The relationship between work-related stressors and the development of mental disorders other than post-traumatic stress disorder

A reference document on behalf of the Danish Work Environment Research Fund

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Summary

This document is a reference document on the relationship between work-related psychosocial factors and the development of mental disorders other than post-traumatic stress disorder. The results are based on a literature search made in January 2007. The search resulted in more than one thousand publications, which were reduced to 83 after title and abstracts were evaluated using 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 mental disorders, which exclude i.e. burnout and fatigue
- The data analysis should be prospective
- There should be relevant statistical estimates of the associations tested for
- The study population should be greater than 100
- The data from the study should not be published elsewhere. In case of double 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

40 papers were included for further evaluation after double publications and studies with exposure or outcome that were not relevant in this context were excluded. 8 studies had used diagnostic instruments as measures of outcome, 5 used validated scales for depression and 27 used screening questionnaires as measures of mental disorders. An evaluation of the quality of the studies based on the exposure assessment, diagnostic measures applied, confounder adjustment and analysis of data was conducted. 29 of the studies were considered to be high quality studies. On this basis the following conclusions were drawn:

The body of evidence only makes it possible to draw conclusions regarding major depression among the disorders dealt with in the study. Studies on other outcomes were too few or too different in design, for any conclusions to be made.
Psychological demands at work as measured by the Job Content Questionnaire and other measures similar to this are associated with future depression. Seven out of ten high quality studies, two of them using diagnostic instruments, support this view. The relative risk estimates were around 2.0.
Low levels of social support at work are strongly associated with future depression; 13 out of 15 high quality studies, three of which using diagnostic instruments, showed this for women, 11 for men.
Three studies on effort reward imbalance, 3 on injustice, 3 on threats, violence and bullying showed also an association with depression.
5 studies on job insecurity showed associations with future depression in men, but not in women. Studies on decision latitude, job strain and long working hours showed mixed results.

Even if this literature study has identified work-related psychosocial factors, which in high quality epidemiological studies predict depression, we still need studies which assess in more detail the duration and intensity of exposure necessary for developing major depression. For other mental disorders further studies based on diagnosis based measures are urgently required. Attention in this context must be drawn to the fact that work-related psychosocial factors might have different impacts in different occupational settings.

Dansk resume

Dette referencedokument er resultatet af et systematisk review på grundlag af en litteratursøgning foretaget på foranledning af Arbejdsmiljøforskningsfonden. Formålet har været at evaluere den videnskabelige sammenhæng mellem arbejdsrelaterede stresspåvirkninger og udvikling af andre psykiske sygdomme end postraumatisk belastningsreaktion.

Udredningen er foretaget af Arbejdsmedicinsk Klinik, Hillerød Sygehus. Professor Stephen Stansfeld, Centre for Psychiatry, Wolfson Institute of Preventive Medicine, Queen Mary´s School of Medicine & Dentistry, UK og Per Fink, Leder af Forskningsklinikken for Funktionelle Lidelser og Psykosomatik, Århus Sygehus har fungeret som eksterne reviewere af dokumentet. Professor Per Bech , Psykiatrisk forskningsenhed, Hillerød Sygehus og seniorforsker Reiner Rugulies, Det Nationale Center for Arbejdsmiljøforskning har dannet et kvalitetssikringsforum.

Litteratursøgningen blev foretaget i januar 2007 og nærværende rapport færdiggjort august 2007. Litteratursøgningen resulterede i 319 artikler efter initial sortering på titel. På bagrund af abstracts vurderet af de to forfattere, reduceredes antallet af relevante studier til 83, der herefter undersøgtes ved gennemgang af originalartiklerne. Inklusionskriterier for nærværende referencedokument var følgende:

- Studiet skulle være longitudinelt, således at sygdomsmålet var foretaget efter eksponeringsvurderingen
- Eksponeringen skulle være arbejdsrelateret stresspåvirkning
- Sygdommen skulle være en egentlig psykiatrisk tilstand, hvilket udelukker fx udbrændthed og fatigue
- Dataanalysen skulle være prospektiv
- Artiklen skulle indeholde relevante statistiske estimater for de testede associationer
- Den undersøgte population skulle være større end 100 personer
- Data fra studiet måtte ikke være publiceret andet steds. I tilfælde af dobbeltpublikation af data fra same studie med same eksponeringsmål og mål for sygdommen valgtes den artikel med mest relevant opfølgningsperiode, analyse og risikovurdering.

40 artikler blev inkluderet til yderligere evaluering. 8 studier havde anvendt diagnostiske instrumenter eller lignende validerede metoder som mål for sygdom. 5 havde anvendt validerede skalaer for depression og 27 screeningsværktøjer som mål for psykisk sygdom. Der foretoges en kvalitetsvurdering af studierne baseret på anvendte eksponeringsmål, diagnostiske metoder, confounderjustering og analysemetoder. 29 af de 40 studier blev bedømt som værende af høj kvalitet. På denne baggrund er følgende konklusioner draget:

Med den viden de pågældende studier giver os, er det kun muligt at drage konklusioner vedrørende depression. Undersøgelser af andre diagnostiske enheder er for få eller for forskellige mht design til at sammenfattende konklusioner kan foretages.

Psykologiske krav i arbejdssituationen som målt ved the Job Content Questionnaire og andre lignende mål are associeret til udvikling af depression. Syv ud af 10 studier af høj kvalitet, to af de som anvendte validerede diagnostiske instrumenter, understøtter denne konklusion. Estimatet for relativ risiko var omkring 2.0. Lav grad af social støtte på arbejdet var stærkt assococieret til udvikling af depression, idet 13 ud af 15 studier af høj kvalitet, 3 af de der anvendte diagnostiske metoder, viste en sådan sammenhæng for kvinder, 11 for mænd. Tre studier af effort-reward ubalance, 3 af uretfærdighed, 3 af trusler, vold og mobning viser lignende sammenhæng. 5 studier af job usikkerhed viste association til udvikling af depression hos mænd, men ikke hos kvinder. Studier af indflydelse, job strain og lang arbejdstid viste inkonsistente resultater.

Selvom dette litteraturstudie har identificeret arbejdsrelaterede stresspåvirkninger, der er associeret med udvikling af depression, er der behov for yderligere studier, der måler varigheden og intensiteten af belastninger associeret til depression mere detaljeret. For andre psykiske sygdommes vedkommende er studier, der anvender diagnosebaserede effektmål nødvendige.

Background

In the spring of 2006, the Danish Working Environment Research Fund published a call for papers, including the above topic. This section describes the call as formulated by the fund. The papers are to be used by the Danish National Board of Industrial Injuries and the associated Committee in connection with the ongoing negotiations as to which disorders should be included in the Danish directory of occupational diseases. The papers will also be used in the continual development of the Industrial Injuries Committee's practice regarding the acknowledgement of disorder caused by the particular nature of a given job, for disorder which are not currently in the directory of occupational diseases.

The Industrial Injuries Committee consists of labour market representatives, specialist doctors, appointed by the National Board of Health and the Danish Working Environment Authority, together with representatives from the National Board of Industrial Injuries. During case evaluation when considering a disorder for possible recognition as an occupational disease, the Industrial Injuries Committee has become aware of a great need for clarification with regard to possible associations between work-related stressors and the development of mental disorder other than post-traumatic stress disorder (PTSD). This includes a great need for a careful evaluation of the character and extent of the potentially increased risk for people exposed to work stress.
In this connection it should be noted that post-traumatic stress disorder was included in the directory of occupational diseases in 2005. Until then, individual cases with this diagnosis had been recognised as occupational diseases on the basis of special circumstances, in the same way that a limited number of other mental disorders had been recognised as a consequence of the particular nature of a given job.

The reform of the occupational health legislation focused very much on the possible importance of gender in the development of occupational disease. It was therefore desirable that this aspect was considered in the literature review.

In the call for papers from the Danish Working Environment Research Fund it was furthermore stated that the scientific reference document should describe, summarise and evaluate possible associations between occupational stressors and the development of mental disorders other than post-traumatic stress disorder. The scientific reference document should at the same time be based on a primarily epidemiological review of the most important international research findings in the area. In this connection, the Working Environment Research Fund was interested in evidence regarding a possible increase in the risk of developing mental disorders other than post-traumatic stress disorder as a consequence of work-related stressors, including a description and evaluation of the evidence in this field, the likely cause-and-effect mechanisms and an estimate of the types and extent of stressors that might lead to the development of mental disorders other than PTSD.

Furthermore, the reference document should explain the stress definition used and the implications of this for the project conclusions. Finally, a very broad approach to the concept of stress was requested, including all relevant work-related stressors. The following had to be examined and evaluated:

- The characteristics of the stressor (types of stressors)
- The extent of the stressors (qualitatively and quantitatively)
- The overall extent of the exposure over time
- The onset of the disorder in relation to the exposure.

Finally, the reference document should include
- Limits and definition of the effect, i.e. which types of effect and stressor are evaluated.
- Limits and definition of the disorder, including the diagnosis, exact information about the background to the diagnosis, and an evaluation of the validity of the results of the study as well as information about the severity of the disorder or the symptoms.
- A description and evaluation of the reliability of the documentation concerning the exposure and the disorder in each individual article.
- As far as possible, a description and evaluation of the risk, related to the specific stressors and overall exposure.
- A description and evaluation of what is known concerning other causes of the disorder.
- The best possible description and evaluation of existing knowledge about the connection between exposures and responses, including where possible the relation to specific stressors and the overall exposure, preferably also including the significance of the intensity and the duration of the exposure as well as possible borderline values.
- An explicit evaluation of the prognosis, including the extent to which there is evidence that the symptoms and clinical findings persist once the exposure stops, together with the significance of the exposure for the prognosis.
- A collective and graded evaluation of the evidence.

If the evidence is insufficient to show an association between occupational disorder and the development of mental disorders other than post-traumatic stress disorder, or if the literature is otherwise inconclusive, this should be described and explained. If further research is found necessary, relevant objectives of such research should be described and included in the overall conclusions of the research project.

On this basis, the following literature review was carried out between January 1, 2007 and September 1, 2007.

The procedure for creating this document has been the following:
Before the application to the Work Environment Research Fund the contractors (authors) asked two researchers in the field to act as reviewer of the document. Professor Stephen Stansfeld, Centre for Psychiatry, Wolfson Institute of Preventive Medicine, Queen Mary´s School of Medicine & Dentistry, UK and Per Fink, Director of the Research Clinic for Functional Disorders, Aarhus University Hospital agreed. As supervisors for the process professor Per Bech , Psychiatric Research Unit, Hillerød Hospital and senior researcher Reiner Rugulies, National Research Centre for the Working Environment accepted this task. Consultations were held with the two latter and all received by the end of April 2007 the first draft of the report. After having received feedback the authors finish the second edition by mid June and a discussion with all parties took place 2nd July in Copenhagen. The final version of the reference document was forwarded to the Fund September 2007.

Exposure

For the purposes of this study, work-related psychosocial stress factors are defined as aspects of the job i.e. work content, organisation, relations etc. which can lead to a stress condition characterised by symptoms or impaired functioning and health. Physical as well as chemical, biological and psychological factors can lead to stress, but in the present context the focus is entirely on the so-called psychosocial stressors. Scientific studies which have examined the association between psychosocial stressors and disorder have generally used three different measures of exposure: Firstly, stressors can be evaluated objectively, e.g. administrative data as number of working hours (88), or by observations (30). Secondly, stressors can be self-reported, measured by standardised questionnaires based on different models such as Karasek´s Job strain model (38). Finally, some studies use the so-called ecological method, where the extent and type of psychosocial work-related factors are based on reports from people with particular types of job in order to avoid the individual experience and strain from becoming a measure of exposure (97). This method often implies use of an environment exposure matrix, where jobs are classified according to the degree of exposure.

An objective description of the exposure has only been used in very few studies, as psychological stressors are either very difficult to measure or because documentation is unavailable. On the other hand it is fairly straightforward in scientific studies to ask people how they are exposed to different stressors in their work.

Psychological stressors in the work environment are highly varied and can be very different dependent on the type of job. In order to compare the results of different types of study, many studies have used models for psychological strain which operationalise the most important stressors. Examples are the Job strain model developed by Robert Karasek and the Effort-reward model developed by Johannes Siegrist. Both of these models have been used in a number of studies of health and psychological strain at work (38;80). 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 sub-dimensions: decision authority and skill discretion. By combining the two main dimensions, four stress conditions are presented: 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", low demands and high decision latitude is termed "relaxed" and 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. Slaughterhouse workers are a good example of a high risk group, as they work with high speed (demands) and have very little influence (decision latitude) over their work tasks. The model has proved to be valuable, partly because it is so simple, and partly because it has turned out to be predictive in a number of areas (16). Some studies have used part of the Job Content Questionnaire (JCQ) as exposure measure, but in many cases the demand and decision latitude dimensions have been measured by items similar but not exactly the same as in the original version of JCQ.

Social support at work and/or during one's free time has been shown to modify the strain which might lead to stress, and in some studies social support is therefore used in combination with the job-strain model in a so-called isostrain model (37). 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 co-workers and one from supervisors. Conflicts and

bullying at the work place might also be considered as a dimension of social support.

As a supplement to the Job strain model, the German sociologist Johannes Siegrist has developed a stress model which is based on the individual experience of the balance between the effort made and the reward received (80). According to this model, the most stressful condition is when the reward does not match the effort made. Reward should not be understood as only financial, but also include the esteem, at a formal and informal level, which is associated with the work, as well as the security of work and the future promotion prospects.

The model distinguishes between extrinsic effort, i.e. pressure to work fast or being interrupted whilst working, and intrinsic effort, i.e. the personality trait over-commitment. The third element is the possibility of recognition and reward. An effort-reward imbalance will, according to the model, lead to stress. Persons with a personality characterised by over-commitment are more likely to accept such an imbalance, and will therefore become stressed. Both models can predict part of the risk of ischemic heart disease (4). However, as it is in the case of the Job strain model, effort reward imbalance has been measured in several studies by proxy measures for the instrument suggested by Siegrist.

A rather new model emphasising the importance of justice at work has been developed (44). This model distinguishes between procedural and relational justice. The former indicates whether decision making procedures include input from affected parties, are consistently applied, suppress bias, are accurate, are correctable, and are ethical. The latter element refers to the polite and considerate treatment of individuals by supervisors.

Other exposure assessments have often been ad hoc, but might be validated as the Japanese Uehata questionnaire (79). Measures of job security and other psychosocial stress factors have been used more prevalently during the last ten years as the psychosocial work environment has changed.

In this context, it is important to emphasise that several studies in their measure of exposure have included the effects of exposure, e.g. the feeling of being stressed or a person's general wellbeing, and these studies therefore cannot be used to evaluate the association between psychological strain and mental disorder.

Outcome

The focus in the present literature review is on mental disorders. So far, the association between work-related psychosocial factors and mental disorders with a clinical diagnosis by a doctor or psychiatrist has only been described in very few studies. The majority of scientific studies which have looked into the associations between psychosocial work-related factors and mental health have used different forms of more or less validated outcome measures. In 2005, Stansfeld and Candy reviewed literature and for that purpose carried out a metaanalysis and found 38 studies, of which only 11 were of a character that made them appropriate for metaanalysis (81). In this case outcome was defined as common mental disorder without any further specification.

The present literature review aims to identify and describe associations between psychosocial factors at work and mental disorders other than PTSD. In order to clarify how mental disorders are classified in diagnostic systems Table 1 gives an overview. The diagnostic groups are not entirely comparable as the definition of depression and other conditions differ, especially regarding severity of symptoms. However, the table indicates that even if different diagnosis classification systems are used comparisons can be made with caution.

Table 2 shows data from a Danish survey among GPs, which gives an idea of how frequent these disorders are in the general population.

Depression

As will be shown, the literature review reveals that depression is the outcome in the majority of the relevant longitudinal studies which have examined the association between work-related psychosocial factors and mental disorders.

The most important recommendation for DSM-V (96) disorders is the diagnosis within affective disorders (mood or emotional disorders) of endogenous depression (bipolar disorders) versus distress disorders. Within the distress disorders major depression is the most serious with greatest impact on social functioning. It is still uncertain how many patients with major depression are in fact suffering with bipolar depression (bipolar II depression) and how many patients with major depression are suffering from stress-induced depression.

Within the chronic stress (distress) disorders dysthymia, describing persistent states of low level depressed mood, and generalized anxiety disorders are included. These disorders have a lot of overlap (co-morbidity) with major depression.

The most important early analysis of the distress disorders was made by Frank and his group at the Johns Hopkins Psychotherapy Research Unit (25). This group referred to chronic stress induced major depression as demoralization disorder. Lack of meaningful connections between the person and her or his workplace contacts defined as lack of social bonds were found to be the most important factor for the development of distress depression or demoralization.

Frank and his group at Johns Hopkins Psychotherapy Research Unit developed the Symptom Check List (SCL) as a self-reported instrument for measuring the" mental temperature". Like inflammation, demoralization or psychological distress should be considered a non-specific process at the screening stage. This process has often been measured by questionnaires like General Health Questionnaire (GHQ), SF-36 and other validated scales. However, if the "temperature" is becoming chronically elevated a specific diagnosis such as major depression should be looked for. In this context the use of a standardized psychiatric interview such as the Composite International Diagnostic Interview (CIDI) or the Present State Examination (PSE) should be considered. It has

been shown that the rate of unemployment because of psychiatric disability is strongly associated with the severity of depressive disorder (e.g. measured by PSE or DSM-IV). Thus the rate of unemployment is significantly higher in patients with major depression compared to dysthymia or generalised anxiety disorder (35;46) With disability-adjusted years (DALYs) is expressed the sum of life years lost to premature mortality and life years lost to disability. Major depression is associated very clearly with much higher DALYs than minor depression, including days lost from work (35). It is, therefore, very important to focus on the relationship between work-related psychosocial factors and major depression.

With this background our objectives have been to focus especially on the specific diagnosis of major depression among the mental disorders.
If, however, standardized clinical interviews of major depression have been lacking the various self-reported instruments have been subclassified in those measuring depression specifically, and those like the SCL that should be classified as non-specific instruments for measuring psychological distress or demoralisation.

Epidemiology
Depression is a frequent mental disorder with life time prevalence in the US of 16 % (43). In the US severe major depressive disorder is associated with low education and income, being divorced and female sex. According to the WHO (2001 - mental HEALTH), the point prevalence of depression is 3.2 % for women and 1.9 % for men, and the 12-month prevalence is 9.5 % and 5.8 %, respectively.
The WHO estimates that depression has a fifth place on the list of disorders with the highest disability adjusted life years-score (57), and that it will have second place by 2020.

In 2000, the prevalence of depression in Denmark was examined by means of a questionnaire-based study (60). The prevalence of major depression was 3.3% (3.6% for women and 3.0% for men). For minor depression the prevalence was 1.9 % for women and 0.9 % for men. Traumatic events occurring privately or at work within the past year, alcohol intake, tobacco consumption and somatic disease were associated with depression. The age group 20 to 34 showed the highest prevalence.

The literature search

The literature search was carried out using the databases PubMed (1960-), EMbase (1980-) and PsychINFO (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 3. There were a total of 3,416 studies (2,291 in PubMED, 659 in EMBASE and 466 in PsychINFO, some of which were duplicates). These were all checked and categorised according to title by one of two authors. A selection was made so 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 83. All of these were read in order to find the relevant exposures and outcome.

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 mental disorders, which exclude i.e. burnout and fatigue
- The data analysis should be prospective
- There should be relevant statistical estimates of the associations tested for
- The study population should be greater than 100
- The data from the study should not be published elsewhere. In 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

Duplicate publications or data from the same study excluded 9 papers (17;31;41;42;50;54;58;59;75). Irrelevant exposure was the case in 13 cases (5;9;18;19;24;40;48;53;61;72;77;87;90). Outcome not relevant excluded 12 papers: (11;12;29;47;49;52;63;71;73;91-93) and 2 papers showed only cross sectional analyses (51;65).

No studies on night or shift work fulfilled the criteria.

Only four papers turned out to be on studies on alcohol consumption (14;26;32;69) and two on drug dependence (56;67). These are very different studies and hard to compare or summarize in this context. It was therefore decided to exclude these studies from further evaluation.

This left 40 studies for evaluation.

The studies were classified according to the criteria shown in Table 4.

Results

Outcome in the form of a psychiatric diagnosis or depression based on a diagnostic classification scale.

Table 5 provides an overview of the eight studies, where outcome was a psychiatric diagnosis or depression measured by means of a scale based on diagnosis classifications. Three of these studies used the Job-strain model as exposure measure (66;78;94). One study used a questionnaire-based instrument for interpersonal conflicts at work (68). Three studies used questionnaire-based variables for psychological strain at work (39;76;95), whereas the last used the ecological method where occupation was a proxy measure for exposure to threats and violence (97).

The Netherlands Mental Health Survey and Intervention Study (NEMESIS) is a prospective study of 2,646 men and women in work aged between 18 and 65 (66). The study is very well described insofar as there is a thorough description of the sampling procedures, non-respondents and methods of analysis. The Job Content Questionnaire (JCQ) was used as 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 getting a depression is 1.8 for women compared to men. The outcome was depression and anxiety disorders were measured by use of diagnostic instruments according to DSM-III-R (Composite International Diagnostic Interview). The data collection took place using trained interviewers. The relative risk of psychosocial strain at work measured as psychological demands, significantly increased risk 3.5 (1.9-6.3) for depression. Social support was negatively associated with depression (RR= 0.8 (0.7 -0.9)), whereas decision latitude and job insecurity were not significantly associated with depression.
In this study, the follow-up time was two years, whilst in a similar Canadian NPHS study it was eight years (78). In the Canadian study, more than 12,000 people in work were followed, and exposure was measured using JCQ and social support in the same way as in the Dutch study. The JCQ was used twice during the follow-up period. The studies both used the same diagnostic instrument. The Canadian study also had a relevant confounder control and the design assured a clean baseline e.g. 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 (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 (1.8-6.1) when measured two years later, in 2002. The study does not state the exact numbers for each gender, but in one figure it is shown that the two-year incidence for depression for men with high job strain is three times greater compared to 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 to those with low. As in the Dutch study, there was an association between social support at work and depression for both men and women.

Based on data from the cohort "Canadian National Population Health Survey", Wang has published data from a two-year follow-up from 1994/1995 to 1996/1997 (95). Job strain in this study was analysed together with other exposure variables, creating a work-stress index. The relative risk of depression during the two-year follow-up period was 2.4 (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 independent variable in the analysis instead of a strain variable derived from JCQ.

A part of the Canadian NPHS cohort were analysed with a focus on the association between weekly working hours and depression (76). The follow-up period was two years, but the actual analysis is

unclear compared to 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 to women with a working week of 35-40 hours per week, were found to have a significantly increased risk of 2.2 (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 three-year period (39). Based on the exposure measures made at baseline, it was found that "unsuitable jobs" gave a relative risk of depression of more than 11 (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 condition and personal resources might increase the risk for development of depression.

At the four-year follow-up, a Finnish study of more than 12,000 people found that interpersonal conflicts at work increased the risk of being admitted to hospital with a psychiatric disorder by a factor of 2.2 (1.3-3.5) (68). The study included confounder adjustments in the usual manner, but unfortunately no account was taken of previous mental disorder in the cohort, and the baseline was not clean. No risk estimates for depression were reported.

In another Finnish register based study Virtanen and co-workers used the JCQ as exposure measure and antidepressant prescription during the following three years as outcome (94). The relative risk for antidepressant prescription was 2.0 (1.0-3.8) for job strain for men and 1.2 (0.7-2.0) for women.

A very thorough 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 (97). Women who had been exposed to violence or threats had an increased odds-ratio of 1.5 (1.3-1.8) for depression. For men violence was associated with depression in the same magnitude, whereas exposure to threats did not reach significant association. The exposure is not self-reported, as the ecological method is used, where job title the year before the admission to hospital was used as a proxy measure for the exposure.

Depression scales
Four studies used the Center for Epidemiology Studies depression scale (CES-D scale) (Table 6). The most convincing is the French GAZEL study of nearly 10,000 employees in a French National Electricity and Gas Company (64). This cohort was followed for three 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, i.e. relative risks, are published, but regressions coefficients showed that for men as well as women psychological demands and social support had significant association with subsequent depression measured by means of CES-D. For men there was also a positive association between depression and low decision latitude, but this did not apply to women. The risk estimates in the first year of follow up were for high levels of psychological demands 1.8 (1.6-2.0) for men and 1.4 (1.1-1.7) for women. OR for low decision latitude was 1.4 (1.2-1.6) for both gender and the risk for low social support at work was 1.6 (1.4-1.8) for men and 1.3 (1.1-1.6) for women (58).

In the Dutch so-called SMASH study of more than 800 employees, four measurements of job-strain were made at one year intervals, showing a significant association between a high score on the depression scale and increased job strain (15). Unfortunately no risk estimates were made.

A small study of 184 female teachers (74) who were followed for nine months, showed a association between "Episodic stressors" (stress and confrontations) and depression. In a study of companies which were in a down-sizing process lasting two years, Moore et al. showed a prevalence of depression which was twice as high for those employees who had experienced two redundancies or more, compared to those who had never experienced one (55).

Finally, the development of depression was studied among rescue workers who were exposed to dead bodies and physical danger and who gave assistance to survivors in disaster situations (27). The study observed the rescue workers for one year by use of the Zung scale and found a relative risk of developing a depression of 3.5 (1.2-10.6). Previous experience of a disaster did not affect the development of depression during the follow-up period.

Outcome measured by other scales
A further 27 studies have measured mental health by use of different scales i.e General Health Questionnaire (GHQ) (1;10;21;22;36;45;84) and (86) (Table 7).
Of the high quality studies Bültmann used the JCQ and found a positive association in both men and women between caseness and demands and social support. Stansfeld showed similar findings in 1999. In this study there is also an association between high effort reward imbalance and risk of psychological distress, estimated for men at 2.6 (2.0-3.5) and women at 1.7 (0.9-2.3).

A third large study from Finland is alone in finding no association between social support and outcome. Instead, this study introduces the variables "procedural justice" and "relational justice", both of which are significantly correlated with a subsequent high score on the GHQ scale (44). This study also identifies an association between demands and depression. Finally, in a study by Johnson of nearly 600 doctors there is an association between depression and control measured by means of the JCQ, a near-significant association between demands and depression, and an association between social support and depression (36).
In a Canadian study with a follow-up time of 1½ years, Bourbonnais found an association between job strain and the psychiatric symptom index. The same cohort showed no association between absence and mental health problems associated with job strain, whereas social support was shown to reduce the risk significantly (7). Other studies from hospitals show a similar picture. A large American study of more than 21,000 nurses showed a significant association between demands and control, and between social support and mental health, measured using the SF36 (13). In contrast a Norwegian study of more than 4,000 nurses aids showed no association between the job strain model and depression symptoms measured by means of the Hopkins symptoms checklist (20). However, the study did find a significant association between high symptoms score and role conflicts, threats and violence, as well as poor social support at work. There was also a negative relationship to reduced working hours. Employment in a psychiatric or a geriatric ward increased the risk of a high symptom score. A Finnish study of mainly female employees at a hospital showed an association between "team climate" and self reported doctor diagnosed depression in the two-year follow-up period (98).
Another study worth mentioning is a large study of more than 4,000 public employees, where the variable work-time control was negatively associated with psychological distress measured by means of GHQ in women, whereas there was no association in men (1).

The effort/reward imbalance model was tested in a Belgian study "the Somstress Study" (28) which showed increasing effort/reward imbalance during the course of one year with a strong statistical association to depression and anxiety symptoms in both men and women. The measure of exposure at time 2 was however done at the same time as 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 justify however the conclusion, that effort/reward imbalance is associated to outcome as the relative risks would be around 2.0 if those with imbalance at time 1 were compared to those without imbalance at the same time.

The Whitehall II study examined job insecurity in government departments which were undergoing privatisation (22). The study found a significant association in men between insecurity and psychological distress depression score measured by means of the GHQ, both for insecurity at baseline and at the follow-up. For women there was a similar association but only for those who experienced job insecurity both at baseline and at the time of follow-up. In a Dutch study, Swaen and colleagues described a similar problem in connection with a threatened closure (86). There was a significantly increased risk of a high GHQ score for men, whereas there was no significant association for women.

In addition to using the GHQ, the Whitehall study also used SF-36 as an outcome measure, where Stansfeld and colleagues found a significant association between depression and psychological demands, work support and the effort/reward imbalance (82-84). For men there was no significant association with regard to demands, whereas there was a significant association in respect of decision latitude, work support and effort/reward imbalance. By use of absence due to psychiatric illness reported on a certificate less than 8 days as outcome the same authors found associations between depression and skill discretion and support in women, whereas in men there was an association to psychological demands, decision latitude and skill discretion, and support from co-workers and supervisors.

Finally, there is an analysis from the Danish Work Environment Cohort Study (DWECS), which included more then 4,000 men and women from a representative sample of the Danish workforce (70). The authors used the five item mental health scale (MHI-5) of the SF-36 questionnaire with a cut-off point of 52 as a proxy measure for caseness of severe depressive symptoms. The study found that low influence at work and low social support from supervisors predicted onset of severe depressive symptoms after 5-years of follow-up among women. Among men, only job insecurity, but not influence or social support, was a statistically significant predictor (70).

In addition to the above-mentioned Canadian study by Shields, the number of working hours has been the object of two studies. A large Japanese study showed no significant increase in the risk of depression for women who worked more than 12 hours per day, whereas the risk for men was 1.4 for those who worked more than 12 hours a day compared to those who worked eight hours or less (85). In contrast to this, a Finnish study found no statistical association between these factors when studying office employees who worked more than 45 hours per week (88).

Overview
The studies do not give a clear picture. In order to get an overview of the results, Table 8 lists the studies according to exposure and the degree of evidence found between occupational stress-related exposure and mental disorders. Table 9 shows in the same manner studies where outcome are self assessed mental health.

The Job- strain model

All three of the studies in Table 5 showed significant associations between job strain and outcome. The Finnish study on antidepressant prescription however only for men (94). Of studies using self assessed mental health as outcome only three showed significant results (3;6;8), while 3 were insignificant (7;62;98).

The sub-elements in the job-strain model: demand and decision latitude show a somewhat different picture. The two high-quality studies, NEMESIS and GAZEL show a clear association between psychological demands and depression. A small study on affective disorders showed the same. In addition, four other large cohort studies, which used GHQ and SF36 as measures of outcome, showed a clear relationship with depression. In the Whitehall II study, where absence due to mental illness was used as outcome, no association was found for women and a significant, negative association for men although in relation to GHQ mentioned above high demands were associated with increased risk in the Whitehal II study for both men and women (82;84) The large DWECS study of the working population and the Finnish study of hospital employees did not find such an association either (70;98). Figure 1 gives an overview of the studies reporting relative risks.

Regarding the association between low decision latitude and depression, the French GAZEL study found an association for men, as did the Whitehall II study, whereas the Danish study found a association for women. A Finnish (45), an English (34) and an American study (13) found the same association, whereas there was no association in the NEMESIS study, in GAZEL and Whitehall with regard to women and in the Danish study with regard to men. The same is the case for the large Dutch NEMESIS study and the large Norwegian study of assistant nurses. Figure 2 shows graphically the results of studies reporting risk estimates.

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.

Social support
This exposure has been included in 4 of the studies using diagnoses or diagnostic scales (64;66;68;78). They all show significant association with the outcome measure, which is depression measured by CIDI in three cases and psychiatric morbidity in the last study. Studies of the Maastricht-cohort (10), among nurses in Canada (7), and among nurses in the USA (13), Eriksen's study of assistant nurses (20), the Whitehall II study (82-84) and the DWECS study of a representative sample of the labour force all show this association (70). However, in the Danish study there is no association for men, and in Kivimäki's study from Finnish hospitals, there is no association at all, possibly due to the introduction of the variable "justice" (44). In all 13 of 15 studies show significant association between social support and outcome at least for women. Results from studies reporting risk estimates are shown in Figure 3.
In conclusion there is in the light of these studies, clear evidence showing an association between low social support at work and depression.

The effort/reward imbalance
There are three studies that deal with this, two of which are based on the same cohort (Whitehall). These show moderate evidence for the association between effort/reward imbalance and depression (28;82;84).

Insecurity

In five studies, there is a clear connection between job insecurity and depression in men (10;22;23;70;86), whereas the evidence regarding women is limited to one study (23)with no association in three studies (10;70;86). The Dutch study NEMESIS did not report separately for men and women (66).

As a whole, there seems to be moderate evidence for an association between job insecurity and depression in men.

Injustice

This exposure has been examined in three studies which all find a significant association with depression (21;45;98). In the two Finnish studies it seems that the data come from the same cohort, but have different outcomes.

Threats and violence

The Danish study by Wieclaw shows a clear association between threats and violence and depression by means of the ecological method (97). This study also finds an increased risk of depression in the caring professions. Eriksen has studied assistant nurses in Norway and found a significant association between the exposure to threats and violence on the one side and depression on the other (20). He also found an increased risk in psychiatric and geriatric wards where these influences also play a role.

Long working hours

There are only three studies which look into this (76;85;88). Only the Canadian study shows a positive association, and only for women. All three studies have methodological problems and do not support the hypothesis about the association between long working hours and depression.

Other measures

Kawakami's study of the electronics industry in Japan showed a clear association between depression, defined on the basis of relatively strict criteria, and having an unsuitable job (42).Using data from the Canadian cohort Wang found associations between an index of work stress indicators and CIDI assessed depression (95). These studies support the notion that psychological demands at work increase risk of depression.

Among studies, which used self assessed mental health as outcome, all found positive associations between exposure and outcome. No work-time control (1), a poor time climate (98) or much trouble or competition (2;79), role conflicts (20), low occupational pride (3), bullying (33;45), and finally exposure to dead bodies, physical danger or disaster situations (27) are other exposures which have a moderate association with impaired mental health.

To give an overview results from studies which have calculated risk estimates on the relationship between different measures of strain in the job and depression and psychological distress are shown in Figure 4.

Discussion

This literature review has to a large extent succeeded in identifying certain occupational psycho-social factors, which in epidemiological studies are associated with the development of depression but the literature is too sparse on other mental disorders.

Most light has been spread on the relationship between demands and social support on the one hand and depression on 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. 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 pressure is more important in the health care sector. This might be the reason for the negative findings in some of the studies dealing with employees in the public sector. The Norwegian study on nurses aids support this view as exposures like role conflicts and threats seemed to be more important than the conventional job strain model measures.

The results regarding decision latitude are contradictory. The term decision latitude reflects the degree of control one experiences over one's working condition. Degree of control is normally associated with social status and as pointed out by Griffin and colleagues control has different importance for prediction mental illness in different social grades (31). Another point made by this group is that there is a spill over 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 co-worker and supervisor support. In the NEMESIS study the measures even included social support outside work. In the Maastricht and Whitehall cohorts a more differentiated approach has been applied. In the Dutch study social support from co-workers and supervisors as well as conflicts with these showed significant association with psychological distress in men, but for women only social support from co-workers reach significant association (10). In the Whitehall II study support from co-workers and supervisors were significantly associated with short term spells of absence from work due to psychiatric illness in men but in women only support from supervisors was significant (84). The studies dealt with in this review do however not clarify what kind of social support that is important in preventing mental disorders. Neither gives the studies any answer to the question if social support is more important for men than for women or vice versa.

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

The majority of the epidemiological 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 could change from weak to strong or vice versa before the onset of the disorder. For this

reason, there is 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 answer several of the questions raised in the call for papers from the Working Environment Research Fund. This applies to precise information about the method of diagnosing the depression and about the severity of the depression. The diagnoses are made by psychiatrists in only 3 cases, but even in these cases there is no information about the diagnostic method. The studies which have used CIDI and maybe also studies using CES-D scale must be considered the most reliable. However these methodological problems do not affect the main conclusions of this review.

In addition, it is impossible to conclude anything with regard to competing causes of the disorder, apart from in those cases where the appropriate adjustment 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.

On this basis it can be concluded that the high-quality epidemiological studies found a clear association between the development of depression on the one hand and high psychological demands at work and low degree of social support on the other hand.

Studies on effort/reward imbalance, job insecurity for men, job injustice, exposure to threats and violence were few but supported the hypothesis that these work related exposures predict depression.

The results for men and women are somewhat similar, except in respect of job insecurity. The risk estimates for men and women are slightly different in the various studies, but there is no general tendency for the risk to be higher in one gender compared to the other.

Future research

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 can not be obtained by means of postal or internet based questionnaires alone. In addition interviews in depth although standardised 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 e.g. depression might have their experiences coloured by there mental illness condition. Using information from other sources might be a way to validate the exposure. But in case of emotional strain other sources might be lacking. The exposure assessment could also be improved by characterisation of specific working conditions, which might be responsible for 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 characterised diagnostically and to gather a sufficient number of cases 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 e.g. depression. A screening instrument e.g. CIDI might be applied in such studies followed by a more direct diagnostic evaluation of each case. Ongoing cohort studies might use the outcome measures as screening instruments and add psychiatric evaluation of cases in order to improve validity of the outcome.

Confounding factors must include personality, private life stressors as well as the common used obtained in many of the referred studies. The analyses should be stratified on gender instead of just adjustments as done in most studies.

As the quality regarding 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 relationship between work-related stressors and the development of mental disorders.

Conclusion

The body of evidence only makes it possible to draw conclusions regarding major depression among the disorders dealt with in the study. Studies on other outcomes were too few or too different in design, for any conclusions to be made.

Psychological demands at work as measured by the Job Content Questionnaire and other measures similar to this are associated with future depression. Seven out of ten high quality studies, two of them using diagnostic instruments, support this view. The relative risk estimates were around 2.0.

Low levels of social support at work are strongly associated with future depression; 13 out of 15 high quality studies, three of which using diagnostic instruments, showed this for women, 11 for men.

Three studies on effort reward imbalance, 3 on injustice, 3 on threats, violence and bullying showed the same associations.

5 studies on job insecurity showed associations with future depression in men, but not in women. Studies on decision latitude, job strain and long working hours showed mixed results.

Even if this literature study has identified work-related psychosocial factors, which in high quality epidemiological studies predict depression, we still need studies which assess in more detail the duration and intensity of exposure needed for developing major depression. For other common mental disorders like anxiety and somatoform disorders studies based on diagnosis based measures are strongly needed. Furthermore, transient 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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Table 1. Mental disorders relevant for this document, marked, in ICD-10 and DSM-IV classification systems. The marked diagnoses are regarded relevant in the context of this literature review as the disorders to some extent are believed to have exogenous causes.

ICD-10	DSM-IV
Mood (affective) disorders (F30-39) **Depressive episode, recurrent depressive disorder (F32-33)** Manic, and bipolar affective disorder (F30-31) Other mood disorders (F34-39)	Mood disorders (317) **Major depressive disorder (339)** Bipolar disorders I and II (350 and 359) Other mood disorders (366 and 375)
Neurotic, stressrelated and somatoform disorders (F40-48) Post-traumatic stress disorder (F43.1)	**Anxiety and somatoform disorders (393 and 445)** Post-traumatic stress disorder (424) **Adjustment disorders (623)**
Mental disorder due to psychoactive substance use (F10-19) **Alcohol abuse (F10)**	**Substance-related disorder (175)** **Alcohol-related disorders (194)**
Organic mental disorders (F00-09), schizophrenia (F20-29), all others (F50-99)	All others (37,123,165, 273, 471, 493,539,609,629,675)

Table 2. Point and life time prevalence of depression, anxiety, somatoform disorders and alcohol abuse among primary care patients in DK (89)

Diagnostic group	Prevalence	Life time prevalence
Moderate/severe depression	2.7 (1.9-3.8)	9.2 (6.8-12.2)
Anxiety	16.4 (12.7-20.9)	25.7 (20.8-312.2)
Somatoform disorder	35.9 (30.4-41.2)	39.4 (33.6-45.5)
Alcohol abuse	2.2 (1.5-3.1)	5.4 (3.6-8.1)

Table 3 Search terms in the literature search

Exposures	Outcomes
workload work conditions job conditions working hours working time night work shift work stress (= stress AND [job OR work OR occupation] psychosocial work environment effort reward motional demands iso strain job strain job security OR job insecurity job control justice meaning of work predictability of work psychosocial demands bullying mobbing teasing	psychiatric psychiatric disorders mental mental health substance use abuse drug alcohol benzodiazepine psychosis psychotic paranoia paranoid disorder mood disorders affective disorders bipolar depressive depression anxiety anxiety disorder generalized anxiety panic disorder obsessive-compulsive disorder OR [OCD]

Table 4. Quality criteria

Population under study	0: Participant rate < 60%, selection bias might be severe 1: Participant rate > 60 % , no clean baseline 2: Clean baseline or adjusted for prevalent cases
Exposure assesment valid and reliable	0: Questionnaire ad hoc or validity not described 1: Questionnaire validity uncertain 2: Questionnaire validated and based on model or exposure "objective"
Outcome	0 : Ad hoc scales not validated 1: Validated scales used as diagnostic measure 2: Diagnostic criteria used or register based
Confounding	0: None or only adjustment for age 1: Partly 2: Fully adjustment incl. socioeconomic/occupational status, life style factors, marital status
Analysis	0: No risk estimate 1: Relevant risk estimate and gender only as covariate 2: Relevant risk estimate and gender separated in analyses

Table 5 . Longitudinal studies on the relation between work stress-related exposures and mental disorders measured by diagnoses or diagnose classification instruments. Quality scores according to figure 1.

Author	Population	Cases	Exposure measures	Follow up time, years	Outcome	Confounder adjustments	Analysis	Results Men or *both gender*	Results Women	Quality score
Kawakami 1990	3045 male workers in an electronic plant (2)	15 cases	Job stress variables (0)	3	Depression (DSM-III) by psychiatrist (2)	Partly by comparing confounders (1)	Clean baseline, adequate analyses (2)	"Unsuitable job": 11.3 (2.0-61.8) Job overload, overtime, human relations: NS		(7)
Plaisier 2007	1529 employed men and 1117 women (2)	117 depression and 89 anxiety disorder cases	JCQ Social support (2)	2	Major depressive episode (Composite International Diagnostic Interview (CIDI) by trained interviewer (2)	Age, gender, health, education (1)	Clean baseline, Job strain not calculated (1)	*Demands: 3.5 (1.9-6.3) for depression, 1.5 NS for anxiety Social support: 0.8 (0.7-0.9) Decision latitude and job insecurity: NS*	Risk for depression for women 1.8 compared to men	(8)
Romanov 1996	10.157 employed men and women (2)	315 events	Interpersonal conflicts at work (0)	4	Psychiatric morbidity (hospitalizations and chronic medication from public registers) (1)	Age, gender, personality, sociological and alcohol (1)	Baseline not clean (1)	*2.2 (1.3-3.5) No gender differences*		(5)
Shields 1999	1649 women and	121 cases	Weekly working	2	Major depression	Age , socioeconomi	No clean baseline	41+/35-40 hours/week:	41+/35-40 hours/week:	(7)

	2181 men 25 to 54 years employed 35 hours per week or more (NPHS Canada) (2)		hours self reported (1)		episode. WMH version of Composite International Diagnostic Interview (CIDI) in 2002 as a questionnaire (1)	cs, education, income, occupation, self employment (2)	(1)	0.6 (0.3-1.3)	2.2 (1.1-4.4)	
Shields 2006	12.011 employed Canadians 18-75 years (2)	128 women and 71 men	JCQ measured twice Coworker and supervisor support (2)	8 for job strain, 2 for support	Major depression episode. WMH version of Composite International Diagnostic Interview (CIDI) in 2002 as a questionnaire (1)	Age, gender, marital status, education, occupation, life style factors (2)	Clean baseline Detailed information on loss of follow-up (1)	*Job strain 1994 and 2000: 3.4 (1.8-6.4)* *No job strain 1994, but 2000: 3.3 (1.8-6.1)* Low coworker support :2.4 (1.7-3.3) low supervisor support: 1.7 (1.0-2.7)	low coworker support 1.8 (1.4-2.4) Low supervisor support 1.6 (1.2-2.2)	(8)
Virtanen 2007	1704 women and 1662 men all employed (2)	199 women and 96 men	JCQ Job strain (2)	3	Antide-pressant prescription. Data from public register (2)	Age, marital status, occupational grade, mental disorder at baseline (2)	(1)	2.0 (1.0-3.8)	1.2 (0.7-2.0)	(9)
Wang 2005	6099 employed Canadiens in NPHS (2)	Not reported	Work stress: 12 questions on skill discretion, decision authority,	2	Major depressive episode during last year (composite	Age, gender, Marital status, income, race, education, medical	Clean baseline (1)	*2.4 (1.5-3.8)*		(6)

			psychological demands, job insecurity, physical exertion and social support (1)		International Diagnostic Interview – Short Form for Major depression . Cut point: 5 (1)	illness, subsequent mental health service use (2)				
Wieclaw 2006	All employed Danes (2)	14166 cases and 58060 controls	Occupation with exposure to threats and violence (1)	1	Affective and stress related diagnoses in psychiatric hospital (2)	Age, sociodemogr aphics (1)	Baseline not clean (1)	Violence: Depression 1.5 (1.2-1.9) Stress 1.6 (1.3-1.8) Threats Stress: 1.6 (1.3-1.9) Depression: Trend	Violence: Depression 1.5 (1.3-1.7), Stress 1.3 (1.2-1.5) Threats Depression 1.5 (1.3-1.8) Stress: Trend	(7)

Table 6 Longitudinal studies on the relation between occupational stress related exposures and mental disorders measured by validated diagnostic scales

Author	Population	Exposure measures	Follow up time, years	Outcome	Confounder adjustments	Analysis	Results Men or *both gender*	Results Women	Quality score
de Lange 2002	824 employed (2)	JCQ, changes over time (2)	1 x 4	Depression : Center for Epidemiological Studies-Depression Scale (CES-D scale) (1)	Age, gender, education (1)	(1)	*Increased job strain assoc. depression*		(7)
Fullerton 2004	116 exposed to rescue work after airplain crash with deaths and survivors and 217 other rescue workers. (1)	1. Previous disaster experience 2. Disaster exposure to dead bodies, physical danger and assistance of survivors (0)	1	Depression (Zung scale, cut off score 50) (1)	Age, gender , marital status, education (2)	No clean baseline (1)	*1: 1.2 (0.3-4.9) 2: 3.5 (1.2-10.6)*		(5)
Moore 2004	1235 employees (2)	Downsizing: Layoffs (1)	2	Depression (CES-D) (1)	Age, gender education (1)	No clean baseline, no risk estimate	*Prevalence of depression 5.2% among never layoffs,*		(5)

						(0)	*10.4 % among those with 2 layoffs (p<0.001)*		
Paterniti 2002	2790 women and 7729 men working in French National Electricity and Gas Company (2)	1.Demands 2.Decision latitude (JCQ) 3.Social support (2)	3	Depression (CES-D) (1)	Age , education, marital status, stressfull personal events, baseline CES-D score (2)	Adjusted for baseline illness (1)	1: p< 0.001 2: p < 0.01 3: p < 0.01	1: p < 0.001 2: NS 3: p< 0.05	(8)
Schoenfeld 2000	184 female teachers (1)	Episodic stressors (threats, confrontations) (0)	3/4	Depression (CES-D) (1)	Age, socioeconomics, race, marital status (2)	No clean baseline (1)		Beta coefficient p < 0.01	(5)

Table 7 Longitudinal studies of the relation between occupational stress related exposure and mental health measured self assessed by scales

Author	Population	Exposure	Follow-up time, years	Outcome	Confounder adjustment	Analysis	Results Men or *Both gender*	Results Women	Quality score
Ala-Mursula 2003	4152 full time municipal employees. 1181 cases (2)	Worktime control (degrees of freedom) (0)	3	GHQ psychological distress (cut point : > 3 symptoms) (1)	Socioeconomics, lifestyle (1)	Clean baseline (2)	1.3 (0.5-3.3)	1.9 (1.2-3.0)	(6)
Babezone 2005	603 employed (2)	Uetana questionnaire 1: Too much competition 2: Time pressure 3: Long working hours Relationship with superiors and co-workers Responsibility (1)	2	GHQ-60 (1)	Age, gender, smoking, alcohol (1)	Clean baseline (2)	*1: 4.0(1.4-10.9) 2: 2.7(1.0-6.9) 3: NS*		(7)
Bildt 2002	222 women and 198 men from the general working population (2)	1. Job strain 2. Low occupational pride 3. Social support, overtime (1)	4	Nottingham life-quality questionnaire (1)	(2)	(1)	1. NS 2. 2.9 (1.2-7.0) 3. NS	1: 2.8 (1.1-6.9) 2:NS 3: NS	(7)
Bourbonnais 1999	1251 female nurses	JCQ job strain	1½	Psychiatric Symptom	Social support, working hours,	Outcome adjusted for		2.0 (1.3-2.9)	(8)

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	(2)	(2)		Index (0)	age, type A (2)	baseline (2)			
Bourbonnais 2001	1793 female nurses (2)	1.JCQ job strain 2.Social support (2)	1½	Certified sick leaves with mental health problems (1)	Social support, working hours, age, type A, but data not shown (1)	(2)		1: 1.2 (0.7-2.2) 2: 0.6 (0.4-0.8)	(8)
Bromet 1988	325 males in a nuclear power plant (2)	1. Demands 2. Decision latitude 3. Social support from co-workers (1)	1	Affective Disorders (Scheduloe for affective disorders (SADS-L) (1)	None (0)	Baseline Not clean	1: p<0.001 2: NS 3: p<0.05		(4)
Bültmann 2002	1785 women and 5243 men, all employed (2)	1.Demands 2.Decission latitude 3.Social support from supervisor 4. Social support from co-workers 5.Emotional demands 6.Conflicts with supervisor 7.Conflicts with co-workers 8.Job insecurity (2)	1	Psychological distress GHQ-12 cut point 4 (1)	Age, education, marital and employment status, presence of disease (2)	Outcome adjusted for baseline (2)	1: 1.5 (1.2-1.9) 2: 1.1 (0.9-1.4) 3: 1.3 (1.1-1.5) 4: 1.3 (1.1-1.5) 5: 1.7 (1.3-2.3) 6: 1.8 (1.3-4.3) 7: 1.4 (1.0-1.9) 8: 1.6 (1.2-2.3)	1: 1.4 (1.0-2.0) 2: 0.9 (0.6-1.2) 3: 1.1 (0.9-1.8) 4: 1.3 (1.0-1.8) 5: 1.4 (1.0-2.0) 6: 1.0 (0.5-1.8) 7: 1.2 (0.7-2.2) 8: 0.9 (0.6-1.6)	(9)
Cheng 2000	21.290 female nurses (2)	1. Demands (JCQ) 2. Control (JCQ) 3. Social support (2)	4	SF36 measured twice (1)	Age, life style, disease status, marital status (2)	Change in outcome (mental health) (1)		Effect size in % 1: 31.2 2: 36.6 3: 31.6	(8)
Eriksen	4076 nurses'	QPSNordic:	1	Hopkins	Age, gender,	Adjustment for	1: p < 0.03		(8)

2006	aids (2)	1. Role conflicts 2.Threats and violence 3.Decrease in support 4.Decrease in work pace 5. Demands, decisions, control of work pace, fairness of leadership, social climate, rewards 6. Department (2)		Symptom Checklist-5 (SCL-5) (1)	family condition, seniority, life style, baseline SCL-5 (2)	baseline illness. Selection bias handled (1)	*2: p < 0.05 3: p< 0.05 4: p < 0.001 5: NS 6: Psychyatric department and apartment units for aged: Sign. increased SCL-5 score*		
Ferrie 2001	539 employees during privatisation (Whitehall II). Examined first time 5-7 years prior to privatization (2)	Employment status 1½ year after privatization: 1. Secure re-employment 2. Insecure re-employment 3. Permanent exit from employment 4.Unemployment (1)	1½	Change in GHQ-12 Score (1)	Age, gender, grade, marital status, baseline illness (2)	Adjustment for baseline illness (1)	*Compared to 1: 2: 1.6 (1.0-2.2) 3: 0.07 (-0.7-0.8) 4: 1.3 (0.6-2.0)*		(7)
Ferrie 2002	931 female and 2429 male civil servants (2)	Self reported job security 1.Continued 2.Insecure to secure 3.Secure to insecure 4.Chr. insecurity (2)	2½	Change in depression score from GHQ-30 (1)	Age, grade baseline illness, negative affect (2)	Clean baseline (2)	Compared to 1 2: 0.24 p=0.004 3: 0.37 p=0.002 4: 0.72 p<0.001.	2: 0.30 NS 3: 0.32 NS 4: 0.84 p < 0.001	(9)

Ferrie 2006	1719 female and 4047 male civil servants (2)	1.Relational injustice 2. Adverse changes in relational justice (2)	5-6 3	GHQ caseness (5 points or more) (1)	Age, grade, baseline illness (2)	Dose-effect relationship (2)	1: 1.5 (1.3-1.8) 2: 1.8 (1.5-2.2)	1: 1.5 (1.2-2.0) 2: 1.7 (1.3-2.3)	(9)
Godin 2005	700 women and 836 men, all employees in 4 plants (Somstress study) (2)	Effort reward imbalance measured twice 1. No-no 2. Yes-no 3. No-yes 4. Yes-yes (2)	1	Symptom Check List SCL90 for A.depression, B.anxiety (1)	Age, education, job dissatisfaction, workplace instability (2)	Clean baseline (2)	Compared to 1. 2: NS 3: A 4.6 (2.3-9.2) B 3.7 (1.7-7.8) 4: A 2.8 (1.3-5.7) B 2.3 (1.1-4.8)	Compared to 1. 2: NS 3: A 3.2 (1.6-6.4) B 2.3 (1.1-4.8) 4: A 4.6 (2.3-9.0) B 4.5 (2.1-9.8)	(9)
Hogh 2005	3791 employees (2)	Nasty teasing at work (1)	5	SF36, mental health (1)	Age, mental health at baseline (1)	Unclear analysis (1)	NS	Sig. association	(6)
Holman	144 employees in call centers (1)	Demands Control Skill utilization (1)	1	Job-related anxiety and depression (Warr) (0)	Age, gender, job site, job tenure, depression at baseline (2)	(0)	*Low control and low skill utilization sig. associated to depression*		(4)
Johnson 1995	495 medical doctors (2)	1.Demands (JCQ) 2.Work control (JCQ) 3.Patient demands 4.Physician resources 5.Social support ((2)	1	GHQ-20 (1)	Age, gender (0)	No clean baseline (0)	*Regression coeff.:* *1: p < 0.1* *2: p< 0.05* *3: p < 0.1* *4: NS* *5: p < 0.05*		(5)

Kivimäki 2003b	6219 women and 1156 men employed in hospitals (2)	1. Work load 2. Decision authority 3. Skill discretion 4. Low social support 5. Low procedural injustice 6. Low pelational injustice (2)	2	GHQ-12 cut point 4 (1)	Age, gender, income, baseline health, life style (2)	Adjustment for baseline health (1)	*1: 1.7 (1.4-2.1)* *2: 0.8 (0.6-0.9)* *3: 0.9 NS* *4: 0.9 NS* *5: 1.4 (1.2-1.7)* *6: 1.2 (1.0-1.4)*		(8)
Kivimäki 2003b	4831 women and 601 men employed in hospitals (2)	Bullying (1)	2	(1)	Age, gender, income, baseline health, life style (2)	Adjustment for baseline health (1)	*2.3 (1.5-3.4)*		(7)
Orth – Gomer 2005	292 female coronary patients and 292 age matched controls (1)	JCQ (2)	5	9 symptoms of depressive feelings (0)	(1)	No clean baseline (1)		Demands/control: 1.6 (NS)	(5)
Rugulies 2006	2004 women and 2129 men, all employed 105 cases during follow-up (2)	1.Demands 2.Influence 3.Social support from supervisor 4.Social support from coworkers 5.Job insecurity (2)	5	Mental health Inventory (MHI-5) (SF-36) (1)	Age family status, education, life style factors, SES (2)	Clean baseline (2)	1: 0.5 (0.2-1.3) 2: 1.6 (0.8-3.3) 3: 0.9 (0.4-2.4) 4: 0.8 (0.4-2.8) 5: 2.1 (1.0-4.2)	1: 1.0 (0.6-1.8) 2: 0.5 (0.3-0.9) 3: 0.6 (0.3-0.9) 4: 1.0 (0.5-2.1) 5: 1.0 0.6-1.7)	(9)
Shimegi 2000	282 employed in a plant	Uehata questionnaire 1. Too		GHQ-3(1)	Age, gender (1)	Clean baseline (2)	*1: 1.4 (1.0-2.0)* 2: 1.0 (0.6-1.7)	2: 2.1 (1.3-3.4)	(6)

	(1)	much trouble at work 2. 2. Poor relationship with superiors (1)							
Stansfeld 1997	1075 female and 3033 male civil servants (Whitehall II) (2)	1. Demands 2. Decision authority 3. Skill discretion 4. Support from coworkers 5. Support from superior 6. Information from superior (2)	5	< 8 days absence due to psychiatric illness, reported on a certificate (1)	Age, employment grade, GHQ, marital status, health, alcohol (2)	Adjustments for baseline illness (2)	1: 0.8 Sig. 2: 0.7 Sig. 3: 0.4 Sig. 4: 0.7 Sig. 5: 0.7 Sig. 6: 1.0 NS	1: 1.2 NS 2: 1.2 NS 3: 0.7 Sig. 4: 0.9 NS 5: 0.7 Sig. 6: 0.7 Sig.	(9)
Stansfeld 1998	7372 civil servants (Whitehall II) (2)	1.Demands 2. Decision latitude 3. Low work support 4. Effort reward imbalance (2)	5	SF36 (1)	Age, employment grade , negative affectivity, illness (2)	Do (2)	1: 1.1 NS 2: 1.6 (1.2-1.9) 3: 1.2 (1.0-1.4) 4: 1.8 (1.3-2.4)	1: 1.6 (1.1-2.2) 2: 1.2 NS 3: 1.4 (1.1-1.8) 4: 2.3 (1.4-4.0)	(9)
Stansfeld 1999	2507 female and 5471 male civil servants (Whitehall II) (2)	1.Demands 2. Decision authority 3. Skill discretion 4. Work support 5. Effort reward imbalance (2)	5	GHQ-30, cut point 5 (1)	Age, employment grade, baseline GHQ score (2)	Clean baseline (2)	1: 1.3 (1.1-1.6) 2: 1.3 (1.1-1.5) 3: 1.1 NS 4: 1.3 (1.2-1.5) 5: 2.6 (1.8-3.6)	1: 1.2 (1.0-1-6) 2: 1.4 (1.1-1.8) 3: 1.1 NS 4: 1.2 (1.0-1.4) 5: 1.7 (1.0-2.9)	(9)

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Suwazono 2003	19077 men 4760 women, all employed (2)	Working hours (1)	1	Mental health symptoms (0)	None (0)	Clean baseline (2)	9-12 hours 1.1 (0.9-1.2) >12 hours 1.4 (1.1-1.8)	9-12 hours 1.1 (0.9-1.3) >12 hours 1.6 (0.6-4.2)	(5)
Swaen 2004	574 exposed 1096 controls, all governmental emploees (2)	Workplace closure threat (2)	1	GHQ-12, cut point at 4 (1)	Stratification (1)	No clean baseline (1)	1.8 (1.4-2.4)	1.2 (0.8-1.9)	(7)
Tarumi 2003	612 white collar workers (1)	Working hours > 45/week (1)	4	Medical insurance claims on mental disorders (1)	Age, gender, occupation (2)	Baseline not clean (0)	*1.6 (0.5-5.0)*		(5)
Ylipaaval-niemi 2005	4278 women and 537 men all hospital personnel (2)	1. Demands 2. Control 3. Strain 4. Team climate 5. Low procedural injustice 6. Low relational justice (2)	2	Self reported "Doctor diagnosed depression" (1)	Age, gender, life style (1)	Clean baseline (1)	*1: 1.1 (0.8-1.6) 2: 1.0 (0.7-1.5) 3: 1.3 (0.9-1.8) 4: 1.6 (1.1-2.2) 5: 1.3 (0.9-1.8) 6: 1.4 (1.0-2.0)*		(7)

Table 8. Longitudinal studies on the relation between work stress-related exposures and mental disorders measured by diagnoses, diagnose classification instruments or validated diagnostic scales

Exposure	High quality studies (> 6 points) with significant result	High quality studies (> 6 points) with insignificant result	Low quality studies (< 7 points) with significant result	Low quality studies (< 7 points) with insignificant result
Job strain	Shields 2006, Virtanen 2007 (men), de Lange	Virtanen 2007 (women)		
Demands	Plaisier, Paterniti			
Low decision latitude	Paterniti (men)	Plaisier , Paterniti (women)		
Effort reward imbalance				
Insecurity		Plaisier		
Injustice				
Threats/violance	Wieclaw		Schoenfeldt	
Low social support	Plaisier, Shields2006, Paterniti, Romanov			
Long working hours	Shields 99 (women)	Shields99 (men)		
Strain otherwise measured	Kawakami, Wang		Fullerton, Moore	

Tabel 9. Longitudinal studies on the relation between work stress-related exposures and mental health self assessed by questionnaire scales

| Exposure	High quality studies (> 6 points) with significant result	High quality studies (> 6 points) with insignificant result	Low quality studies (< 7 points) with significant result	Low quality studies (< 7 points) with insignificant result
Job strain	Bildt (women), Bourbonnais99	Bildt (men), Bourbonnais01, Ylipaavalni		Ort-Gomer
Demands	Bültmann , Cheng, Kivimäki03a, Stansfeld98 (women), Stansfeld99	Rugulies, Standsfeld97, Stansfeld98 (men), Ylipaavalni	Bromet Johnson	Holman
Low decision latitude	Cheng, Kivimäki03a, Ruguleis (women), Stansfeld97 (men) Stansfeld98 (men), Stansfeld99	Bültmann, Eriksen, Rugulies (men), Stansfeld97 (women),Stansfeld98 (women), Ylipaavalni	Holman Johnson,	Bromet
Effort reward imbalance	Godin, Stansfeld98, Standsfeld99			
Insecurity	Bültmann (men), Ferrie01, Ferrie02 (men), Rugulies (men), Swaen (men)	Bültmann (women), Ferrie02 (partly women), Ruguleis (women), Swaen (women)		
Injustice	Ferrie06, Kivimäki03a, Ylipaavalni			
Threats/violance	Eriksen, Kivimäki03b			
Low social support	Bültmann, Bourbonnais01, Cheng, Eriksen, Rugulies (women), Shimegi (women), Stansfeld97, Stansfeld98, Stansfeld99	Kivimäki03a, Rugulies (men), Babezone, Bildt, Shigemi (men)	Johnson Bromet	
Long working hours			Suwazono (men)	Suwazono (women), Tarumi
Strain otherwise measured	Babezone, Eriksen, Ylipaavalni, Shimegi		AlaMursula (women), Hogh (women)	Hogh (men) AlaMursula (men)
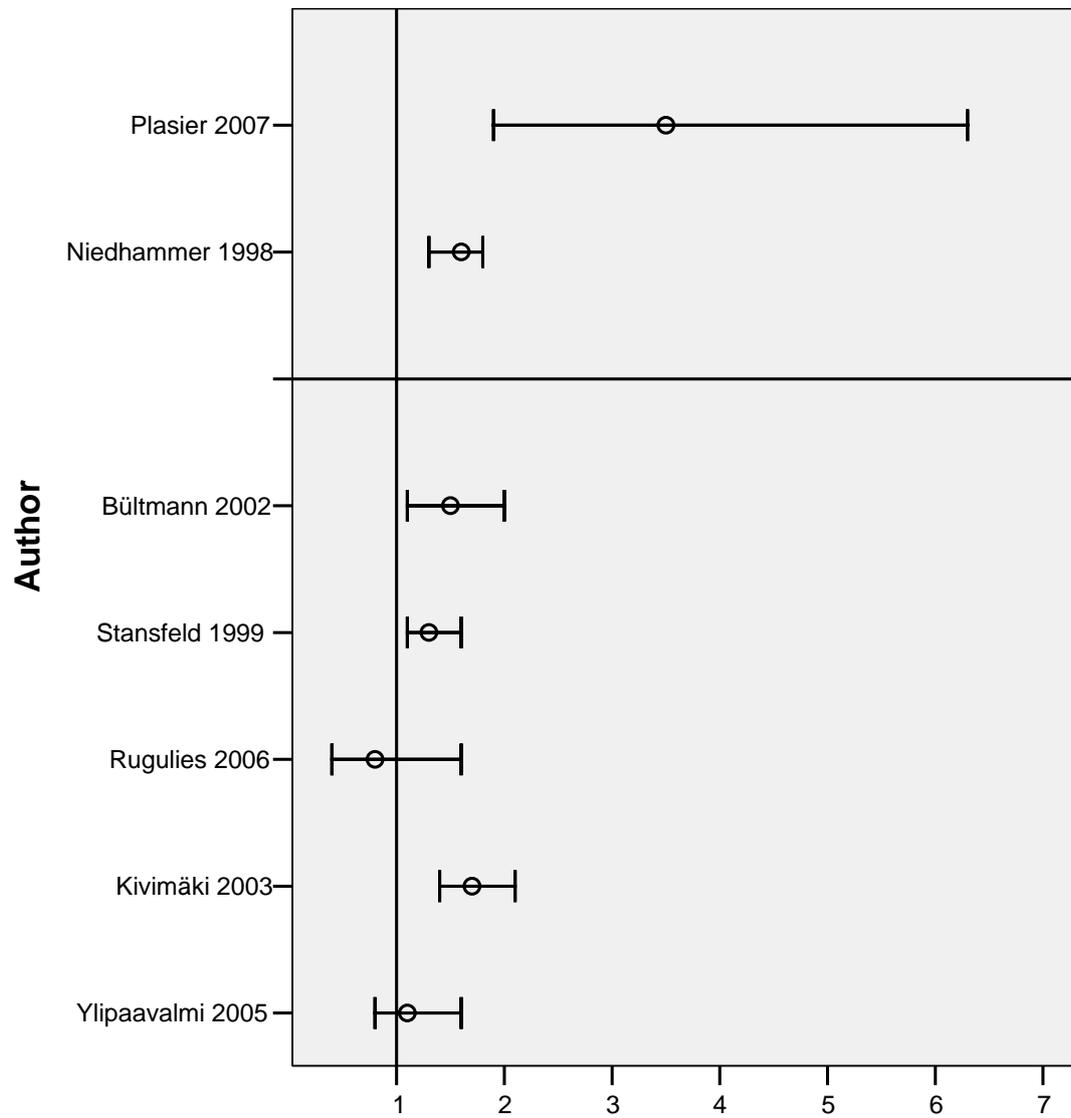
Figure 1. Relative risk (95 % CI) in longitudinal studies reporting risk estimates on the relationship between psychological demands at work and measures of depression (upper quadrant) and psychological distress (lower quadrant)
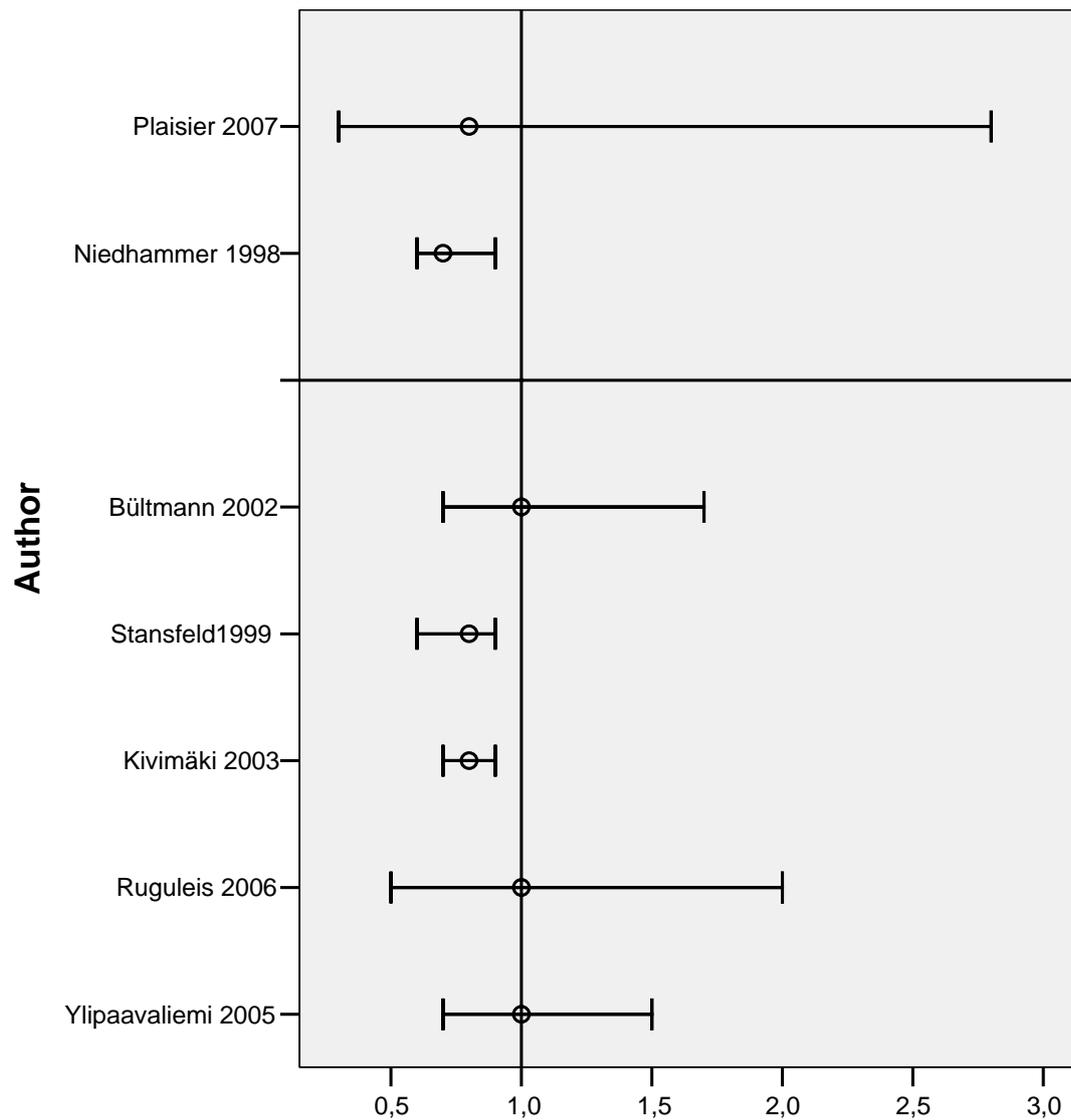
Figure 2. Relative risk (95 % CI) in longitudinal studies reporting risk estimates on the relationship between decission latitude at work and measures of depression (upper quadrant) and psychological distress (lower quadrant)

Plaisier 2007

Shields 2006

Niedhammer 1998

Author

Bültmann 2002

Stansfeld 1999

Romanov 1996

Rugulies 2006

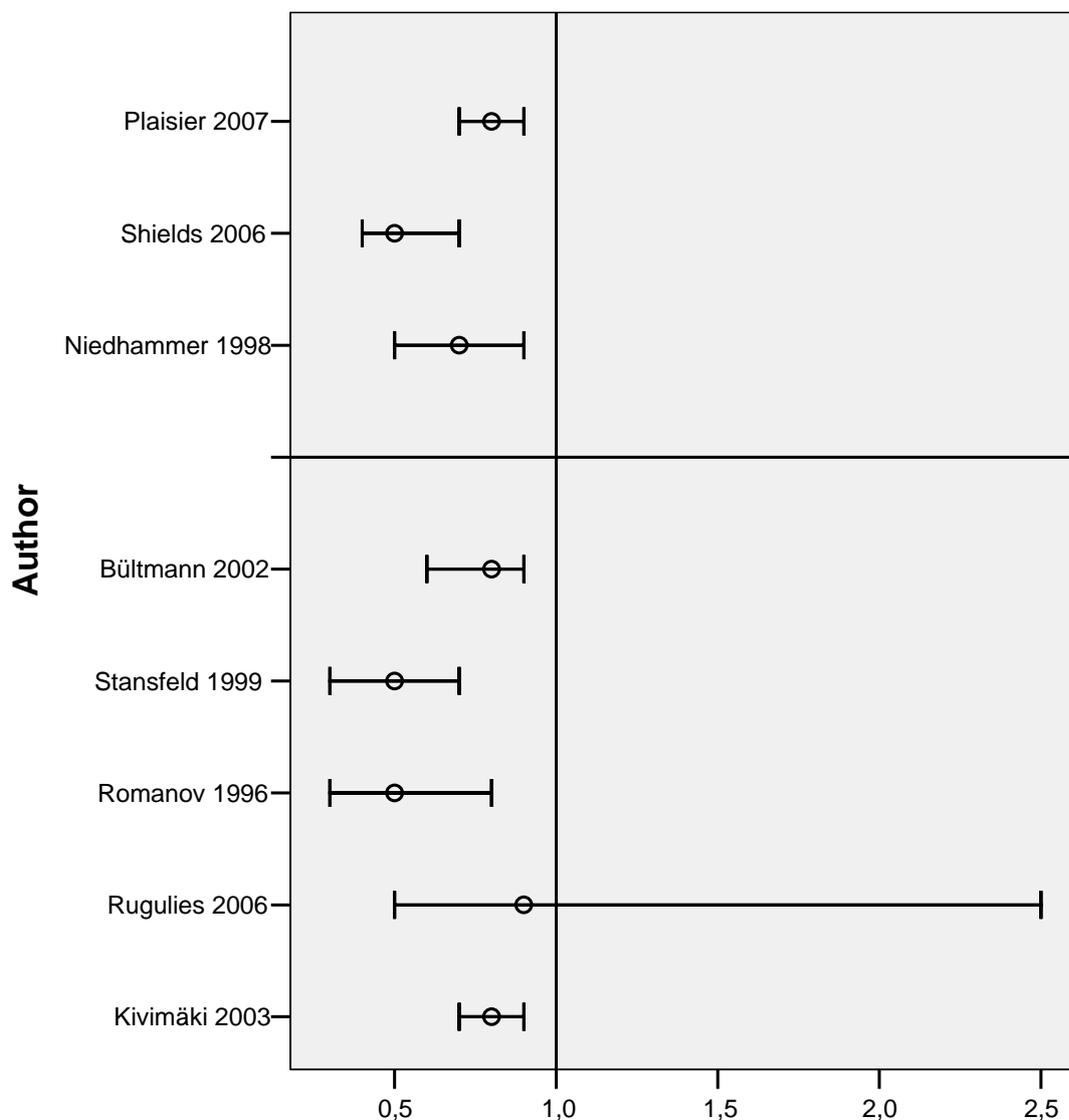Kivimäki 2003

0,5   1,0   1,5   2,0   2,5

Figure 3. Relative risk (95 % CI) in longitudinal studies reporting risk estimates on the relationship between social support at work and measures of depression (upper quadrant) and psychological distress (lower quadrant)

Figure 4. Relative risk (95 % CI) in longitudinal studies reporting risk estimates on the relationship between different strains in the job and measures of depression (upper quadrant) and psychological distress (lower quadrant)