less frequently a family history of depression, were more educated, and had more depressive symptoms at baseline than members of work units with low psychological demands. Members of work units with low decision latitude were more often women, had less frequently a family history of depression, were less educated, had smaller household incomes, consumed less alcohol, and reported neuroticism and depressive symptoms more frequently at baseline than members of work units with high decision latitude

Table 2. Baseline characteristics of public employees with low, medium or high levels of psychological demands and decision latitude. [BMI=body mass index; CMDQ=common mental disorder questionnaire; DKr=Danish krone]

Characteristic	Psychological demands						Decision latitude					
	Low 1.70–2.66		Medium 2.67–2.99		High 3.00–4.06		High 1.73–2.37		Medium 2.38–2.62		Low 2.63–3.72	
	N	%	N	%	N	%	N	%	N	%	N	%
Women	789	78.8	786	78.8	871	79.2	681	72.8	849	80.3	862	83.0
Age												
<35 years	163	16.3	230	23.1	209	20.3	151	16.1	213	20.2	238	22.9
35–44 years	249	24.9	247	24.8	232	22.5	223	23.8	271	25.6	234	22.5
45–54 years	380	38.0	340	34.1	376	36.4	356	38.0	370	35.0	370	35.7
≥55 years	209	20.9	181	18.1	215	20.8	206	22.0	203	19.2	196	18.9
Previous depression	132	13.5	120	12.4	130	13.0	116	12.8	132	12.8	134	13.3
Family history of depression	281	28.6	267	27.1	258	25.4	267	29.0	280	26.9	259	25.4
Professional education beyond primary or high school												
<3 years	192	19.2	138	13.9	179	17.4	118	12.7	160	15.2	231	22.3
3–4 years	755	75.6	731	73.5	661	64.4	664	71.2	742	70.4	741	71.6
>4 years	52	5.2	126	12.7	187	18.2	150	16.1	152	14.4	63	6.1
Household income >500 000 DKr	460	48.3	502	52.2	520	52.2	533	58.9	536	53.1	413	41.5
Alcohol consumption >14 grams/week	247	25.0	234	23.8	244	23.8	271	29.2	236	22.7	218	21.2
Traumatic life event during last six months ^a	347	34.4	308	30.7	327	31.6	317	33.7	324	30.5	341	32.7
Living alone	179	17.9	186	18.6	199	19.3	170	18.2	204	19.3	190	18.3
Full-time work	833	90.1	852	92.3	896	92.9	769	89.9	902	92.4	910	92.7
Neuroticism personality trait ^b	152	15.2	129	12.9	169	16.4	105	11.2	161	15.2	184	17.7
CMDQ depressive symptoms ^c	82	8.2	91	9.2	99	9.6	70	7.5	107	10.2	95	9.2
Smoking												
Never smoked	446	49.7	515	55.9	485	52.0	459	54.1	512	52.7	475	51.0
0–19 years	203	22.6	214	23.2	216	23.2	179	21.1	230	23.7	224	24.0
≥20 years	248	27.7	193	20.9	231	24.8	210	24.8	229	23.6	233	25.0
BMI (kg/m ²)												
<18.5	18	1.8	19	1.9	16	1.6	15	1.6	16	1.5	22	2.1
18.5–25	634	64.0	630	63.9	654	63.8	589	63.5	692	66.3	637	61.9
>25	338	34.1	337	34.2	355	34.6	324	34.9	336	32.2	370	36.0

^a Serious illness, serious injury, being assaulted, death of a relative or friend, marital problems, or the serious illness, serious injury or assault of a close relative. Measured at follow-up.

^b Dichotomized score based on neuroticism scale from Eysenck Personality Questionnaire Revised (31).

^c A screening instrument designed for case finding (27).

(table 2). Previous depression, a family history of depression, neuroticism, smoking, and depressive symptoms reported at baseline, and traumatic life events reported at follow-up, were significantly associated with a diagnosis of depression at follow-up (table 3).

We observed no interaction between psychological demands and decision latitude ($P=0.36$ for dichotomous exposure variables and $P=0.49$ for continuous exposure variables). We analyzed psychological demands and decision latitude in separate models. We found a linear relation between the level of decision latitude and depression using both locally weighted scatter plot smoothing and log likelihood testing to exclude quadratic and cubic effects, and analyzed decision latitude as a continuous variable. The relation between the level of psychological demands and depression was not accepted as linear. The results are presented in table 4.

By log likelihood testing, we found no significant differences between the models used in the logistic regression (adjusted for age, gender, previous episodes of depression, family history of depression, educational level, income, alcohol consumption, traumatic life-events, living alone, depressive symptoms, smoking, body mass index, and neuroticism), and the partially adjusted models used in the spline analyses (adjusted for previous episodes of depression, traumatic life-events, depressive symptoms, smoking, and neuroticism) for neither psychological demands ($P=0.96$) nor decision latitude ($P=0.96$).

Psychological demands were not significantly associated with depression. The adjusted OR of the highest and the medium tertiles of psychological demands compared to the lowest tertile were 0.80 (95% CI 0.38–1.69) and 0.72 (95% CI 0.33–1.57), respectively.

For low decision latitude, we found an adjusted OR of 1.85 (95% CI 0.55–6.26) for a one point decrease on the five-point scale.

In separate analyses of the decision latitude subscales, decision authority and skill discretion, we found adjusted OR of depression of 1.58 (95% CI 0.71–3.53) and 1.23 (95% CI 0.32–4.67), respectively for a 1-point decrease on the 5-point scale (see table 5 on http://www.sjweh.fi/data_repository.php).

Figure 2 shows the results of the restricted cubic spline regression of the relation between increasing psychological demands and the OR of depression as well as the linear effect based on logistic regression on exposure measure. The figure shows no consistent trend in the depression OR by level of psychological demands.

Figure 3 shows the results of the restricted cubic spline and linear logistic regression analyses of the relation between increasing decision latitude and depression. The two analyses show a similar monotonous, but non-significant, increase in the depression OR by decreasing levels of decision latitude.

Table 3. Baseline characteristics of 3046 public employees with or without a diagnosis of depression at follow-up. [BMI=body mass index; CMDQ=common mental disorder questionnaire; OR=odds ratio; 95% CI=96% confidence interval]

Characteristic	No depression at follow-up (N=2988)	%	Depression at follow-up (N=58)	%	OR	95% CI
Women	2343	78.8	49	86.0	1.65	0.78–3.50
Age						
<35 years	590	19.8	12	21.1	1	
35–44 years	716	24.1	12	21.1	0.82	0.37–1.85
45–54 years	1073	36.1	23	40.3	1.05	0.52–2.13
≥55 years	595	20.0	10	17.5	0.83	0.35–1.93
Previous depression	358	12.4	24	44.4	5.67	3.28–9.80
Family history of depression	784	26.8	22	38.6	1.93	1.10–3.40
Education beyond primary or high school						
<3 years	499	16.8	10	17.5	1	
3–4 years	2104	71.0	43	75.4	1.02	0.51–2.04
>4 years	361	12.2	4	7.0	0.55	0.17–1.78
Household income >500 000 Dkr	1462	51.2	20	37.7	0.58	0.33–1.01
Alcohol consumption >14 grams/week	712	24.2	13	22.8	0.93	0.50–1.73
Traumatic life event during last six months ^a	947	31.8	35	60.3	3.28	1.93–5.58
Living alone	556	18.7	8	14.0	0.71	0.33–1.50
Full-time work	2533	91.8	48	88.9	0.71	0.30–1.69
Neuroticism personality trait ^b	427	14.4	23	40.4	4.04	2.35–6.92
CMDQ depressive symptoms ^c	253	8.5	19	33.3	5.36	3.04–9.44
Smoking						
Never smoked	1423	52.7	23	44.2	1	
0–19 years	624	23.1	9	17.3	0.89	0.41–1.94
≥20 years	652	24.2	20	38.5	1.90	1.03–3.48
BMI (kg/m ²)						
<18.5	51	1.7	2	3.6	2.17	0.51–9.29
18.5–25	1884	64.0	34	60.7	1	
>25	1010	34.3	20	35.7	1.10	0.63–1.92

^a Serious illness, serious injury, being assaulted, death of a relative or friend, marital problems, or the serious illness, serious injury or assault of a close relative. Measured at follow-up.

^b Dichotomized score based on neuroticism scale from Eysenck Personality Questionnaire Revised (31).

^c A screening instrument designed for case finding (27).

As a sensitivity check, we analyzed incident cases ($N=103$) of questionnaire-reported physician-diagnosed depression occurring between baseline and follow up. We found an adjusted OR of depression of 0.75 (95% CI 0.41–1.36) for a 1-point increase on the psychological demands scale and an adjusted OR of 1.43 (95% CI 0.60–3.39) for a 1-point decrease on the decision latitude scale.

Table 4. Odds ratios (OR) of depression by increasing levels of psychological demands and decreasing levels of decision latitude. [95% CI=95% confidence interval; OR_{adj}=adjusted OR.]

Exposure	Depression (N=58)	No depression (N=2988)	OR	95% CI	OR _{adj} ^a	95% CI	OR _{adj} ^b	95% CI
Psychological demands								
Low (1.70–2.66)	26	984	1		1		1	
Medium (2.67–2.99)	15	987	0.58	0.30–1.09	0.72	0.33–1.57	0.76	0.36–1.61
High (3.00–4.06)	17	1017	0.63	0.34–1.17	0.80	0.38–1.69	0.78	0.37–1.62
Continuous ^c	58	2988	0.82	0.42–1.61	1.07	0.46–2.49	1.00	0.44–2.24
Decision latitude								
High (1.73–2.37)	14	926	1		1		1	
Medium (2.38–2.62)	22	1040	1.40	0.71–2.75	1.30	0.56–3.02	1.26	0.55–2.88
Low (2.63–3.72)	22	1022	1.42	0.72–2.80	1.65	0.72–3.74	1.71	0.77–3.79
Continuous ^c	58	2988	1.48	0.55–4.01	1.85	0.55–6.26	1.81	0.57–5.76

^a Adjusted for age, gender, previous episodes of depression, family history of depression, educational level, income, alcohol consumption, traumatic life-events, living alone, depressive symptoms, smoking, body mass index, full-time work, and neuroticism.

^b Adjusted for previous episodes of depression, traumatic life-events, depressive symptoms, and neuroticism.

^c Increase in OR by 1 on the 5-point scale.

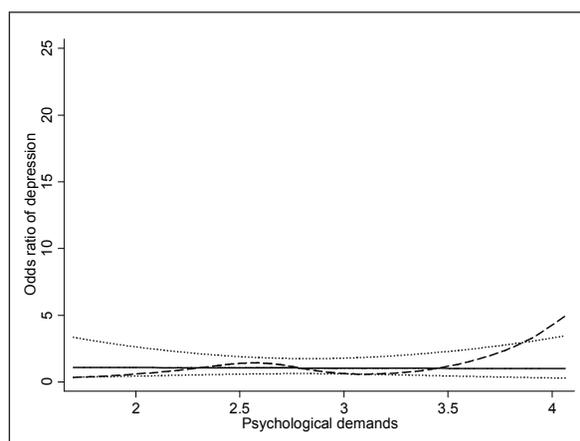


Figure 2. Psychological demands and adjusted odds ratio of depression. Results of a restricted cubic spline analysis (dashed line) and of logistic regression (solid line) with 95% confidence intervals (dotted lines) adjusted for previous depression, traumatic life events, baseline depressive symptoms, and neuroticism.

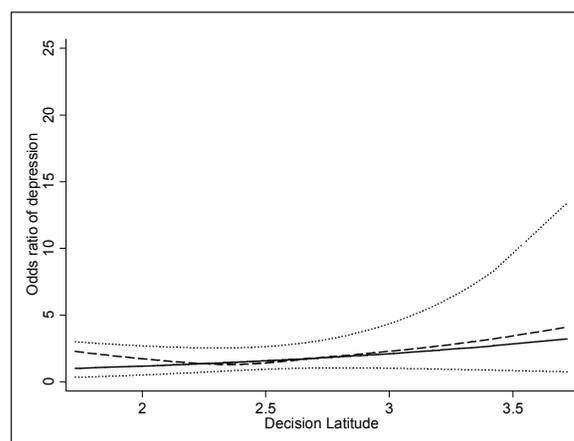


Figure 3. Decision latitude and adjusted odds ratio of depression. Results of a restricted cubic spline analysis (dashed line) and of logistic regression (solid line) with 95% confidence intervals (dotted lines) adjusted for previous depression, traumatic life events, baseline depressive symptoms, and neuroticism.

Discussion

We did not find any statistically significant relation between either work unit average levels of decision latitude or psychological demands and depression. We did, however, find a statistically non-significant relation between low levels of decision latitude and depression. This is an important finding because these measures of exposure were independent of the individual workers' interpretation of his or her psychological working conditions but represented a hypothetical average worker. Therefore, this study circumvented the serious problem of reporting bias due to low mood of depressed participants. Other individual factors that may bias findings due to self-reported measures of the working environment, such as personality and temperament, were circumvented as well.

Only few studies have been conducted in this field using independent measures of psychosocial working conditions. Some studies based on non-self reported measures have shown a relation between psychological demands and depression (10, 12, 14), and some have shown a relation between other measures of psychosocial working conditions and depression (15, 17, 40, 41). The few studies investigating non-self-reported measures of decision latitude have found no statistically significant results (10, 16, 18). It is unclear, whether these conflicting results are caused by differences in the methods of obtaining exposure information or other factors.

Participants with sub-clinical depression would not be diagnosed with depression in the SCAN examination and thus not excluded at baseline. In order to avoid confounding by sub-clinical depression, the analyses of this study are adjusted for depressive symptoms at baseline.

The study included only 58 cases of depression which limits the statistical power as illustrated by the wide confidence intervals of most risk estimates, and this may explain our negative findings. Based on previously reported prevalence and recurrence rates of depression we had expected twice the number of cases (35, 42). Our lower-than-expected number of cases may in part be due to a healthy worker effect, as non-participants at baseline were more often prescribed antidepressant medication (23), and in part due to the low baseline participation rate.

The low number of cases, furthermore, limits the ability to adjust thoroughly for potential confounders. However, we found no significant differences between the fully adjusted models used in the logistic regression and the partially adjusted models used in the spline analyses. The confidence intervals for dichotomous and continuous interaction between psychological demands and decision latitude were very wide indicating that the power of the study was not sufficient to determine any possible interaction.

At baseline, only 45% of the invited workers participated and this could have affected the external validity due to differential participation, but we found no clear indications that the low baseline participation distorted the estimates of the associations between psychological demands or decision latitude and use of antidepressants at follow-up (23).

During follow-up, the participation rate (72%) was higher than at baseline, but selection may still have biased our findings. However, we found only a small difference between participants' and non-participants' levels of decision latitude at baseline and no difference between psychological demands and depressive symptoms (table 1).

Traditionally, the combined effects of high psychological demands and low decision latitude (job strain) have been described as a quadrant term with median splits of psychological demands and decision latitude. We examined their combined effects in regression analyses with demands and decision latitude included as independent covariates and further included their multiplicative interaction term. We examined the effects with continuous variables and dichotomized at the median. In our opinion, this method of analyses gives more information than the traditional quadrant median split model (43). We found no interaction effects, and the mutually adjusted linear effects of demands and decision latitude were very similar to the separate effects of the two factors. We have therefore only reported the separate effects.

The level of psychological demands ranged from 1.7–4.1 [mean 2.84, standard deviation (SD) 0.39], and the level of decision latitude ranged from 1.7–3.7 (mean 2.52, SD 0.26). It is thus not possible to determine the

effect of very low or high levels of exposure based on this population. Studies with higher exposure contrast are needed to determine the risk of more extreme levels of exposure. The limited variation between work units may also be a problem due to the low statistical power of the study. We previously reported that the contrasts in mean exposure levels between work units were 15.3% for psychological demands and 19.5% for decision latitude, which is comparable to those found for other work-unit-based grouping strategies for psychosocial factors at work (8). The exposure homogeneity within work units was higher than that seen for grouping strategies for gaseous and other chemical exposures. Fifty percent of the work units had ratios of the 97.5th and the 2.5th percentiles below 2.95 for psychological demands and below 2.17 for decision latitude.

Decision latitude is related to social class, and it has been argued that the associations between low decision latitude and poor health are confounded by material disadvantage (44). Work unit mean levels of decision latitude and income are associated in our population ($P < 0.001$), and our results might have been confounded by socioeconomic factors. However, we adjusted our results for income, educational level, alcohol consumption, and smoking, and any effects of residual confounding from non-controlled socioeconomic factors therefore seem small.

The period from baseline measurement of exposure until case classification at follow-up lasted two years and new, transient cases occurring during this period were not included. From studies of traumatic life-events, we know that the risk of depression increases steeply shortly after the event and then declines during the next months (45). On the other hand, long-term contextual threat has been shown to play an important etiological role in depression and to increase the subsequent risk of depression significantly (46). Thus, the temporal relation between psychosocial exposure and depression is uncertain, our follow-up period might have been sub-optimal and our effects underestimated. Cross-sectional analyses may capture some of the short-term effects of job strain on the risk of depression.

The results of the sensitivity analysis of questionnaire-reported physician-diagnosed depression are comparable with the results of the primary analysis and do not indicate that the undiagnosed cases of depression between baseline and follow-up affect the OR estimates.

The analyses were adjusted for confounders measured on the individual level. It is, however, possible that the results have been confounded by risk factors of depression shared by members of the different work units. Many other aspects of the work environment, such as unjust working conditions or an imbalance between effort and reward, have been suggested as possible causes of depression (3–5) and could bias the results.

Likewise, factors such as management style and group culture in the work unit may also be possible confounders. It is important to consider the lack of adjustment for possible confounders on the group level in this study.

In conclusion, this study suggests that low decision latitude may predict depression, but overall no statistically significant associations between high psychological demands or low decision latitude and depression were seen.

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