Fatigue as a predictor of sickness absence: results from the Maastricht cohort study on fatigue at work

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Objectives: To investigate whether there is a relationship between fatigue and sickness absence. Two additional hypotheses were based on the theoretical distinction between involuntary, health related absence and voluntary, attitudinal absence. In the literature, the former term is usually used to describe long term sickness absence, the latter relates to short term sickness absence. In line with this, the first additional hypothesis was that higher fatigue would correspond with a higher risk of long term, primarily health related absence. The second additional hypothesis was that higher fatigue would correspond with a higher risk of short term, primarily motivational absence.

Methods: A multidimensional fatigue measure, as well as potential sociodemographic and work related confounders were assessed in the baseline questionnaire of the Maastricht cohort study on fatigue at work. Sickness absence was objectively assessed on the basis of organisational absence records and measured over the six months immediately following the baseline questionnaire. In the first, general hypothesis the effect of fatigue on time-to-onset of first sickness absence spell during follow up was investigated. For this purpose, a survival analysis was performed. The effect of fatigue on long term sickness absence was tested by a logistic regression analysis. The effect of fatigue on short term sickness absence was investigated by performing a survival analysis with time-to-onset of first short absence spell as an outcome.

Results: It was found that higher fatigue decreased the time-to-onset of the first sickness absence spell. Additional analyses showed that fatigue was related to long term as well as to short term sickness absence. The effect of fatigue on the first mentioned outcome was stronger than the effect on the latter outcome. Potential confounders only weakened the effect of fatigue on long term absence.

Conclusions: Fatigue was associated with short term but particularly with long term sickness absence. The relation between fatigue and future sickness absence holds when controlling for work related and sociodemographic confounders. Fatigue as measured with the Checklist Individual Strength can be used as a screening instrument to assess the likelihood of sickness absence in the short term.

Sickness absence is a complex phenomenon since its occurrence and course are influenced by a range of factors, including social factors (for example, social security system, health care, culture), work related factors (work content, work conditions), organisational factors (company size, the existence of health promotion programmes and absence policies) and individual factors (personality, health).[1–4] Sickness absence can be seen as a coping mechanism. It may be a reaction to symptoms of stress or ill health or it may be a reaction to the perceived causes of these symptoms.[1 5] In this way, absence can be the result of ill health or it can be the result of a negative attitude towards the job originating from, for instance, a low motivation, low satisfaction, or low commitment. Either or both can contribute to the decision to report oneself ill.[6] In the literature short term sickness absence and a high absence frequency are assumed to be more related to attitude.[7 8] Long term sickness absence is suggested to be particularly related to ill health and inability to perform work tasks.[8 9] As such, long term sickness absence is referred to as a primarily involuntary absence measure while short term absence and absence frequency can be seen as primarily voluntary absence measures.[9 10] This dual explanation for sickness absence is related to the fact that in most countries a medical certificate is required after a certain number of absence days.[9] In line with the above mentioned theoretical distinction, several authors have reported different risk factors of long term and short term absence, or of absence duration and of frequency.[3 5 9 11]

The aim of the present study was to investigate fatigue as a predictor of sickness absence. Fatigue is found prevalent in the general population,[12 13] in clinical populations,[14] and in employees.[15] There are several reasons why fatigue may be an important predictive factor for sickness absence.[16 17] Firstly, there is a high prevalence of fatigue cases in the working population.[15] Secondly, the fatigue state was found to be rather robust.[18] Thirdly, fatigue can be a disabling condition.[19] Finally, in the Netherlands a substantial proportion of the employees who receive a sickness or disability benefit are given the diagnostic label of "adaptive or exogenous reaction" within the ICD-10. This diagnostic group includes job stress, overstrain, and burnout.[20 21] Fatigue is an important symptom of the mental, stress related health complaints that fall within this diagnostic group.[16 22]

In the literature, fatigue is generally described and measured as a multidimensional phenomenon.[19 23 24] Indeed in previous studies, cognitive, motivational, and physical fatigue dimensions were strongly interrelated.[18 25] Fatigue was hypothesised and found to have a multifactorial aetiology.[19 23 26–28] The severity of fatigue is continuously distributed in the population.[12 13 19] In previous studies, fatigue was strongly associated with a bad mental health state, impaired functioning and a variety of long term illnesses.[12 15 25 29 30] However, just like sickness absence, fatigue is a non-specific measure which may also reflect attitude. The relationship between fatigue and attitude or motivation is less established thus far in comparison with the relationship between fatigue and ill health.

In previous studies, attitude as represented among others by job satisfaction and commitment, appeared to be related primarily to short term sickness absence and absence frequency.[9 31 32] In the last decade health has been given more

Abbreviations: CIS, Checklist Individual Strength; MCS, Maastricht cohort study.

attention as a potential predictor of sickness absence.[11 33] Physical, mental, and general health indicators appeared to be predictive particularly of long term sickness absence.[1 9 11 33–37] In a study by De Croon and colleagues,[38] need for recovery was found predictive of future long term sickness absence (>14 days). Need for recovery is a measure of acute work related fatigue. Under conditions of prolonged exposure to work related stressors and insufficient recovery, acute fatigue is assumed to lead to cumulative health deterioration and sickness absence.[38–40] Thus far though, the effect of long term, general fatigue on sickness absence has not been investigated in a structured manner.

In the present study we tested first whether there is a relationship between fatigue and sickness absence in general. To get more insight in this relationship, two additional hypotheses were formulated which were based on the distinction between primarily health related, long term absence and primarily attitudinal, short term absence. In line with this distinction, the first additional hypothesis was that higher fatigue goes together with a higher risk for long term absence. The second additional hypothesis was that higher fatigue goes together with an increased risk for short term absence. As mentioned before, fatigue was often found related to ill health in the literature. To a far lesser extent fatigue was investigated in relation to motivation or described as an expression of motivation or attitude. Since previous studies showed that ill health was more related to long term absence than to short term absence,[9] the effect of fatigue on long term sickness absence was expected to be stronger than the effect of fatigue on short term sickness absence.

Work characteristics such as job demands, control, and social support and sociodemographics may confound the relationship between fatigue and sickness absence (1) since these are associated with fatigue[41] and (2) because they play a role in the aetiology of sickness absence.[2 3 11 42 43] Similar combinations of factors were included, for example, in studies by de Croon and colleagues[38] and Smulders and Nijhuis.[11] The potential confounding of the sociodemographics and the work related characteristics may relate to an underlying motivational or health related mechanism with regard to the relationship between fatigue and sickness absence. These confounders were therefore included in all analyses.

METHOD

Maastricht cohort study

This study is part of the large scale Maastricht cohort study (MCS) on fatigue at work (1998–2001). A heterogeneous cohort coming from 45 different companies and institutions was followed for three years by four-monthly self report questionnaires. The prospective study design made it possible to investigate the relationship between fatigue and future sickness absence. The baseline questionnaire of the MCS, which was administrated in May 1998, was used to determine fatigue and the potential confounders—that is, work characteristics and sociodemographic characteristics). For the present study, absence data for the period July–December 1998 were used, which covered the six months following the administration of the baseline questionnaire.

Exclusion criteria

Employees who were fully or partially sick listed at the time of the baseline questionnaire were excluded from the study population. It was argued that the perception of the work situation of long term sick listed employees might be biased because of work related sickness absence or recall bias as a consequence of time out of work. Furthermore, sickness absence is a strong predictor of future absence behaviour.[11 43] The exclusion of absent employees at baseline does more justice to the aim of the present study to examine the effect of fatigue on future sickness absenteeism. Secondly, employees who reported to suffer from a long term illness at baseline were excluded because the illness may affect sickness absence behaviour directly or indirectly via the aetiology and natural course of fatigue. Thirdly, employees with more than one contract were excluded. The need or the motivation to report sick in one job may lead to the systematic actual initiation of sickness absence in the "other" job. Finally, women who were on the sick list because of pregnancy or maternity leave were excluded from participation.

Study population

In the present study, organisational absence records from 40 participating companies and institutions were used. Other companies were not able to deliver sick leave data due to technical reasons. This means that for 10 956 participants of the baseline measurement sick leave data were available. After application of the exclusion criteria, 7495 cohort participants were available for analysis. The main part of the excluded subjects had a long term illness; other exclusion criteria were smaller in terms of the number of excluded subjects.

Measures

Fatigue

In this study, fatigue was measured with the Checklist Individual Strength (CIS).[25 44] The CIS contains 20 items that are scored on a 7-point Likert scale. It is a multidimensional self report questionnaire that covers the following subscales: subjective fatigue (eight items on somatic symptoms and general feelings of fatigue), reduction in motivation (four items), reduction in concentration (five items) and reduction in activity (three items). Items do not refer to the work situation but are stated in general terms. The reference period of the scale is the last two weeks. The CIS was developed for clinical populations, in particular for people suffering from the chronic fatigue syndrome[25–45] but was also validated in the working population.[30] In the present study we used the total fatigue score, which was based on all 20 items. Reliability of the scale was good, as expressed by a Cronbach's alpha coefficient of α=0.93. The response scale ranged from 20–140. A higher score means a higher degree of fatigue. A CIS-total cut off point was stated in a pilot study.[46] It was based on samples with expected differences in fatigue levels. Employees scoring above the cut off were designated as probable fatigue cases and as being "at risk" for sickness absence or work disability.[46] In the statistical analyses, we included fatigue as a continuous variable. The CIS cut off point was only used for graphical presentation of some results.

Potential confounders

Sociodemographics and work characteristics were included as potential confounders. Educational level and gender were included as dummy variables. Educational level was operationalised as low (primary school, lower vocational education, or lower secondary school), medium (intermediate vocational education or upper secondary school) and high (upper vocational education or university). Age was included as a continuous variable. Work related confounders were operationalised by measures of psychological demands, skill discretion, decision authority, supervisor and co-worker support.[47–49] These variables were measured by a Dutch version of the Job Content Questionnaire (JCQ).[50 51] *Psychological job demands* were measured with five items on quantitative workload, work pace and conflicting demands. *Decision authority* was measured with three items on the ability to make work related decisions.[49 52] *Skill discretion* was measured with five items, covering elements of task variety and creativity required on the job.[52] *Social support from co-workers and supervisor social support* were both assessed with four items. The response options for the work characteristics varied on a 4-point Likert scale from

Table 1 Description of the study population

Variable	Total group (n=7274–7494) Mean (SD) or %
Fatigue	53.35 (21.62)
% Education low	30.0
% Education medium	32.3
% Education high	37.7
Age	40.36 (8.86)
% Male	74.5
Psychological job demands	33.06 (5.60)
Skill discretion	36.76 (5.43)
Decision authority	35.83 (6.93)
Supervisor support	10.59 (2.27)
Co-worker support	11.92 (1.55)

"strongly disagree" to "strongly agree". The internal consistency of the scales was moderate to good, ranging from $\alpha=0.69$ for psychological job demands to $\alpha=0.84$ for supervisor support. A higher score indicated higher demands, higher control, and higher support.

Sickness absence

The use of objective absence data was expected to reduce self report bias.[53 54] We firstly wanted to know whether there is a relationship between fatigue and sickness absence. For this end we operationalised sickness absence as the time to the onset of the first absence spell. All first absence spells, regardless of duration, were included. In the analysis in which the additional hypothesis on the relationship between fatigue and long term sickness absence was investigated, we used the time lost index. The group of employees with more than 42 calendar days of sickness absence over half a year was contrasted with the group of employees with 0–7 calendar days of sickness absence. In the Netherlands, most employees are called for consultation by an occupational physician within the first couple of weeks after the onset of the sick leave.[55] By that time, employees will have been asked to provide information on the reason of the sick leave and many will have undergone a physical examination. Thus overall, sickness absence of more than 42 days can be considered as certified. In the analysis in which the relationship between fatigue and short term absence was tested, time-to-onset of the first short sickness absence spell was taken as an outcome. We included time-to-onset in this particular outcome, because the variety in time-to-onset of the first short absence spell was high. Moreover, in general a higher absence frequency is related to a shorter time-to-onset of the first absence spell. The inclusion of time-to-onset in the short term absence operationalisations therefore emphasises the theoretical distinction between primarily health related, long term absence and primarily attitudinal, short term absence.

Data analyses

Descriptives were calculated for the study population (table 1). All data analyses in which the hypotheses were tested were executed in two steps. Firstly, fatigue was included to calculate a crude effect of fatigue on sickness absence. Secondly, potential sociodemographic and work related confounders were included altogether. The hypothesis that postulated that high fatigue leads to an increased sickness absence risk in general and the one that postulated that high fatigue leads to an increased risk of a short term sick leave episode, were tested by executing survival analyses (Cox proportional hazards modelling). In the survival analyses, all employees who were absent from work at the beginning of follow up (1st July) were excluded. The relative risks per standard deviation of change in fatigue were calculated together with their 95% confidence intervals. The results of the first hypothesis were visualised in a graph in which fatigue was dichotomised at the earlier described CIS-total cut off point.[46] The analyses were performed using the SAS program.[56] The hypothesis on the relationship between fatigue and long term sickness absence was tested by a logistic regression analysis. An odds ratio and its 95% confidence interval again indicated the relative risk of long term sickness absence per standard deviation of change in fatigue.

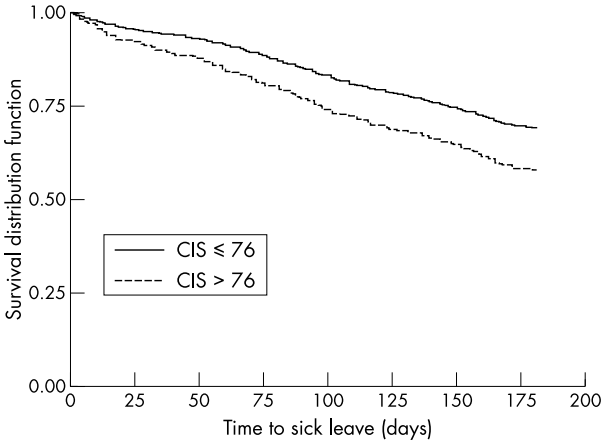

Figure 1 Survival plots of the relative risk of reporting sick for employees designated as probable fatigue cases (CIS>76) and employees who are not designated as probable fatigue cases (CIS≤76).

RESULTS

The means and standard deviations of all study variables are depicted in table 1. The study population consisted of 7495 employees, of whom 74.5% were male. A low educational level was reported by 30.0% of the study population, 32.3% had a medium educational level, and 37.7% had a high education. The mean age was 40.36 (SD 8.86; table 1). For further details on the descriptives of the potential work related confounders see table 1. The mean fatigue score was 53.35 (SD 21.62). Of the study population, 147 employees were on sick leave at 1 July 1998. This group was excluded from the survival analyses.

In a preliminary analysis, it was tested whether there is a relationship between fatigue and the risk of reporting ill, independent of absence duration. The survival analysis indicated that higher fatigue predicted a quicker onset of the first sick leave episode (crude RR=0.83, 95% CI=0.80–0.86; adjusted RR=0.85, 95% CI=0.81–0.88). The potential sociodemographic and work related confounders had no effect on the height of the crude RR of fatigue. The results are graphically presented in figure 1. In this figure, the unadjusted relationship between fatigue and time-to-onset of the first sickness absence spell (regardless of duration) is visualised by making use of the CIS-total cut off point that was described earlier. The survival plot shows that the time-to-onset of the first sickness absence spell is shorter for probable fatigue cases in comparison with employees who are not designated as probable fatigue cases.

To further explore the relationship between fatigue and sickness absence, our first additional hypothesis was that higher fatigue increases the future likelihood to report sick for more than 42 days. The results are shown in table 2. The ORs represent the increase of the likelihood of long term sickness absence, in case of an increase of the size of a standard deviation on the fatigue scale. Fatigue had a strong effect on long term sickness absence, both before and after controlling for confounding (crude OR=1.53, 95% CI=1.36–1.72; adjusted OR=1.40, 95% CI=1.23–1.61).

Table 2 Fatigue as a predictor of long term sickness absence. Number of subjects, crude ORs, and adjusted ORs.

	n*	OR†	95% CI	n*	OR‡	95% CI
0–7 days	6277	1		5862	1	
>42 days	257	1.53	1.36–1.72	229	1.40	1.23–1.61

*Difference with total study population due to the restricted variety in sickness absence (0–7 or >42 days) or missing data on one or more research variables.
†Crude odds ratio, increase per standard deviation in fatigue score.
‡Adjusted for gender, educational level, age, psychological demands, skill discretion, decision authority, supervisor support and co-worker support, increase per standard deviation in fatigue score.

Table 3 Fatigue as a predictor of time-to-onset of first short sickness absence spell. Number of subjects, crude RR, and adjusted RR

	n*	RR†	95% CI	n*	RR‡	95%
Incident short term sick leave	6584	0.85	0.81–0.89	6153	0.85	0.81–0.90

*Difference with total study population due to sick leave on 1 July 1998, due to restricted variety in sickness absence (no absence spells during follow up or first short absence spell) or due to missing data on one or more research variables.
†Crude odds ratio, increase per standard deviation in fatigue score.
‡Adjusted for gender, educational level, age, psychological demands, skill discretion, decision authority, supervisor support, and co-worker support, increase per standard deviation in fatigue score.

Our second additional hypothesis was that higher fatigue increases the likelihood of short term absence. This was investigated by a survival analysis in which time-to-onset of first short sick leave episode was taken as an outcome. The results confirmed our hypothesis (table 3; crude RR=0.85, 95% CI=0.81–0.89; adjusted RR=0.85, 95% CI=0.81–0.90). The results were comparable to those found while testing our first, general hypothesis on the relationship between fatigue and sickness absence.

DISCUSSION

The aim of the present study was to examine the effect of fatigue on future sickness absence. Future sickness absence was measured over the six months following the fatigue measurement. Advantages were the prospective design and the objective sickness absence measure that was included. There appeared to be a relationship between fatigue and sickness absence. While further exploring this relationship, it appeared that fatigue was particularly strongly related to long term sickness absence. Nevertheless, the relative risk of fatigue for a quick onset of short term sickness absence episode was also found significant. The fact that the relative risk of fatigue for long term sickness absence was decreased when potential confounding of sociodemographics and work related factors was controlled for, points at complex relationships between these factors, fatigue, and sickness absence. The fact that the confounders did not affect the relative risk for short term sickness absence points at differential underlying causal mechanisms for short term and long term sickness absence.

As was already mentioned in the introduction, in the literature short term sickness absence is often referred to as voluntary, motivational absence, while long term sickness absence is mostly referred to as health related, involuntary sickness absence. Following this reasoning while interpreting the stronger effect of fatigue on long term than short term absence, the conclusion can be drawn that high fatigue may be less of an indicator or correlate of bad motivation or attitude than of ill health. This interpretation fits in with the presentation of fatigue in the literature as a disabling condition.[19]

Next to an effect of fatigue on the number of absence days, we found that fatigue was predictive of a quick onset of the first (short) sickness absence spell. As already mentioned, there is a strong relationship between absence frequency and time-to-onset of a sick leave episode. This is because more frequent absence episodes are automatically distributed over a longer time period, which implies a higher chance of a quick onset of the first absence spell. A single absence spell though may occur at every moment in the period over which absence is measured. Therefore, the results of the analyses on time-to-onset of first sickness absence spell also in a way refer to absence frequency.

The present study was based on a prospective design. By predicting future sickness absence behaviour in a population of employees who were not on sick leave at the time of the measurement of the predictors, we tried to make the causal direction of fatigue on future sickness absence more plausible. Nevertheless, the possibility of bi-directional or (solely) reverse causation cannot be ruled out.[57] This is because part of the relationship between fatigue and future sickness absence may still be explained by a cross-sectional relationship at baseline between fatigue and sickness absence history. However, solely reverse causation seems unlikely since it does not seem plausible that the strong effects of fatigue we found, particularly on long term sickness absence, will disappear when an effect of sickness absence on future fatigue is introduced in the model.

Notwithstanding the above mentioned, the exclusion of sick listed employees at baseline may have led to an underestimation of the relationship between fatigue and sickness absence because we may have excluded a less healthy population with probably higher absence rates. Furthermore, fatigue and the work related confounders were assessed within the same questionnaire. This may have led to self report bias originating from for example cognitive consistency, negative affectivity, or a bad work attitude.[58] In this way, controlling for potential confounding may have led to an underestimation of the effects of fatigue on the outcomes. However, we found no indications of inflated correlations between the work characteristics and fatigue, nor did we systematically find that the work related confounders strongly affected the effect of fatigue on sickness absence.

The results of the present study apply to a follow up period of six months. The length of the follow up period of employees is often an arbitrary choice, but appeared well chosen since we found a rather strong effect of fatigue on sickness absence for this follow up period. Furthermore, since the period immediately followed the fatigue measurement, it can be concluded

that the time lag of the effect of higher fatigue on sickness absence was short. Future studies may shed more light on whether the effect of fatigue on sickness absence may be extended to a longer follow up period.

It seems that the multidimensional fatigue instrument which was used in the present study is a useful screening instrument for employees at risk for sickness absence. This procedure might be included in the sociomedical guidance or health surveillance by occupational health services. The fatigue instrument can also establish priorities with regard to the timing of interventions for specific risk groups, as time-to-onset of first sick leave episode was found to be shorter for employees with a higher fatigue score. The results subscribe and extend the results from a recent study, in which the same fatigue measurement used in our study was found to be strongly predictive for work disability.[59]

As already mentioned, the present study is an important starting point to investigate further the underlying causal chain of health related and attitudinal reactions that underlie the effect of fatigue on long term and short term sickness absence respectively. Moreover, it is recommended to study predictors of sickness absence across specific diagnosis groups as a refinement of the present study. This will not only increase insight but will also shed more light on the contents of interventions to prevent sickness absence or to shorten its duration.

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REFERENCES

1 **Kristensen TS**. Sickness absence and work strain among danish slaughterhouse workers: an analysis of absence from work regarded as coping behaviour. *Soc Sci Med* 1991;**32**:15–27.
2 **Alexanderson K**. Sickness absence: a review of performed studies with focused on levels of exposures and theories utilized. *Scand J Soc Med* 1998;**26**:241–9.
3 **Niedhammer I**, *et al*. Psychosocial factors at work and sickness absence in the Gazel cohort: a prospective study. *Occup Environ Med* 1998;**55**:735–41.
4 **Savikko A**, Alexanderson K, Hensing G. Do mental health problems increase sickness absence due to other diseases? *Soc Psychiatry Psychiatr Epidemiol* 2001;**36**:310–6.
5 **Dwyer DJ**, Ganster DC. The effects of job demands and control on employee attendance and satisfaction. *Journal of Organizational Behavior* 1991;**12**:595–608.
6 **Steers RM**, Rhodes SR. Major influences on employee attendance: A process model. *J Appl Psychol* 1978;**63**:391–407.
7 **Chadwick-Jones JK**, Nicholson N, Brown C. *Social psychology of absenteeism*. New York: Praeger, 1982.
8 **Stansfeld S**, Head J, Ferrie J. Short-term disability, sickness absence, and social gradients in the Whitehall II study. *Int J Law Psychiatry* 1999;**22**:425–39.
9 **M Marmot**, A Feeney, M Shipley, *et al*. Sickness absence as a measure of health status and functioning: from the UK Whitehall II study. *J Epidemiol Community Health* 1995;**49**:124–30.
10 **Geurts SA**, Buunk BP, Schaufeli WB. Health complaints, social comparisons, and absenteeism. *Work and Stress* 1994;**8**:220–34.
11 **Smulders PGW**, Nijhuis FJN. The Job-Demands-Job Control Model and absence behaviour: results of a 3-year longitudinal study. *Work and Stress* 1999;**13**:115–31.
12 **Loge JH**, Ekeberg O, Kaasa S. Fatigue in the general Norwegian population: normative data and associations. *J Psychosom Res* 1998;**45**:53–65.
13 **Pawlikowska T**, Chalder T, Hirsch SR, *et al*. Population based study of fatigue and psychological distress. *BMJ* 1994;**308**:763–6.
14 **Chen MK**.The epidemiology of self-perceived fatigue among adults. *Prev Med* 1986;**15**:74–81.
15 **Bultmann U**, Kant I, Kasl SV, *et al*. Fatigue and psychological distress in the working population: psychometrics, prevalence and correlates. *J Psychosom Res* 2002;**52**:445–52.
16 **Terluin B**, Van der Klink JJL, Surmenage. In: JJL Van der Klink, *ed. Psychische problemen en de werksituatie* (Mental problems and the work situation). Amsterdam: NIA, 1993.
17 **Schröer CAP**. De toename van arbeidsongeschiktheid wegens psychische aandoeningen. [The increase of work disability due to mental disorders]. *TBV*, 1997; **5**: p. 16–23.
18 **Janssen N**, Ouwens MJNM, Janssen PPM, *et al*. Work-related risk factors in the natural course of fatigue: prospective results from the Maastricht cohort study on fatigue at work. Submitted for publication, 2003.
19 **Wessely S**. Chronic fatigue: symptom and syndrome. *Ann Intern Med* 2001;**134**:838–43.
20 **Van Eck MAA**. De diagnosestelling: Categorie V. In: Bijl R, Bauduin D, *eds. Categorie V: arbeidsongeschikt wegens psychische stoornissen* [Category V: work disabled due to a mental disorder]. Utrecht: NcGv; 1991.
21 **Csánky HW**. De verzekeringsarts en de cliënt met psychische klachten: eerste ervaringen met het standaardonderzoek voor psychische stoornissen. In: Hoogduin CAL, Knepper S, Csánky HW, *eds. Onderzoek bij psychische stoornissen voor bedrijfs-en verzekeringsartsen* [Research in mental disorders for company doctors and medical advisers]. Houten: Bohn Stafleu Van Loghum, 1999:65–75.
22 **Terluin B**, Van der Klink JJL. Klinisch beeld en beloop van overspanning. In: Hoogduin CAL, *et al, eds. Behandelingsstrategieen bij burnout* [Treatment strategies for burnout]. Houten/Diegem: Bohn Stafleu Van Loghum, 1996.
23 **Lewis G**, Wessely S. The epidemiology of fatigue: more questions than answers. *J Epidemiol Community Health* 1992;**46**:92–7.
24 **Smets EM**, Garssen B, Bonke B, *et al*. The Multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue. *J Psychosom Res* 1995;**39**:315–25.
25 **Vercoulen JH**, Swanink CM, Fennis JF, *et al*. Dimensional assessment of chronic fatigue syndrome. *J Psychosom Res* 1994;**38**:383–92.
26 **Meijman T**, Schaufeli W. Psychische vermoeidheid en arbeid. Ontwikkelingen in de A&O psychologie. [Mental fatigue and work. Developments in work and organizational psychology]. *De Psycholoog* 1996;**31**:236–41.
27 **Bultmann U**, Kant IJ, Kasl SV, *et al*. Lifestyle factors as risk factors for fatigue and psychological distress in the working population: prospective results from the Maastricht cohort study. *J Occup Environ Med* 2002;**44**:116–24.
28 **Bultmann U**, Kant IJ, Van den Brandt PA, *et al*. Psychosocial work characteristics as risk factors for the onset of fatigue and psychological distress: prospective results from the Maastricht cohort study. *Psychol Med* 2002;**32**:333–45.
29 **Vercoulen JH**, Hommes OR, Swanink CM, *et al*. The measurement of fatigue in patients with multiple sclerosis. A multidimensional comparison with patients with chronic fatigue syndrome and healthy subjects. *Arch Neurol* 1996;**53**:642–9.
30 **Beurskens AJ**, Bultmann U, Kant I, *et al*. Fatigue among working people: validity of a questionnaire measure. *Occup Environ Med* 2000;**57**:353–7.
31 **Hackett RD**. Work attitudes and employee absenteeism: a synthesis of the literature. *Journal of Occupational Psychology* 1989;**62**:235–48.
32 **Cheloha RS**, Farr JL, Absenteeism, job involvement, and job satisfaction. *J Appl Psychol* 1980;**65**:467–73.
33 **Nijhuis FJN**, Smulders PGW. Die Wirkung von Arbeitsanforderungen und persönlichen Kontrollmöglichkeiten auf Gesundheitsbeschwerden und Fehlzeiten. *Zeitschrift fur Arbeits- und Organisationpsychologie* 1996;**40**:173–80.
34 **Jenkins R**. Minor psychiatric morbidity in employed young men and women and its contribution to sickness absence. *Br J Ind Med* 1985;**42**:147–54.
35 **Hendrix WH**, Spencer BA, Development and test of a multivariate model of absenteeism. *Psychol Rep* 1989;**64**:923–38.
36 **Hensing G**, Spak F, Alexanderson K, *et al*. Sick-leave among women and the role of psychiatric disorder. *Scand J Soc Med* 1997;**25**:185–92.
37 **Bourbonnais R**, Mondor M. Job strain and sickness absence among nurses in the province of Québec. *Am J Ind Med* 2001;**39**:194–202.
38 **Croon de EM**, Sluiter JK, Frings-Dresen MHW. Need for recovery after work predicts sickness absence. A 2-years prospective cohort study in truck drivers. *J Psychosom Res* 2003 (in press).
39 **Meijman T**. *Mentale belasting en werkstress. Een arbeidspsychologische benadering* [Mental strain and work stress. An I/O psychology approach]. Assen: Van Gorcum, 1989.
40 **Kompier M**, Mulders H, Meijman TF, *et al*. Absence behaviour, turnover and disability: A study among city bus drivers in the Netherlands. *Work and Stress* 1990;**4**:83–9.
41 **Bültmann U**. *Fatigue and psychological distress in the working population: the role of work and lifestyle*. Maastricht: Thesis Maastricht University, 2002.
42 **North FM**, Syme SL, Feeney A, *et al*. Psychosocial work environment and sickness absence among British civil servants: the Whitehall II study. *Am J Public Health* 1996;**86**:332–40.
43 **Vahtera J**, Pentti J, Uutela A. The effect of objective job demands on registered sickness absence spells: Do personal, social and job-related resources act as moderators? *Work and Stress* 1996;**10**:286–308.
44 **Vercoulen JHMM**, Alberts M, Bleijenberg G. Kort instrumenteel: De Checklist Individual Strength (CIS). *Gedragstherapie* 1999;**32**:131–6.

45 **Vercoulen JH**, Swanink CM, Fennis JF, *et al*. Prognosis in chronic fatigue syndrome: a prospective study on the natural course. *J Neurol Neurosurg Psychiatry* 1996;**60**:489–94.
46 **Bultmann U**, de Vries M, Beurskens AJ, *et al*. Measurement of prolonged fatigue in the working population: determination of a cutoff point for the checklist individual strength. *J Occup Health Psychol* 2000;**5**:411–6.
47 **Karasek RA**. Job demands, job decision latitude, and mental strain: implications for job redesign. *Administrative Science Quarterly* 1979;**24**:285–308.
48 **Johnson JV**, Hall EM. Job strain, work place social support and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health* 1988;**78**:1336–42.
49 **Karasek RAT**, Theorell T. *Healthy work: stress, productivity, and the reconstruction of working life*. New York: Basic Books, 1990.
50 **Karasek RA**. *Job Content Questionnaire and User's Guide*. Los Angeles: University of Southern California, Department of Industrial and Systems Engineering, 1985.
51 Houtman I *Reliability and validity of the Dutch version of the Karasek Job Content Questionnaire*. NIOSH/APA conference on Stress, Work, and Health. Washington, DC: APA, 1995.
52 **Karasek R**, Brisson C, Kawakami N, *et al*. The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;**3**:322–55.
53 **Frese M**, Zapf D. Methodological issues in the study of work stress: objective vs subjective measurement of work stress and the question of longitudinal studies. In: C.L. Cooper, Payne R, *eds. Causes, coping and consequences of stress at work*. Chichester: Wiley, 1988:375–411.
54 **Vahtera J**, Kivimaki M, Uutela A, *et al*. Hostility and ill health: role of psychosocial resources in two contexts of working life. *J Psychosom Res* 2000;**48**:89–98.
55 **Rijk de A**, Van Lierop B, Janssen N, *et al*. *Geen kwestie van motivatie maar van situatie: een onderzoek naar man/vrouw verschillen in werkhervatting gedurende het eerste jaar na ziekmelding* [Not a matter of motivation but situation: a study on gender differences in work resumption patterns in the first year after the onset of the sick leave]. Doetinchem: Elsevier; 2002.
56 **Institute S**. *SAS/STAT user's guide, version 6, volume 1*. Cary, NC: SAS Insititute, 1989.
57 **Tharenou P**. A test of reciprocal causality for absenteeism. *Journal of Organizational Behavior* 1993;**14**:269–87.
58 **Algera JA**. Taakkenmerken [Job characteristics]. In: Drenth PJD, Thierry H, de Wolff CJ, *eds. Nieuw handboek arbeids-en organisatiepsychologie* [New handbook I/O psychology]. Houten: Bohn Stafleu Van Loghum, 1992: 63–92.
59 **van Amelsvoort LG**, Kant IJ, Beurskens AJ, *et al*. Fatigue as a predictor of work disability. *Occup Environ Med* 2002;**59**:712–13.