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The Relation between Work-related Psychosocial Factors and the Development of Depression

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This review is based on a literature search made in January 2007 on request by the Danish National Board of Industrial Injuries. The search in PubMed, EMBASE, and PsycINFO resulted in more than 1,000 publications. This was reduced to 14 after the titles, abstracts, and papers were evaluated by using the following criteria: 1) a longitudinal study, 2) exposure to work-related psychosocial factors, 3) the outcome a measure of depression, 4) relevant statistical estimates, and 5) nonduplicated publication. Of the 14 studies, seven used standardized diagnostic instruments as measures of depression, whereas the other seven studies used self-administered questionnaires. The authors found moderate evidence for a relation between the psychological demands of the job and the development of depression, with relative risks of approximately 2.0. However, indication of publication bias weakens the evidence. Social support at work was associated with a decrease in risk for future depression, as all four studies dealing with this exposure showed associations with relative risks of about 0.6. Even if this literature study has identified work-related psychosocial factors that in high-quality epidemiologic studies predict depression, studies are still needed that assess in more detail the duration and intensity of exposure necessary for developing depression.

depression; prospective studies; psychology; work

Abbreviations: CI, confidence interval; JCQ, Job Content Questionnaire; NEMESIS, Netherlands Mental Health Survey and Intervention Study; RR, relative risk.

INTRODUCTION

Depression is a frequent mental disorder with severe consequences. The 1-year prevalence of major depression has been reported to be between 2 and 5 percent in several studies; however, prevalence rates as low as 0.6 percent and as high as 10.3 percent have also been found (1). Regarding lifetime prevalence, a recent review of 16 epidemiologic studies reported rates in the range of 3.0–24.4 percent, with a mean lifetime prevalence of 11.7 percent (2). It is unclear to what extent the substantial variation in both 1-year and lifetime prevalence of depression across studies reflects true differences in prevalence, cultural differences in reporting, or differences in the instruments that have been used to measure major depression (1). Milder forms of depression, also referred to as ''minor depression'' or ''subthreshold depressive symptoms,'' have been researched less but are thought to have even higher prevalence (3).

According to the World Health Organization, depression is one of the most disabling of disorders, ranking fifth place on the list of disorders with the highest disability-adjusted life-years score (4), and it is estimated that depression will

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move up to second place by the year 2020. It has been shown that the risk for days lost from work was approximately five times higher for patients with major depression compared with nondepressive persons, and even for patients with minor depression the risk was approximately 1.6 times higher (5). This association between severity of depression and days lost from work has been confirmed recently (6), and the impact of comorbidity with chronic medical conditions on work loss or quality of life is also reported (3, 7, 8).

The exact causes for the development of depression are still not known. It is widely assumed that the etiology is multifactorial involving genetic, biologic, and psychosocial factors (9). Studies have consistently shown that women have a higher risk for depression than men do, although the gender ratios differed considerably among the studies (1). Low socioeconomic status has also been identified as a risk factor for major depression in a recent meta-analysis (10). Family and twin studies suggest a genetic component in the etiology of major depression; however, the specific genes or gene-environment interactions have not been identified yet (11). There is also evidence that both anxiety disorders and minor depression are important risk factors for the onset of a major depression (3, 12).

Regarding psychosocial factors, research has focused mainly on adverse life events and lack of social support (9). Among life events, both the experience of severe physical diseases, such as myocardial infarction (13) or cancer (14), and the experience of loss, such as the death of a significant person, separation, or divorce (9), have predicted the risk of major depression.

A possible effect of exposure to adverse psychosocial working conditions on the risk of common mental disorders has been discussed for some time; however, most studies have been cross-sectional (15). Only recently have studies used longitudinal study designs in this research area (16). A review and meta-analysis by Stansfeld and Candy (16) on the prospective association between psychosocial working conditions and the risk of common mental disorders identified 38 studies, of which 11 were suitable for a meta-analysis. However, Stansfeld and Candy did not conduct subanalyses on the effect of psychosocial working conditions on specific common mental disorders, such as depression.

The present review is, on the one hand, an update of the review by Stansfeld and Candy (16) including several studies published after 2005 and, on the other hand, a specific focus on the effect of psychosocial working conditions on the risk of depression. The review is based on a report for the Danish Working Environment Research Fund on the relation between work-related stressors and the development of mental disorders other than post-traumatic stress disorder, which we finalized in September 2007. The report was requested by the Danish National Board of Industrial Injuries and the associated committee in connection with providing scientific evidence for the ongoing negotiations as to which disorders should be included in the Danish directory of occupational diseases.

EXPOSURE

For the purposes of this study, work-related psychosocial stress factors are defined as aspects of the job (i.e., work content, organization, relations, and so on) that can lead to a stress condition characterized by symptoms or impaired functioning and ill health. Physical as well as chemical, biologic, and psychological factors can lead to stress, but in the present context the focus is entirely on the so-called psychosocial stressors. Scientific studies that have examined the association between psychosocial stressors and disorder have generally used three different measures of exposure. 1) Stressors can be evaluated objectively (e.g., administrative data as number of working hours) (17) or by observation (18). 2) Stressors can be self-reported, measured by standardized questionnaires based on different models, such as the Job Strain Model of Karasek et al. (19). 3) Some studies use the so-called ecologic method, where the extent and type of psychosocial work-related factors are based on reports from people with particular types of jobs in order to avoid the common method bias, when both exposure and outcome are measured by self-report by the individuals (20). This method often implies the use of an environmental exposure matrix, where jobs are classified according to the degree of exposure.

An objective description of the exposure has been used in only a very few studies, as psychological stressors are either very difficult to measure or because documentation is unavailable (21, 22). On the other hand, it is fairly straightforward in scientific studies to ask people how much or how frequently they are exposed to different stressors in their work (23, 24). In this context, it is important to emphasize that some self-reported measures assess characteristics of the workplace (i.e., potential stressors), whereas others assess how people feel when they are exposed to stressors (i.e., stress reactions, reduced well-being). For the purpose of this review, we selected studies that assessed the characteristics of the workplace, because using stress reactions as a predictor variable when the outcome (depression) is thought to be a kind of stress reaction would constitute a ''triviality trap.''

Psychological stressors in the work environment are highly varied and can be very different depending on the type of job. In order to compare the results of different types of studies, we used many studies of models for psychological strain that operationalize the most important stressors. Examples are the Job Strain Model developed by Karasek et al. (19) and the Effort-reward Imbalance Model developed by Siegrist (25). Both of these models have been used in a number of studies of health and psychological strain at work. The first model has been particularly dominant within occupational health research during the last 20 years.

The Job Strain Model uses two main dimensions: demands and decision latitude. The decision latitude dimension consists of two subdimensions: decision authority and skill discretion. By combining the two main dimensions, we present four stress conditions: Persons who experience high demands and have a high decision latitude are termed ''active,'' the combination of high demands and low decision latitude is termed ''strained,'' that of low demands and high decision latitude is termed ''relaxed,'' and the combination of both low demands and low decision latitude is termed ''passive.'' According to the model, people in strained jobs bear the highest risk for developing stress-related disorders.

Social support at work has been shown to modify the strain that might lead to stress, and in some studies social

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support is therefore used in combination with the job-strain model in a so-called isostrain model (26). In this context, it is decisive whether or not the social network provides real support in the handling of psychosocial strain. Most studies have used two measures of social support, one from coworkers and one from supervisors (19). However, social interactions at work can also be negative, and measures of conflicts and bullying at the workplace represent these more negative aspects (27).

In addition to the Job Strain Model, Siegrist et al. (28) have developed a stress model, called the Effort-reward Imbalance Model, that is based on the individual experience of the balance between the effort made and the reward received. According to this model, the most stressful condition is when the reward does not match the effort made. Reward includes financial rewards, esteem rewards, promotion prospects, and job security. Moreover, it is assumed in this model that people with a personal disposition called ''work-related overcommitment'' are at especially increased risk for poor health, when exposed to high effort and low reward.

OUTCOME

So far, the association between work-related psychosocial factors and depression with a clinical diagnosis by a physician or psychiatrist has been described in only a very few studies. The majority of scientific studies that have looked into the associations between psychosocial work-related factors and mental health have used different forms of more or less validated outcome measures, with several studies using general measures of distress (16). To a certain extent, this makes sense, especially in the light of recent considerations of group depression as a distress disorder in the forthcoming *Diagnostic and Statistical Manual of Mental Disorders: DSM-V* (29). However, for this review, we excluded studies that used measures of distress and included only studies that assessed depression by 1) a clinical diagnosis by a physician, 2) a validated diagnostic interview, conducted by a trained interviewer, or 3) a validated rating scale for depression.

LITERATURE SEARCH

The literature search was carried out by using the databases PubMed (1960-), EMBASE (1980-), and PsycINFO (1967-) up until January 28, 2007. Only longitudinal studies and studies published in English in peer-reviewed journals were included. The search words are listed in table 1. There were a total of 3,416 studies (2,291 in PubMed, 659 in EMBASE, and 466 in PsycINFO, some of which were duplicates) (figure 1). These were all checked and categorized according to title by one of the authors. A selection was made so that only longitudinal studies on work-related issues and mental disorder were considered. The result was 319 articles, the abstracts of which were read by two authors. After the exclusion of irrelevant articles following the same criteria, the number of relevant articles was 81. All of these were read in order to find the relevant exposures and outcome. The bibliographies of all selected articles, as well as the personal files and reference lists of the authors, were checked to identify further studies that might fulfill the eligibility criteria. In addition, the meta-analysis from Stansfeld and Candy (16) was searched for further qualifying studies.

TABLE 1. Search terms in the literature search

Exposures	Outcomes
Workload	Psychiatric
Work conditions	Psychiatric disorders
Job conditions	Mental
Working hours	Mental health
Working time	Substance use
Night work	Abuse
Shift work	Drug
Stress*	Alcohol
	Benzodiazepine
Psychosocial work environment	Psychosis
Effort reward	Psychotic
Emotional demands	Paranoia
Iso-strain†	Paranoid disorder
Job strain	Mood disorders
Job security or job insecurity	Affective disorders
Job control	Bipolar
Justice	Depressive
Meaning of work	Depression
Predictability of work	Anxiety
Psychosocial demands	Anxiety disorder
Bullying	Generalized anxiety
Mobbing	Panic disorder
Teasing	Obsessive-compulsive disorder

* Stress AND (job OR work OR occupation).

† Job strain plus exposure to low social support at work (''isolated high strain'' work).

The selection for inclusion in the review was made according to the following criteria:

- The study should be longitudinal so that the outcome has been measured after the exposure.
- Exposure should be work-related psychosocial factors.
- Outcome should be a measure of depression.
- The data analysis should be prospective.
- There should be relevant statistical estimates of the associations tested.
- The study population should be greater than 100.
- The data from the study should not be published elsewhere. In the case of duplicate publication or publication of data from the same study with the same exposure measure or outcome, the paper with the most relevant follow-up period, analysis, and risk estimate was chosen.

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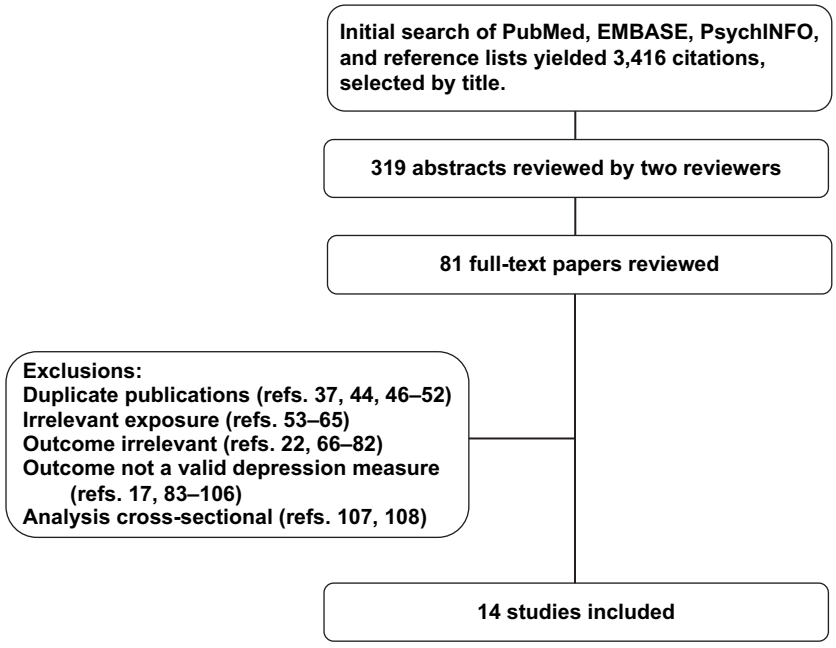


FIGURE 1. Search strategy on the relation between work-related psychosocial factors and depression.

RESULTS

Table 2 provides an overview of the 14 studies included in this review. In seven studies, the assessment of depression was based on psychiatric diagnoses, scales with diagnostic classifications, or antidepressant prescription, whereas in the seven other studies, depression was measured with a questionnaire.

Psychological strain at work and outcome in the form of a psychiatric diagnosis or depression based on a diagnostic classification scale

Three of the seven studies used the job strain model as exposure measure (30–32). Three studies used questionnaire-based variables for psychological strain at work (33–35), whereas the last used the ecologic method where occupation was a proxy measure for exposure to threats and violence (20).

The Netherlands Mental Health Survey and Intervention Study (NEMESIS) is a prospective study of 2,646 working men and women aged between 18 and 65 years (30). The study is very well described insofar as there is a thorough description of the sampling procedures, nonrespondents, and methods of analysis. The Job Content Questionnaire (JCQ) was used as the exposure measure, but no job strain variable was calculated. The analysis unfortunately does not distinguish between male and female respondents, but it is stated that the relative risk of depression is 1.8 for women compared with men. The outcome was depression and anxiety disorders according to the *Diagnostic and Statistical Manual of Mental Disorders: DSM-IIIR* diagnosed by use of the diagnostic tool, the Composite International Diagnostic Interview (often referred to as ''CIDI''). The data collection took place by use of trained interviewers. The relative risk of psychosocial strain at work, as measured by psychological demands, was significantly increased at 3.5 (95 percent confidence interval (CI): 1.9, 6.3) for depression. Social support was negatively associated with depression (relative risk (RR) = 0.8, 95 percent CI: 0.7, 0.9), whereas decision latitude and job insecurity were not significantly associated with depression.

The follow-up time was 2 years, while in a similar Canadian National Population Health Survey study, it was 8 years (31). In the Canadian study, more than 12,000 employed people were followed, and exposure was measured by using the JCQ and social support as in the Dutch study. However, it has to be noted that only a shortened form of the JCQ was used and that the reliability of the exposure measures was regarded as problematic. The studies both used the same diagnostic instrument. The Canadian study also had a relevant confounder control, and the design ensured a clean baseline; for example, only incident cases were included in the analyses. Self-reported job strain in 1994 and 2000 caused a relative risk of depression of 3.4 (95 percent CI: 1.8, 6.4). Similarly, for those who did not report job strain in 1994 but did in 2000, the relative risk of depression was 3.3 (95 percent CI: 1.8, 6.1) when measured 2 years later, in 2002. The study does not state the exact numbers for each gender, but in one figure it is shown that the 2-year incidence for depression for men with high job strain is three times greater compared with that for men with low job strain. This is the same for women, where the incidence is twice as high for those with high job strain compared with the incidence

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TABLE 2. Longitudinal studies on the relation between work-related psychosocial factors and depression

Author(s), year, and reference	Population	Exposure measures	Follow-up time, years	Outcome	Confounder adjustments	Analysis	Risk of depression		
							Men	Women	Both genders
Wieclaw et al., 2006 (20)	Among all employed Danes, 14,166 cases and 58,060 controls	Occupation with exposure to threats and violence	1	Depression diagnosed in psychiatric hospital	Age, sociodemographics	Baseline not clean†	Violence: RR* = 1.5 (95% CI*: 1.2, 1.9) Threats: RR = 1.2 (95% CI: 0.9, 1.5)	Violence: RR* = 1.5 (95% CI:* 1.3, 1.7) Threats: RR = 1.5 (95% CI: 1.3, 1.8)	
Plaisier et al., 2007 (30)	1,529 employed men and 1,117 women	JCQ* social support	2	CIDI* by trained interviewer	Age, gender, health, education	Clean baseline; job strain not calculated		Risk for depression for women: RR = 1.8 compared with men	Demands: RR = 3.5 (95% CI: 1.9, 6.3) Social support: RR = 0.8 (95% CI: 0.7, 0.9) Decision latitude and job insecurity: NS*
Shields, 2006 (31)	12,011 employed Canadians aged 18–75 years	JCQ measured coworker and supervisor support twice.	8 for job strain, and 2 for support	CIDI in 2002 as a questionnaire	Age, gender, marital status, education, occupation, lifestyle factors	Clean baseline; detailed information on loss of follow-up	Low coworker support: RR = 2.4 (95% CI: 1.7, 3.3) Low supervisor support: RR = 1.7 (95% CI: 1.0, 2.7)	Low coworker support: RR = 1.8 (95% CI: 1.4, 2.4) Low supervisor support: RR = 1.6 (95% CI: 1.2, 2.2)	Job strain in 1994 and 2000: RR = 3.4 (95% CI: 1.8, 6.4) No job strain in 1994 but in 2000: RR = 3.3 (95% CI: 1.8, 6.1)
Virtanen et al., 2007 (32)	1,704 women and 1,662 men all employed	JCQ	3	Antidepressant prescription; data from public register	Age, marital status, occupational grade, mental disorder at baseline		Job strain: RR = 2.0 (95% CI: 1.0, 3.8)	Job strain: RR = 1.2 (95% CI: 0.7, 2.0)	
Kawakami et al., 1990 (33)	3,045 male workers in an electronics plant	Job stress variables	3	DSM-III* by psychiatrist	Partly by comparing confounders	Clean baseline; adequate analyses	"Unsuitable job": RR = 11.3 (95% CI: 2.0, 61.8) Job overload, overtime, human relations: NS		
Shields, 1999 (34)	1,649 women and 2,181 men aged 25–54 years and employed ≥35 hours per week	Weekly working hours self-reported	2	CIDI in 2002 as a questionnaire	Age, socioeconomics, education, income, occupation, self-employment	No clean baseline	≥41 vs. 35–40 hours/week: RR = 0.6 (95% CI: 0.3, 1.3)	≥41 vs. 35–40 hours/week: RR = 2.2 (95% CI: 1.1, 4.4)	

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Wang, 2005 (35)	6,099 employed Canadians	Work stress: 12 questions on skill discretion, decision authority, psychological demands, job insecurity, physical exertion, and social support	2	Major depressive episode during last year by CIDI–Short Form for Major Depression	Age, gender, marital status, income, race, education, medical illness, subsequent mental health service use	Clean baseline			RR = 2.4 (95% CI: 1.5, 3.8)
Paterniti et al., 2002 (36)	2,790 women and 7,729 men working in the French National Electricity and Gas Company	Demands, decision latitude (JCQ), social support	3	CES-D*	Age, education, marital status, stressful personal events, baseline CES-D score	Adjusted for baseline illness	*p* values of regression coefficients Demands: <0.001 Decision latitude: <0.01 Social support: <0.01	Regression coefficient *p* values Demands: <0.001 Decision latitude: NS Social support: <0.05	
de Lange et al., 2002 (38)	824 employed persons	JCQ changes over time	1 × 4	CES-D	Age, gender, education	Changes in exposure and outcome			Increased job strain associated with depression
Schonfeld, 2001 (39)	184 female teachers	Episodic stressors (threats, confrontations)	3 × 4	CES-D	Age, socioeconomics, race, marital status	No clean baseline; no risk estimate		Regression coefficient *p* value: <0.01	
Moore et al., 2004 (40)	1,235 employees	Downsizing: layoffs	2	CES-D	Age, gender, education	No clean baseline; no risk estimate			Prevalence of depression 5.2% among never layoffs; 10.4% among those with two layoffs ($p < 0.001$)
Fullerton et al., 2004 (41)	116 persons exposed to rescue work after an airplane crash with deaths and survivors and 217 other rescue workers	Previous disaster experience and disaster exposure to dead bodies, physical danger, and assistance of survivors		Zung scale	Age, gender, marital status, education	No clean baseline			Previous disaster experience: RR = 1.2 (95% CI: 0.3, 4.9) Disaster exposure to dead bodies, etc.: RR = 3.5 (95% CI: 1.2, 10.6)

Table continues

TABLE 2. Continued

Author(s), year, and reference	Population	Exposure measures	Follow-up time, years	Outcome	Confounder adjustments	Analysis	Risk of depression		
							Men	Women	Both genders
Ylipaavalniemi et al., 2005 (42)	4,278 women and 537 men, all hospital personnel	Demands, control, job strain, bad team climate, low procedural injustice, low relational justice	2	Self-reported ''doctor-diagnosed depression''	Age, gender, lifestyle	Clean baseline			Demands: RR = 1.1 (95% CI: 0.8, 1.6) Control: RR = 1.0 (95% CI: 0.7, 1.5) Job strain: RR = 1.3 (95% CI: 0.9, 1.8) Bad team climate: RR = 1.6 (95% CI: 1.1, 2.2) Low procedural injustice: RR = 1.3 (95% CI: 0.9, 1.8) Low relational justice: RR = 1.4 (95% CI: 1.0, 2.0)
Godin et al., 2005 (43)	700 women and 836 men, all employees in four plants (Somstress Study)	ERI* measured twice 1) no-no 2) yes-no 3) no-yes 4) yes-yes‡	1	SCL90* for depression	Age, education, job dissatisfaction, workplace instability	Clean baseline	ERI no-no compared with Yes-no: RR: NS No-yes: RR = 4.6 (95% CI: 2.3, 9.2) Yes-yes: RR = 2.8 (95% CI: 1.3, 5.7)		

* RR, relative risk; CI, confidence interval; JCQ, Job Content Questionnaire; CIDI, Composite International Diagnostic Interview; NS, not significant; DSM-III, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition; CES-D, Center for Epidemiologic Studies Depression [Scale]; ERI, effort reward imbalance; SCL90, Symptom Check List-90.

† Clean baseline (cases with depression at baseline are excluded from the analyses). The risk estimates are therefore based on incident cases.

‡ Refer to text.

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for those with low job strain. As in the Dutch study, there was an association between social support at work for both men and women.

On the basis of data from the Canadian National Population Health Survey cohort, Wang (35) published data from a 2-year follow-up from 1994/1995 to 1996/1997. Job strain in this study was analyzed together with other exposure variables, creating a work-stress index. The relative risk of depression during the 2-year follow-up period was 2.4 (95 percent CI: 1.5, 3.8), controlled for relevant confounders, but gender-specific estimates were not reported. It is not stated why the work-stress index was used as an independent variable in the analysis instead of a strain variable derived from the JCQ.

A part of the Canadian National Population Health Survey cohort was analyzed with a focus on the association between weekly working hours and depression (34). The follow-up period was 2 years, but the actual analysis is unclear compared with the later analyses based on this cohort. Furthermore, it is not stated whether the study refers to incident cases of depression or whether the risk estimates are also based on cases of earlier depression. Women working more than 40 hours per week compared with women working 35–40 hours per week were found to have a significantly increased risk of depression of 2.2 (95 percent CI: 1.1, 4.4). There was no such increased risk for men.

In a Japanese study of more than 3,000 male industrial workers, 35 cases of depression diagnosed by a psychiatrist were found during a 3-year period (33). According to baseline exposure measures, it was found that ''unsuitable jobs'' gave a relative risk of depression of more than 11 (95 percent CI: 2.0, 61.8). A nested case-control design was applied. ''Human relations'' also predicted significant depression, but in an overall multivariate analysis this variable was not significant. The exposure measure seems to be an ad hoc instrument, but the design and outcome measures are strong, indicating that a mismatch between working conditions and personal resources might increase the risk for developing depression.

In a Finnish register-based study, Virtanen et al. (32) used the JCQ as the exposure measure and antidepressant prescription during the following 3 years as the outcome. The relative risk for an antidepressant prescription was 2.0 (95 percent CI: 1.0, 3.8) for job strain for men and 1.2 (95 percent CI: 0.7, 2.0) for women. An antidepressant prescription is a rather rough proxy measure of depression as the drugs are sometimes also used for other conditions. However, the results from this study were supported by similar results regarding a 12-month prevalence of depressive disorders.

A Danish study, including more than 14,000 people who were admitted to a psychiatric ward and nearly 60,000 controls, examined the association between violence and threats at work on the one side and affective and stress-related diagnoses on the other (20). Women who worked in jobs that had, on average, a high level of exposure to violence and threats had an increased odds ratio of 1.5 (95 percent CI: 1.3, 1.8) for depression. For men, violence was associated with depression of the same magnitude, whereas exposure to threats did not reach significant association. The exposure is not self-reported as the ecologic method is used, whereby the job title the year before hospital admission was used as a proxy measure for the exposure. We therefore regarded the results from this study as longitudinal results, although the study itself was a case-control study.

Psychological strain at work and outcome measured with depression scales

Four studies used the Center for Epidemiologic Studies Depression (CES-D) Scale. The most convincing is the French study of nearly 10,000 employees of Electricité de France–Gaz de France, known as the ''GAZEL Study'' (36). This cohort was followed for 3 years. The baseline exposure used the JCQ and a measure for social support at work. Confounder adjustment was carried out and controlled for psychiatric symptoms at baseline. In the paper, no risk estimates, that is, relative risks, are published, but regression coefficients showed that for men as well as women high psychological demands and low social support had a significant positive association with subsequent depression measured by means of the Center for Epidemiologic Studies Depression Scale. For men, there was also a positive association between depression and low decision latitude, but this did not apply to women. For high levels of psychological demands, the risk estimates for depression in the first year of follow-up were 1.8 (95 percent CI: 1.6, 2.0) for men and 1.4 (95 percent CI: 1.1, 1.7) for women. The odds ratio for low decision latitude was 1.4 (95 percent CI: 1.2, 1.6) for both genders (37).

In the Study on Musculoskeletal Disorders, Absenteeism, Stress, and Health (known as the ''SMASH Study'') involving more than 800 Dutch employees, four measurements of job strain were made at 1-year intervals, showing a significant association between a high score on the depression scale and increased job strain (38). Unfortunately, no risk estimates were made.

A small study of 184 female teachers (39) who were followed for 9 months showed an association between ''episodic stressors'' (stress and confrontations) and depression. In a study of companies that were in a down-sizing process lasting 2 years, Moore et al. (40) showed a prevalence of depression that was twice as high for those employees who had experienced two layoffs or more, compared with those who had never experienced one. Indirect threats to employment also increased the risk of depression, but the analyses reported that only direct layoff contacts seem to increase the risk significantly.

Fullerton et al. (41) studied the development of depression among rescue workers who were exposed to dead bodies and physical danger and who gave assistance to survivors in disaster situations. The study observed the rescue workers for 1 year by use of the Zung depression scale and found a relative risk of developing depression of 3.5 (95 percent CI: 1.2, 10.6). Previous experience of a disaster did not affect the development of depression during the follow-up period.

A Finnish study of nearly 5,000 mainly female employees at a hospital showed an association between ''team climate'' and self-reported, physician-diagnosed depression in the

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2-year follow-up period (42). No significant association between job strain and depression was found (RR = 1.3, 95 percent CI: 0.9, 1.8). Neither were demands (RR = 1.1, 95 percent CI: 0.8, 1.6) nor control (RR = 1.0, 95 percent CI: 0.7, 1.5) associated with depression. However, a low degree of relational justice at the workplace was associated with increased risk of depression (RR = 1.4, 95 percent CI: 1.0, 2.0).

The effort/reward imbalance model was tested in a Belgian study known as ''the Somstress Study'' (43), which showed that an increasing effort/reward imbalance during the course of 1 year had a strong statistical association with depression and anxiety symptoms in both men and women. In the analyses, the reference group was those who did not experience effort/reward imbalance at either baseline or time 2, the follow-up (in table 2 labeled ''no-no''). Only those reporting an effort/reward imbalance at time 2 had increased risk of depression, especially the ''no-yes'' group who went from a balanced to an imbalanced situation during the follow-up period. The measure of exposure at time 2 was, however, done at the same time as the outcome evaluation. For this reason, the risk estimates might be biased, as the two sets of variables cannot be considered independent. A closer look into the data, however, justifies the conclusion, that effort/reward imbalance is associated with outcome as the relative risks would be approximately 2.0 if those with imbalance at time 1 were compared with those without imbalance at the same time.

Taken as a whole, the studies using the Job Strain Model did not show consistent results, but there is a certain support for the proposition that psychological demands increase the risk of depression.

An overview of results from studies that have calculated risk estimates on the relation between work-related psychological strain and depression is shown in figure 2. Only nine of the 14 studies reported calculations or relative risks, which could be used in a graphical expression. The relative risks in most studies are seen to be significantly higher than 1 regarding strain and demands.

Social support and depression

Social support as an exposure variable has been included in four of the studies (30, 31, 37, 42). The studies, however, used different, not comparable, measures of social support. In the NEMESIS (30), a broad definition of emotional social support including private life support was applied. A high degree of social support was negatively associated with depression (RR = 0.8, 95 percent CI: 0.7, 0.9). The effect was stronger for men compared with women. Social support did not buffer the unfavorable effect of working conditions.

In the GAZEL Study (31), the risk for depression by low social support at work was 1.6 (95 percent CI: 1.4, 1.8) for men and 1.3 (95 percent CI: 1.1, 1.6) for women. In this study, the measure of social support dealt only with coworker support. In the Canadian National Population Health Survey study (37), both coworker and supervisor support were taken into account. The risk for depression was significantly increased with lack of both, most pronounced for coworker support (table 2). Finally, a Finnish study (42) used ''team climate'' covering whether the interpersonal atmosphere was supportive, including support for innovation, a shared vision, and commitment to excellence as the exposure measure. A low degree of team climate increased the risk of depression to 1.6 (95 percent CI: 1.1, 2.2).

In conclusion, in light of these studies, there is clear evidence showing an association between low social support at work and increased depression.

Publication bias and feasibility of a meta-analysis

The feasibility of a formal meta-analysis was discussed after a search was performed and studies were included. Exposure measures were somewhat diverse and, for some of the studies, findings were reported independently for men and women. Thus, two funnel plots were made (plotting the point estimates against their variance), one plot using a broad definition of ''job strain'' and one main finding from each study and another plot where the studies were regrouped according to more narrow definitions. Each funnel plot was supplemented with a test for publication bias by using Kendall's tau, assessing the rank correlation between variance and point estimate.

The first funnel plot included the main finding from each of the 10 studies judged to include a broad conceptualization of ''work-related strain'' as the exposure variable (not shown); the plot clearly indicated publication bias (Kendall's tau, 0.74; $p < 0.01$). The studies were then regrouped into studies using the strict definition of job strain according to Karasek et al. (19) (figure 2, topmost part); studies reporting only one or two of the dimensions from the strict definition, demand (figure 2, upper middle part) and decision latitude (figure 2, lower middle part); and ''other'' operationalizations of work-related strain (figure 2, lowest part). The first three groups each included too few studies to make assessment of possible publication bias meaningful. Visual inspection of the plot for the last group indicates strong publication bias (Kendall's tau, 0.97; $p < 0.01$). Thus, we have not pooled the point estimates from the individual studies by a formal statistical meta-analysis.

DISCUSSION

This literature review has identified occupational psychosocial factors that, in longitudinal epidemiologic studies, were associated with the development of depression. The associations were strongest and most consistent with regard to high psychological demands and low degree of social support. The risk estimates for men and women were slightly different in the various studies, but there was no general tendency for the risk to be higher in one gender compared with the other.

Demands have, however, been measured in different ways, and not all studies have published the exact items used. This is especially a problem as the JCQ has changed over time and the nature of jobs has changed too. The main problem is to what extent demands are measured by variables indicating speed and tempo at work or troubles and other more cognitive burdens. Work pace and time pressure might be relevant in industrial settings, while psychological

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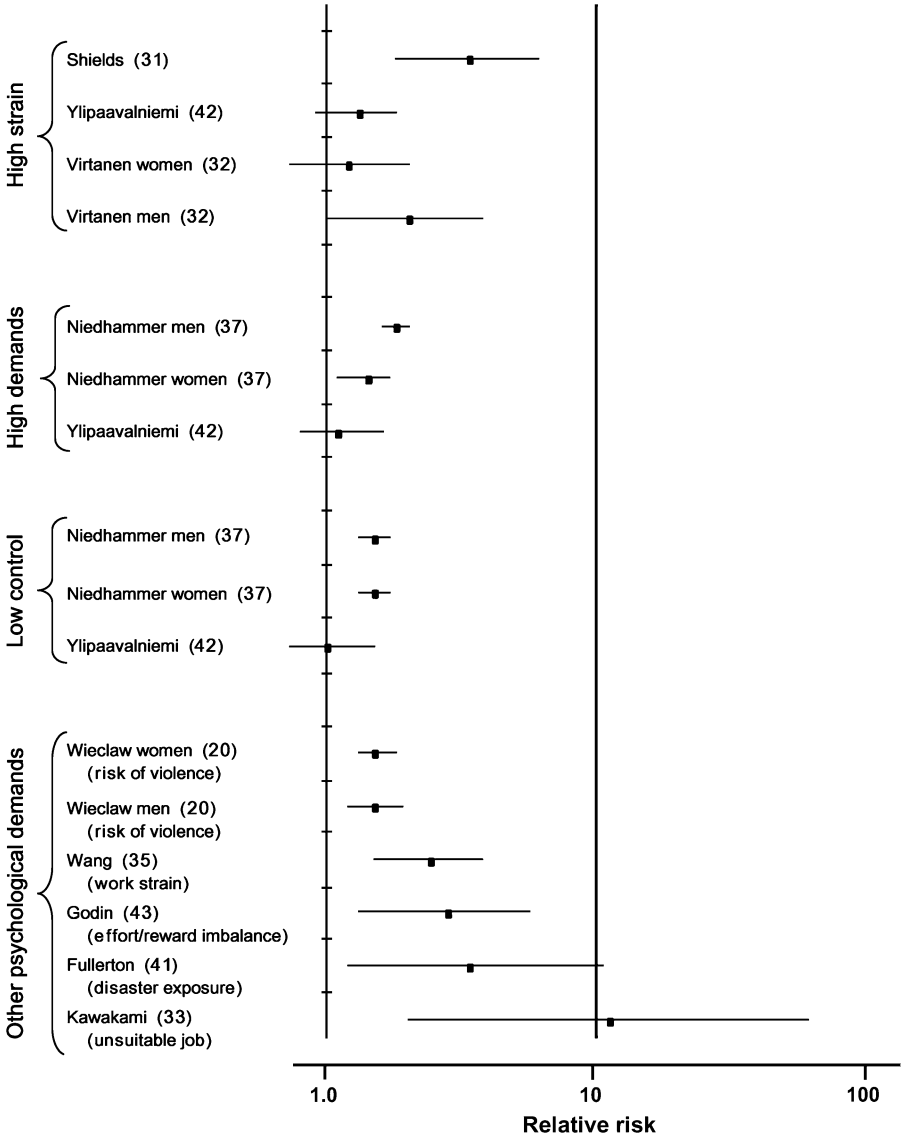


FIGURE 2. Relative risk and 95% confidence interval in longitudinal studies on the relation between work-related strain and development of depression. The studies are grouped according to exposure.

pressure is more important in the health-care sector. This issue has been recently discussed in detail (16). This might be the reason for the negative findings in some of the studies dealing with employees in the public sector.

The results regarding decision latitude are contradictory. The term ''decision latitude'' reflects the degree of control one experiences over one's working condition. The degree of control is normally associated with social status and, as pointed out by Griffin et al. (44), control has different levels of importance for prediction of mental illness in different social groups. Another point made by this group is that there is a spillover effect from work to private life and vice versa regarding control, and this effect is different for men and women. Again, this dimension might be more useful to apply in studies in industrial settings or in working environments where other psychological exposures are not so dominant. The lack of homogeneous results regarding decision latitude might partly be a result of this.

Social support has been measured in different ways, most often as a combination of coworker and supervisor support. In the NEMESIS, the measures even included social support outside work. The studies dealt with in this review, however, do not clarify what kind of social support is important in preventing depression. Neither answers the question if social support is more important for men than for women or vice versa.

The epidemiologic studies do not allow any conclusions to be drawn with regard to the duration or the intensity of the exposure. A limited number of the studies measured

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exposure several times before the outcome measure, but it was not clear whether an increase in the exposures measured caused an increased risk of developing depression more than a long-term exposure did. The studies document neither the overall extent of the exposure over time nor the onset of the depression in relation to the exposure.

The majority of the epidemiologic studies included in this review measured exposure only a few years prior to the outcome. This means that the studies cannot state whether or not the exposure was present at the onset of the depression, which means that there is a strong possibility that the exposure might have changed from weak to strong or vice versa before the onset of the disorder. For this reason, there is likely to be an underestimation of the statistical association between exposure and disorder. Although the studies seem to conclude that there is evidence for an association between certain types of psychosocial strain at work and the development of depression, the studies cannot give answer to the duration or intensity of exposure needed to increase the risk of depression. This applies to precise information about the method of diagnosing the depression and about the severity of the depression. In addition, it is impossible to conclude anything with regard to competing causes of the disorder, except in those cases where the appropriate adjustments for alcohol consumption and other lifestyle factors have been made. In those studies where adjustment for confounding has been carried out, the risk estimate has not been affected to any great extent.

The assessment of publication bias is slightly hampered by the facts that some of the included studies have published independent risk estimates for men and women, some studies report several risk estimates with various confounder controls, and the delimitation of studies with ''other'' operationalizations of ''job strain'' is somewhat subjective. Nevertheless, the indication of publication bias in relation to job strain seems very strong with a correlation coefficient of almost one for the large fraction of studies using nonstandard definitions of work-related strain. Among all the studies, only one study reported only nonsignificant associations (42). One might suspect that this nonsignificant finding was published mainly because the social support variable in the same study turned out as statistically significant and, thus, the job strain finding was published alongside this other finding irrespective of its nonsignificance. In this context, it is of interest to note that a study of predictors of false positive findings among epidemiologic studies of various exposures and various types of cancers (45) found that one of the strongest predictors was ''fishing expeditions,'' that is, testing post hoc hypotheses in a data set at hand. Because all the risk factors studied in this paper have their origin in relation to diseases other than depression, post hoc testing and publication bias are almost to be expected. For controlled trials, the largest studies have been considered the most reliable in situations with publication biases, but there is no reason to assume that this would also be true for observational studies.

FUTURE RESEARCH

In future research, it will be important that exposure measures are both more broad and more precise. To date, assessment of psychosocial working conditions in epidemiologic studies is mainly focused on the components of the demand/control/support model and, to a lesser extent, on the effort/reward imbalance model. Whereas these models have great merits, other psychosocial working conditions, for example, emotional demands, interpersonal conflicts, quality of management, or predictability at work, have been suggested as health-hazardous factors. However, these factors have rarely been investigated in epidemiologic studies.

In future research, more precise exposure measures are needed. Most studies until now have no evaluation of the duration or the intensity of a given exposure. Such evaluation cannot be obtained by means of postal or Internet-based questionnaires alone. In addition, interviews in depth, although standardized, can be applied in order to gather more information on the quality and quantity of stressors. This method, however, contains a risk for information bias, especially as cases of depression might have their experiences colored by their mental illness condition. Using information from other sources might be a way to validate the exposure. Yet, in the case of emotional strain, other sources might be lacking. The exposure assessment could also be improved by characterization of specific working conditions that might be responsible for the increased risk for development of mental disorders.

All this can be obtained by using a nested case-control design. Cases have to be incident cases well characterized diagnostically, and gathering a sufficient number of cases for a case-control design is the only feasible way. The cases could be derived from a cohort study with exposure assessment several times prior to the follow-up as done in the SMASH Study in order to estimate the duration of exposure and the relation between exposure and onset of depression. A screening instrument might be applied in such studies, followed by a more direct diagnostic evaluation of each case by use of the Composite International Diagnostic Interview. Ongoing cohort studies might use the outcome measures as screening instruments and add psychiatric evaluation of cases by standardized methods in order to improve the validity of the outcome.

Confounding factors must include personality and private life stressors, in addition to the confounders included in many of the reviewed studies. The analyses should be stratified by gender instead of just adjusting for gender as done in most studies. As the quality regarding the design of several of the referred studies is high, adjustments, as described above, of measures applied in these studies might to some extent improve the validity of these studies and thereby give further contribution to our knowledge about the relation between work-related stressors and the development of mental disorders. In order to minimize publication bias, detailed protocols for future analyses in the research area should be published before follow-up data are collected. Just a few such studies will be much more reliable than many selective publications based on fishing expeditions.

CONCLUSION

A total of 14 longitudinal epidemiologic studies on the relation between work-related psychological stress factors

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and the development of depression have been traced and evaluated. Psychological strain at work seems to be associated with future depression. Moderate evidence for a relation between psychological demands in the job and development of depression was found. The relative risk estimates were approximately 2.0. However, indication of publication bias weakens the evidence. Social support at work seems to decrease the risk for future depression, as all four studies dealing with this exposure showed associations with relative risks to be about 0.6.

Even if this literature study has identified work-related psychosocial factors that in high-quality epidemiologic studies predict depression, we still need studies that assess in more detail the duration and intensity of exposure needed for developing major depression. For other common mental disorders, such as anxiety and somatoform disorders, studies based on clinical diagnostic measures are strongly needed. Furthermore, transient and less severe reactions as adjustment disorder may be even more relevant to study as these probably are more prevalent and overall result in more sick leave than the more severe mental disorders. Attention in this context must be drawn to the fact that work-related psychosocial factors might have different impacts in different occupational settings.

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