Practice of Epidemiology

Job Strain and the Risk of Depression: Is Reporting Biased?

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It is unknown whether the relation between job strain and depression reflects causal characteristics of the working environment or reporting bias. The authors investigated reporting bias by analyzing individual versus work-unit measures of job strain and the risk of depressive symptoms (n = 287) and a diagnosis of depression (n = 97) among 4,291 employees within 378 work units in Aarhus, Denmark, 2007. All participants reported psychological demands and decision latitude, and the authors estimated mean values for each work unit. The odds ratios predicting depressive symptoms or a diagnosis of depression for the highest versus the lowest levels of individual, self-reported high psychological demands and low decision latitude were significantly increased above 2.5. When participants were classified by the work-unit mean levels, these associations were substantially smaller. For depressive symptoms, the odds ratios were 1.49 (95% confidence interval (CI): 0.88, 2.53) and 1.08 (95% CI: 0.84, 1.39), respectively, for psychological demands and decision latitude. For a diagnosis of depression, the odds ratios were 1.33 (95% CI: 0.57, 3.09) and 1.02 (95% CI: 0.68, 1.56), respectively, for psychological demands and decision latitude. These findings indicate that reporting bias inflates associations between job strain and the occurrence of depression, if studies rely on individual self-reports.

Abbreviations: CI, confidence interval; SCAN, Schedules for Clinical Assessment in Neuropsychiatry.

The point prevalence of major depression is 4.1% (95% confidence interval (CI): 3.0, 5.5) in the adult Danish population (1). Established risk factors include family history of major depression, low socioeconomic position (2), and traumatic life events (3). Some 15–20 prospective follow-up studies indicate that depression is related to the perception of adverse psychosocial factors at work (4–6), but it is not known whether this relation reflects a causal link with characteristics of the working environment or reporting bias (5, 7–10). An important reason for this state of ignorance is lack of reliable independent measures of adverse psychosocial work characteristics. Almost all studies rely on self-reports and, when the outcome under study such as depression also to a large extent is based upon subjective reporting, there is an overwhelming risk for circular reasoning and trivial associations as pointed out already 20 years ago (7).

There are strong theoretical arguments that the individual worker’s emotional and cognitive perception and processing of working conditions constitute an essential causal link between the working environment and depression (11). However, if we want to identify risk factors within the psychosocial working environment, we need measurements that are unbiased, as well as measurements that are independent of the appraisal of a specific, individual worker but reflect an average worker’s psychological processing (7, 12–14). The former should equal the counterfactual exposure ratings that depressed workers would have given if not in a depressive mood. The latter may be obtained by aggregated measures among workers with similar psychosocial working conditions and is not accounted for by the few other options, such as organizational events and methods based upon observation of work tasks (15). Lack of independent measures of
The objective was to examine if reporting bias inflates the association between job strain and depression. The latter analysis is, contrary to the former, expected to be less affected by biased reporting of exposure. We did identical analyses for self-reported depressive symptoms because these analyses may be more vulnerable to biased reporting of outcome. The objective was to examine if reporting bias inflates the association between job strain and depression.

### MATERIALS AND METHODS

#### Study population

We recruited 502 work units within several large public workplaces in Aarhus, Denmark. Each work unit was at the lowest organizational level up to the first level of management. From personnel records, we extracted information on 10,036 workers (a median of 13 workers per work unit; 10th and 90th percentiles: 3, 43). From lists of managers, we identified the names of 490 work-unit leaders and recovered 450 of them in the personnel records. A total of 4,489 employees (including 267 leaders) from 474 different work units returned a completed questionnaire between January and April, 2007, with information about psychosocial working conditions and health (response rate, 45%). Men of younger age and employees with less sick leave and fewer prescriptions for antidepressant medication were underrepresented among questionnaire responders (data not shown). After exclusion of 41 participants with incomplete information, 468 work units and 4,448 participants (including 263 leaders) remained. We furthermore excluded 157 participants from 90 work units with less than 3 nondepressed responders (3.5%) to avoid very unstable average measures of exposures. The resulting study population consisted of 4,291 participants (including 224 leaders) employed within 378 work units. The scientific ethics committee of Aarhus County approved the study, and participants gave written, informed consent.

#### Measures of depressive symptoms and a diagnosis of depression

We measured depressive symptoms by the Common Mental Disorder Questionnaire (22). Six questions asked for the last 4 weeks and were all answered on a 5-point scale ranging from 1 (“not at all”) to 5 (“extremely”). Each question was assigned a value of 1 if the point score was 3 or higher, else a value of null. Participants were classified with depressive symptoms if they had a summary score of 3 or above.

In the next step, we measured a diagnosis of depression according to the International Classification of Diseases, Tenth Revision, criteria for research that were obtained by the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) interview, version 2.1, part I (23). The following sections of part I were applied: depressive (sections 6–8) and bipolar (section 10) disorders and the screen for psychotic symptoms (section 14). The interview focused on the previous 3 months and was computer aided and semistructured (24).

#### Cases of depressive symptoms and a diagnosis of depression

A total of 310 (287 included and 23 excluded) participants of the 4,489 responders had a point score of depressive symptoms above the chosen cutoff level of 3 and were classified with depressive symptoms (Table 1). They were
invited to participate in the SCAN interview. We expected that persons with a diagnosis of depression would also have high levels of stress symptoms, and 79 participants reporting a high score on the Perceived Stress Scale (25) during the last 4 weeks were invited to be SCAN interviewed. This was also the case for 80 participants who reported a high score on the Copenhagen Burnout Inventory (26). We further invited a random sample \((n = 433)\) of all responders to study the relation between a diagnosis of depression and scores of depression, stress, and burnout (Table 1).

The burnout score was based on 6 questions with 5 ordinal response categories (from 1 “never” to 5 “always”). An average value of 4 (“often”) or more defined a high burnout score. We computed the stress score from 4 questions with 5 ordinal response categories (from 1 “never” to 5 “very often”). A summary value of \(\geq 10\) defined a high stress score.

The 4 groups overlapped and, in total, 761 (715 included and 46 excluded) participants were invited, and 589 (77.4%) completed the SCAN interview (Table 1). The time from survey to interview ranged from 1 to 171 days (average, 93 days). The International Classification of Diseases, Tenth Revision, diagnostic criteria for a depressive episode (codes F32.0, F32.1, F32.3) were fulfilled for 100 participants of which 97 were included in the analyses. Eighty-two were diagnosed among those with depressive symptoms (32.9% of the SCAN interviewed). Thirty cases (47.6%) occurred among those with a high stress score, 21 cases (36.8%) among those with a high burnout score, and 20 cases (6.0%) in the random sample.

The frequency of participants reporting depressive symptoms \((n = 23, 11.6\%)\) was higher among the 198 excluded than among the 4,291 included participants \((n = 287, 6.6\%)\) (Table 1). Exclusion was independent of work-unit levels of job strain, and furthermore the levels of psychological demands (mean, 2.8) and decision latitude (mean, 2.4) among the excluded, nondepressed participants were comparable with the levels of the included, nondepressed participants (Figures 1 and 2) and, thus, this exclusion should not bias our findings.

**Measures of individually reported and work-unit mean job strain**

We characterized the psychosocial work environment according to Karasek’s and Theorell’s job strain model (27), which consists of the dimensions of psychological demands, skill discretion, and decision authority. We measured these dimensions with the “quantitative demands,” “possibilities for development,” and “influence at work” scales from the Copenhagen Psychosocial Questionnaire (referred to as “COPSOQ”) (28). Each dimension was covered by four 5-point scale questions ranging from 1 (“always”) to 5 (“never”). For each dimension, we computed the mean of the 4 items. The mean of decision authority and skill discretion was then computed to obtain a score for decision latitude. This score was then reversed, and a high score corresponds with low decision latitude.

We estimated the mean scores of the individually reported psychological demands and decision latitude among the respective workers for each of the 378 work units except for the 287 workers who were classified with depressive symptoms. Subsequently, these mean values were assigned to all employees of the particular work unit.

**Data analyses**

We compared the distribution of the potential confounders across the 2 outcome categories and computed odds ratios with 95% confidence intervals. We depicted the distributions of psychological demands and decision latitude for the 287 participants with depressive symptoms and their 2,612 nondepressed colleagues of 179 work units and tested the differences by \(t\) tests.
We analyzed odds ratios and computed their 95% confidence intervals by logistic regression in separate models for depressive symptoms and a diagnosis of depression. We analyzed the effects of psychological demands and decision latitude independently of each other by up to 5 levels, rounding the respective exposure scores into the nearest whole number (1–5). When exposure was the work-unit mean measures, we took the multilevel structure into account because data clustered within work units. When exposure was the individual reports, we did standard analyses because all data were on the individual level. All models also included dummy variables for age (4 levels), sex, previous depression, family history of depression, income, education (3 levels), alcohol consumption, negative life event during the last 6 months, and living alone. These covariates were decided upon a priori from a review of the literature (2, 3, 29–32) and were included in all analyses. Controls were the non-case participants of the respective analyses.

We also conducted analyses that included the neuroticism personality trait (33) in addition to the above-mentioned covariates, but this variable was not included in the main analyses. Furthermore, we conducted a sensitivity analysis restricted to work units with relatively homogenous psychosocial working conditions by restricting the study population to the 50% of the work units with the lowest variance of psychological demands and decision latitude.

We calculated the contrast in mean exposure levels between the work units by the following formula (34): Contrast = \( \frac{S_{W} - S_{B}}{S_{W} + S_{B}} \), where \( S_{W} \) is the within-work-unit variance, and \( S_{B} \) is the between-work-unit variance. The homogeneity of exposure levels for each work unit was assessed by the ratio of the 97.5th and the 2.5th percentiles (35).

All analyses were conducted with SAS, version 9.1.3, statistical software (SAS Institute, Inc., Cary, North Carolina). The logistic regression analyses were performed with the GENMOD procedure. We computed variance components of the exposure measures with the NESTED procedure.

RESULTS

Nurses (29.2%) and social work and counseling professionals (17.6%) were the most prevalent professions (Table 2). The 378 work units were dominated by hospital departments (28.8%) and departments for social services and employment (25.7%) (Table 3). Table 3 gives further details of the work units. The potential confounders, except female sex, alcohol consumption, and age, were significantly associated with depressive symptoms or a diagnosis of depression (Table 4). The neuroticism personality trait showed an odds ratio of 25.67 (95% CI: 19.1, 34.5) for depressive symptoms and an odds ratio of 19.9 for a diagnosis of depression (95% CI: 12.2, 32.5).

Participants with depressive symptoms reported about 10% higher levels of high psychological demands and low decision latitude than did their nondepressed work-unit colleagues (\( P < 0.01 \)), and decision latitude showed lower and less extreme scores than did psychological demands for participants both with and without depressive symptoms (Figures 1 and 2). The means of the work-unit means were identical to the means of the participants with no depressive symptoms, but the variability was reduced, as expected. All distributions showed good approximation to a normal distribution. The contrasts in mean exposure levels between work units were 15.3% and 19.5% for psychological demands and decision latitude, respectively. 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.

A high level of psychological demands (“always,” a score of 5) was associated with depressive symptoms with an adjusted odds ratio of 3.35 (95% CI: 1.47, 7.61), and a diagnosis of depression was associated with an adjusted odds ratio of 3.15 (95% CI: 0.96, 10.40) (Table 5). A high level of low decision latitude showed an odds ratio of 4.85 (95% CI: 3.43, 54.91). No cases of a diagnosis of depression occurred above a decision latitude score of 4 (“sometimes”) and, for this level, the odds ratio was 2.87 (95% CI: 1.38, 5.94). The odds ratios were generally higher for less extreme levels of low decision latitude than for psychological demands. These results were when exposure was individual self-reports. When exposure was the work-unit means, the odds ratios were reduced substantially, with the highest value seen for...
the association between depressive symptoms and high psychosocial demands (odds ratio = 1.49, 95% CI: 0.88, 2.53) (Table 5).

Results based on individual and work-unit mean exposure measures were not directly comparable, because the latter measure did not include low or high exposure observations. Analyses using the same exposure level as the reference (“seldom,” a score of 2) still showed substantially higher odds ratios when exposure was individual compared with work-unit means, except for the association between a diagnosis of depression and psychological demands, which showed comparable low odds ratios of about 1.3 (Table 5).

If we repeated the above analyses by adding neuroticism to the models, the odds ratios of depressive symptoms and a diagnosis of depression declined by about 30% (data not shown). The sensitivity analyses based on the 50% of the work units with the lowest variance of psychological demands and decision latitude did not change results substantially (data not shown).

DISCUSSION

In this cross-sectional study, there are strong associations between perceived high psychological demands and low decision latitude, on the one hand, and depressive symptoms and a diagnosis of depression, on the other hand, when exposure information is based on individual self-reports. When we characterize working conditions by the aggregated reports of the nondepressed work-unit colleagues, the evidence of such associations is weak.

Our finding of a strong effect of self-reported psychosocial work factors is as expected from previous studies (4–6). Kold et al. (36) and Bonde et al. (37), in a study population that partly overlapped ours, observed a relation between adverse aggregated work-unit climate and hospitalization for depression but not for antidepressive medication. Kouvonen et al. (16) did not find an association between the workplace aggregated measures of social capital and depression. DeSanto et al. (20) rated several hundred jobs within a large aluminum manufacturer with respect to psychological demands and control and reported increased risk of depression insurance claims among those employed in jobs rated with high demands, but not in jobs rated with low control. Virtanen et al. (19) found that high demands among hospital workers, assessed by bed occupancy in the ward, predicted antidepressant treatment in a dose-response fashion. Stansfeld et al. (38) found no association between control, work pace, and conflicting demands assessed by managers of civil service departments and psychiatric disorders. This was contrary to results based on self-reports. Waldenström et al. (18) reported a strong association between psychosocial work factors obtained by external work content analysis and a Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, diagnosis of major depression, but this exposure information was essentially self-reported.

Adjustment for negative affectivity (including neuroticism) has been suggested as an effective measure to account for reporting bias in work stress research (39). In this study, we observe strong associations between a high neuroticism
The participation rate during the initial survey was low (45%). Selection bias may explain some of the high odds ratios seen for the individually reported psychosocial factors if depressed nonparticipants more often experience low levels of psychological demands and high levels of decision latitude, but it can hardly explain the discrepancy we observe between results based on individual and work-unit exposure information. Moreover, if we extrapolate the work-unit–based exposure assessments to the nonrespondents and analyze the association with redeemed antidepressant prescriptions as recorded in a registry that covers all pharmacies in Denmark, this does not indicate bias toward the null but, if anything, bias toward positive associations. Thus, the age- and gender-adjusted relative odds ratios are 1.17 (95% CI: 0.90, 1.53) for high psychological demands and 1.36 (95% CI: 0.89, 2.08) for low decision latitude when we compare the subsample of respondents with the entire source population. Thus, we observe a slightly stronger association between adverse psychosocial work characteristics and prescription of antidepressive medicine among responders than in the entire study population. Although this finding is reassuring, we acknowledge that the high prevalence of antidepressive drug prescription may be a poor proxy of depression.

The aggregated exposure measures applied in this study circumvent the serious problems of reporting bias, and this measure furthermore is expected to yield more valid estimates of the individual worker’s long-term exposure because psychosocial factors show large intraindividual variability over time (40–43). The exposure contrasts between work units (15.3% and 19.5% for psychological demands and decision latitude, respectively) are comparable with those found for other work-unit–based grouping strategies for psychosocial factors at work (16, 37), while lower values are seen when grouping is based on job title and occupation (44). The exposure homogeneity within work units (expressed by the ratio of the 97.5th and the 2.5th percentiles of the exposure distributions) is higher than that seen for grouping strategies applied for gaseous and other chemical exposures (35).

In spite of the above advantages of group-based exposure assessment, there are also limitations. Because of the low participation rate and exclusion of exposure ratings of depressed participants, our measures of exposure are based upon only a subgroup of the work unit. We cannot exclude that this rating is different from the rating that depressed individuals would have given if not in a depressive mood or different from the rating nonparticipants would have provided if they had participated. Perhaps even more important,
Table 5. Odds Ratios for Depressive Symptoms and a Diagnosis of Depression With Levels of High Psychological Demands and Low Decision Latitude: The Effect of Individual Versus Work-Unit Mean Exposure Information, Århus, Denmark, 2007

<table>
<thead>
<tr>
<th>Exposure and Category Designation</th>
<th>Depressive Symptoms</th>
<th>A Diagnosis of Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Cases</td>
<td>Crude OR</td>
</tr>
<tr>
<td>Individual exposure information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High psychological demands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (never)</td>
<td>9</td>
<td>1.00c</td>
</tr>
<tr>
<td>2 (seldom)</td>
<td>48</td>
<td>0.77</td>
</tr>
<tr>
<td>3 (sometimes)</td>
<td>114</td>
<td>1.00</td>
</tr>
<tr>
<td>4 (often)</td>
<td>87</td>
<td>1.00</td>
</tr>
<tr>
<td>5 (always)</td>
<td>29</td>
<td>1.00</td>
</tr>
<tr>
<td>Low decision latitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (never)</td>
<td>3</td>
<td>0.96</td>
</tr>
<tr>
<td>2 (seldom)</td>
<td>82</td>
<td>1.00</td>
</tr>
<tr>
<td>3 (sometimes)</td>
<td>162</td>
<td>1.00</td>
</tr>
<tr>
<td>4 (often)</td>
<td>39</td>
<td>1.00</td>
</tr>
<tr>
<td>5 (always)</td>
<td>1</td>
<td>0.96</td>
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<tr>
<td>Work-unit mean exposure information</td>
<td></td>
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<tr>
<td>High psychological demands</td>
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<tr>
<td>2 (seldom)</td>
<td>49</td>
<td>1.00</td>
</tr>
<tr>
<td>3 (sometimes)</td>
<td>213</td>
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<tr>
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<td>1.00</td>
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<td>Low decision latitude</td>
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<td></td>
</tr>
<tr>
<td>2 (seldom)</td>
<td>136</td>
<td>1.00</td>
</tr>
<tr>
<td>3 (sometimes)</td>
<td>151</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio.

a Controls are all noncases.
b Adjusted for age (4 levels), sex, previous depression, family history of depression, income, education (3 levels), alcohol consumption, negative life event during the last 6 months, and living alone.
c Reference category.
d Alternative reference category to make results directly comparable with results based on work-unit mean exposure information.
e A total of 9 controls but no cases with a diagnosis of depression occurred in this category; these controls were not included in the models.
f A total of 6 controls but no cases occurred in category “4.” For “often,” these controls were not included in the models.
the psychosocial environment may be heterogeneous within work units that include a number of different professions leading to misclassification of exposure. There is a need for refinement of the crude work-unit–based exposure assessment in future work.

One may question if a difference on the exposure scales from, for example, “seldom” to “sometimes” encompasses any relevant exposure contrast that is coherent with our everyday experience about how adversities affect our mental well-being and health. Still, this contrast is sufficient to generate an odds ratio of 1.67 (95% CI: 1.04, 2.67) for the association between low decision latitude and a diagnosis of depression. This finding is, furthermore, not in conflict with previous studies on the subject (4–6), but only when exposure is individual and self-reported.

The fact that results are about the same whether the outcome is a diagnosis of depression or depressive symptoms may be interpreted as there is no biased reporting of depressive symptoms. However, depressive symptoms and job strain are so closely interwoven that it probably is not possible to disentangle the biased reporting of symptoms from biased reporting of exposure. The finding, however, stresses that clinical outcome data may not suffice to avoid biased reporting of exposure, because the underlying disorder may heavily influence how exposure is experienced and reported as long as it generates perceivable symptoms (contrary to purely subclinical effects).

Our results suggest that the strong associations between individually reported adverse psychosocial factors at work and depression, at least partly, reflect reporting bias and not factors that the average worker would find psychologically strenuous (8, 45). Selection bias and confounding are alternative explanations, but they are less likely as discussed above.

This is a cross-sectional study, and the simultaneous collection of exposure and outcome data will, no doubt, contribute to the strong effect of individually reported psychological demands and decision latitude (10). The question is if the results also apply to prospective designs relying on individually reported exposures. Depression may have a long preclinical course with subthreshold symptoms that influence the reporting of working conditions. Therefore, follow-up studies that rely on self-reported, individual exposure information may also suffer from reporting bias, even if cases present at baseline are excluded. In some studies, attempts have been made to limit this bias by adjusting for minor psychiatric morbidity or negative affectivity (5).

However, it is unclear whether adjustments capture all types of relevant preclinical forms of depression. Furthermore, it can be argued that preclinical depressive symptoms or other forms of reduced psychological well-being might be an intermediate step in the causal link between work environment exposures and the onset of clinical depression, and adjustment therefore is inappropriate.

To conclude, this study indicates that reporting bias inflates associations between high psychological demands and low decision latitude at work and the occurrence of depression, if studies rely on individual self-reports. To clarify possible causal contributions to these associations, better independent, objective, and high-contrast measures of psychosocial exposures at work must be developed. Analytical grouping strategies able to capture categories of workers with homogenous working conditions may be a promising way forward.

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