

REVIEW ARTICLE

A meta-analysis of observational studies identifies predictors of sickness absence[☆]

Saskia F.A. Duijts^{a,*}, Ijmert Kant^a, Gerard M.H. Swaen^b,
Piet A. van den Brandt^a, Maurice P.A. Zeegers^c

^aDepartment of Epidemiology, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

^bDow Chemical Terneuzen, Terneuzen, The Netherlands

^cDepartment of Public Health & Epidemiology, University of Birmingham, Birmingham, United Kingdom

Accepted 21 April 2007

Abstract

Objective: About one in every three employees seen by their occupational physician is absent from work because of psychosocial health complaints. To implement preventive measures, it is necessary to identify predictors for this type of sickness absence.

Study Design and Setting: A meta-analysis was carried out to quantify the association between predictive factors and psychosocial sickness absence and to assess clinical outcomes and heterogeneity. Eligible for inclusion were prospective studies that examined this association and provided sufficient information to estimate summary odds ratios (SORs).

Results: Twenty prospective studies were included. Significant SORs for sick leave >3 days were found for being unmarried, 1.37 (95% confidence interval [CI] = 1.15–1.64), experiencing psychosomatic complaints, 1.79 (95% CI = 1.54–2.07), using medication, 3.13 (95% CI = 1.71–5.72), having a burnout, 2.34 (95% CI = 1.59–3.45), suffering from psychological problems, 1.97 (95% CI = 1.37–2.85), having low job control, 1.28 (95% CI = 1.23–1.33), having low decision latitude, 1.33 (95% CI = 1.16–1.56), and experiencing no fairness at work, 1.30 (95% CI = 1.18–1.45).

Conclusion: This study shows that predictors of sickness absence can be identified in a homogeneous manner. The results provide leads to public health interventions to successfully improve psychosocial health and to reduce sickness absence. © 2007 Elsevier Inc. All rights reserved.

Keywords: Meta-analysis; Predictor; Sickness absence; Observational

1. Introduction

Sickness absence is a complex phenomenon [1]. It can be the result of various causes, such as musculoskeletal or psychosocial complaints, and the occurrence and course can be influenced by a range of factors, such as demographics, health (behavior), mental health, work, personal and organizational factors [2–5]. The magnitude of sickness absence due to psychosocial health complaints is substantial and represents a major concern in Western societies [6]. These complaints encompass both psychological conditions, such as depression, as well as social problems, such as work family conflicts [7]. In the Netherlands, about

one in every three employees seen by their occupational physician is absent from work because of psychosocial health complaints [8]. For the individual, reintegration after psychosocial absenteeism causes more difficulties and generally takes longer to return to work following physical problems. For both employers and society, the consequences of this type of sickness absence involve enhanced payments and reduced productivity [9]. Because of the economic and social impact of sickness absence due to psychosocial health complaints, early intervention is an all-important matter and should receive profound attention in occupational health practice. At this moment, a randomized controlled trial on the effectiveness of preventive intervention in employees at risk for sickness absence due to psychosocial health complaints is in progress. To enable identification of at-risk employees, insight into predictive factors for sickness absence due to psychosocial health complaints is needed. For the trial, the predictive factors were detected using data of the Maastricht Cohort Study

* Funded by the Health Research and Development Council (Zorg Onderzoek Nederland).

* Corresponding author. Tel.: +31-43-388-2368; fax: +31-43-388-4128.

E-mail address: sfa.duijts@epid.unimaas.nl (S.F.A. Duijts).

What is new?

- **Key substantive finding**
Predictors of sick leave from a meta-analysis of observational studies were unmarried status, psychosomatic complaints, using medication, burnout, psychological problems, low job control, low decision latitude, and unfairness at work.
- **Key methodologic finding**
Two-thirds of the presented effect sizes could be determined using fixed effect pooling. In 60% of the randomly determined effect sizes, possible explanations for heterogeneity were identified.

on Fatigue at Work [7,10]. Employees who reported sickness absence due to, for example, fatigue or conflicts at work were identified, and predictive factors for this specific type of sickness absence were assessed. Hereafter, an instrument consisting of these factors was developed to screen employees for their risk of sickness absence and to early intervene with these employees to prevent sickness absence due to psychosocial health complaints [7]. Results of the trial will be known in April 2007. To have a large-scale overview of research on influential factors and to provide the results of the trial a scientific basis, the current meta-analysis attempted to identify predictive factors for sickness absence due to psychosocial health complaints. The multiversity of sickness absence promotes the exploration of factors for separate causes of the concept. That is, studying sickness absence due to, for example, musculoskeletal problems might ascertain other predictive factors (e.g., ergonomic and physical factors) and probably other results than the assessment of sickness absence due to psychosocial health complaints. However, in contrast to several somatic reasons for sickness absence, psychosocial causes for sickness absence are rarely explicitly described in studies. Moreover, numerous studies seem to explore all-causes sickness absence because underlying diagnoses for sickness absence are not identified or reported. Consequently, the partition of psychosocial complaints from all-causes sickness absence is a complex and rather indefinite process. To optimize this extrication, and to increase the probability of assessing studies on sickness absence due to psychosocial health complaints, the omission of studies on sickness absence due to specific somatic complaints is essential. With this, the exclusion of all-causes sickness absence studies cannot be guaranteed, but the homogeneity of the remaining set of studies improves. Up to now, neither a systematic summary of previous studies nor a quantification of predictive factors for sickness absence due to psychosocial health complaints has been conducted. Above all, no attention has been given to the expected presence

of heterogeneity when studying this association. Our hypothesis is that clarification of these issues could provide imperative leads to public health interventions to prevent sickness absence due to psychosocial health complaints. The objective of this study is to review all epidemiologic studies up to August 2006 exploring predictive factors for sickness absence due to psychosocial health complaints, by assessing the clinical outcomes of selected studies and by quantifying the association.

2. Methods

2.1. Search strategy

Publications were identified through computerized Medline, PsycINFO, and Embase searches for studies that have been published up to August 2006, with no language restrictions. The keywords used were rather broad, that is, sickness absence and its determinants, and involved combinations of *demo**, *health*, *mental health*, *fatigue*, *psycho**, *person**, *organ**, *econ**, *environment**, *predict**, *absenteeism*, *sick leave*, and *sickness absence*. Additionally, references cited in published original and review papers were examined until no further studies were found. Eligible for inclusion in this meta-analysis were all prospective studies that addressed the influence of potentially predictive factors, such as sociodemographic factors, health (behavior), mental health, psychosocial work factors, personal factors, and organizational factors, on sickness absence due to psychosocial health complaints. Also, studies that provided sufficient information to estimate an odds ratio (OR) as well as its associated standard error (SE) were suitable for inclusion. The International Classification of Primary Care was used to recognize the psychosocial health complaints, in which both psychological and social problems were included. Studies that addressed a specific disease or condition as the main cause for sickness absence, such as musculoskeletal, cardiovascular, and respiratory conditions, were omitted. With this, the homogeneity of the set of remaining studies increased, but the exclusion of all-causes sickness absence studies could not be guaranteed. This selection method might be disputable, but is thought to be the most optimal manner to retrieve studies on the association between predictive factors and sickness absence due to psychosocial health complaints.

2.2. Data extraction

Several hundreds of references and abstracts were scanned for eligibility to select those relevant for our purposes and to determine the main focus of the articles. Qualitative and quantitative information was extracted from each paper by two reviewers. For one reviewer, the original papers were blinded for authors, affiliations, journal name, publication year, and acknowledgments. The reviewers independently assessed the following qualitative items:

general information (i.e., geographic area of the study), population characteristics (i.e., type of subjects and setting), study characteristics (i.e., design, type of predictor, measures, and follow-up time), study outcome (i.e., occurrence of sick leave [11]), and type of sickness absence data (i.e., self-reported data or data from employer's records). "Occurrence of sick leave" data were divided into two periods, that is, medically uncertified (≤ 3 working days) and medically certified sick leaves (> 3 working days). This partition was based on the lowest duration of certified sick leaves found in the included studies (i.e., > 3 days). In addition, the study characteristic "minimum duration of sick leave" was used as a factor in the sensitivity analyses to investigate its potential reason for heterogeneity. Furthermore, original quantitative data that allowed us to pool crude or adjusted ORs, and their corresponding SEs, were extracted from the articles to estimate the association between a range of predictive factors and sickness absence due to psychosocial health complaints. Adjusted effects were estimated using the most complete models, that is, all models were adjusted for demographic factors and additional factors such as behavioral risks (e.g., smoking, alcohol), health status, occupation, and baseline sickness absence. Data that could not be obtained directly were recalculated when necessary. When adjusted ORs could not be calculated, two-way tables were constructed to calculate the unadjusted ORs and corresponding SEs [12]. Results reported in rate ratios, that is, the quotient of the incidence rates in the exposed and nonexposed group, were considered comparable to results reported in ORs. When there was disagreement between reviewers on qualitative or quantitative data, it was discussed until consensus was reached.

2.3. Statistical analysis

We pooled ORs if at least two studies reported data on the relation between a specific predictive factor and sickness absence. However, when the reported results within a single study (population) were stratified for different categories of a specific predictive factor, we estimated an intrastudy effect (intrastudy odds ratios [IOR]). Standard meta-analytic procedures assume that results within a given analysis are independent. Our sorting of quantitative data, extracted from the included articles, into definite categories of predictive factors ensured that all of the summary odds ratios (SOR) would be based on independent samples [13]. We used the Stata statistical software package (StataCorp, College Station, TX, USA) [14] to weight log ORs by the inverse of their variances to obtain a pooled measure and the corresponding 95% CI. When results from the fixed and random effects models were different, we presented the latter as it represents a more conservative approach. Heterogeneity was investigated by evaluating whether CIs around the individual effect sizes of pooled studies overlapped sufficiently and by using the DerSimonian and Laird Q statistic ($P < 0.10$) [15]. To explore possible reasons for the observed heterogeneity,

sensitivity analyses were performed on the following study characteristics: geographical area, measures of predictive factors, follow-up time, and minimum duration of sick leave.

3. Results

3.1. Study characteristics

Approximately 200 references were identified in total. The publications were scanned, particularly on the cause of sickness absence, and initially 56 epidemiologic studies of predictive factors for sickness absence due to psychosocial health complaints were found to be relevant. Thirty-six of these articles were excluded—11 because a cross-sectional study design was used, 24 because no sufficient data could be extracted, and one because extremely fatigued employees were included at baseline. The remaining 20 articles that were included in the review [1,2,16–33] described prospective cohort studies, were published in English, and were, with the exception of one [18], all performed in Europe (Table 1). The studies were carried out in a range of occupational settings, including the industrial sector, the health care sector, the public sector, and the educational sector. Most studies investigated the association between a range of predictive factors and sickness absence—nine were focused at sociodemographic factors (SD) [16,18–20,22,24,26,27,30], eight at health (behavior) (H) [16–18,20,21,24,26,30], eight at mental health (MH) including fatigue [1,17,18,20,21,24,26,30], 18 at psychosocial work factors (PS) [2,16–24,26–33], two at personal factors (P) [22,24], and seven at organizational factors (O) [19,21–23,25,30,31]. Apart from one study that used employer's records to gather information about predictive factors [25], all studies used self-administered questionnaires to assess the influence of predictive factors on sickness absence due to psychosocial health complaints. Two studies used self-reported sickness absence data [19,20], and the remaining studies only used employer's records to determine the occurrence of sick leave (Table 1).

3.2. SORs

Crude and adjusted IORs and SORs for the influence of predictive factors on occurrence of sick leave ≤ 3 days (Table 2) and occurrence of sick leave > 3 days (Table 3) were calculated by means of data extracted from the 20 included studies. Two-third of the presented effect sizes were determined using fixed effect pooling. Significant adjusted ORs, exclusively on occurrence of sick leave ≤ 3 days, were found in four predictive factors, that is, no exercising, 1.19 (1.06–1.35), being exposed to job strain, 1.20 (1.13–1.28), suffering from life events, 1.14 (1.03–1.27), and going through reorganization, 1.32 (1.15–1.52). Significant adjusted ORs on both occurrence of sick leave ≤ 3 days and occurrence of sick leave > 3 days were found in eight predictive factors, that is, being unmarried, 1.28

Table 1

Characteristics of studies on the association between predictive factors and sickness absence due to psychosocial health complaints

Reference	Country (yr)	Participants, setting	Predictor(s) ^a	Measures ^b	FU ^c	Min dur ^d
Janssen et al., 2003 [1]	Netherlands (2003)	Employees from different sectors	MH	Quest; employer's records	6	42
Niedhammer et al., 1998 [2]	France (1998)	Electricity firm employees	PS	Quest; employer's records	12	7
Ala-Mursula et al., 2002 [16]	Finland (2002)	Municipal employees	SD,H,PS	Quest; employer's records	36	3
Andrea et al., 2003 [17]	Netherlands (2003)	Employees from different sectors	H,MH,PS	Quest; employer's records	18	90
Bourbonnais and Mondor, 2001 [18]	Canada (2001)	Nurses	SD,H,MH,PS	Quest; employer's records	20	5
De Croon et al., 2003 [19]	Netherlands (2003)	Truck drivers	SD,PS,O	Quest; self-report abs data	24	14
Eriksen et al., 2003 [20]	Norway (2003)	Nurses' aides	SD,H,MH,PS	Quest; self-report abs data	3	3
Godin and Kittel, 2004 [21]	Belgium (2004)	Employees from different sectors	H,MH,PS,O	Quest; employer's records	12	7
Hammer et al., 1981 [22]	USA (1981)	Manufacturing employees	SD,PS,P,O	Quest; employer's records	12	14
Kivimaki et al., 2000 [23]	Finland (2000)	Hospital staff	PS,O	Quest; employer's records	24	4
Kivimaki et al., 2001 [24]	Finland (2001)	Hospital employees	SD,H,MH,PS,P	Quest; employer's records	24	3
Knutsson and Goine, 1998 [25]	Sweden (1998)	Manufacturing employees	O	Employer's records	12	30
Krantz and Ostergren, 2002 [26]	Sweden (2002)	Employees from different sectors	SD,H,MH,PS	Quest; employer's records	12	14
Melchior et al., 2003 [27]	France (2003)	Electricity firm employees	SD,PS	Quest; employer's records	72	7
North et al., 1996 [28]	England (1996)	Civil servants	PS	Quest; employer's records	12	7
Rael et al., 1995 [29]	England (1995)	Civil servants	PS	Quest; employer's records	12	7
Vaananen et al., 2003 [30]	Finland (2003)	Industrial employees	SD,H,MH,PS,O	Quest; employer's records	21	4
Vaananen et al., 2004 [31]	Finland (2004)	Industrial employees	PS,O	Quest; employer's records	21	4
Vahtera et al., 2004 [32]	Finland (2004)	Municipal employees	PS	Quest; employer's records	66	3
Verhaeghe et al., 2003 [33]	Belgium (2003)	Health care employees	PS	Quest; employer's records	12	10

^a Potential predictors: (SD) Sociodemographic factors; (H) Health; (MH) Mental health; (PS) Psychosocial work factors; (P) Personal factors; (O) Organizational factors.

^b Quest: self-administered questionnaire; self-report abs data: self-reported absence data; Employer's records: absence data from personnel department records.

^c FU: Follow-up time in months.

^d Min dur: minimum duration of certified sick leave in days.

(1.14–1.44) and 1.37 (1.15–1.64), respectively, experiencing psychosomatic complaints, 1.43 (1.08–1.90) and 1.79 (1.54–2.07), using medication, 1.44 (1.32–1.58) and 3.13 (1.71–5.72), having a burnout, 1.28 (1.23–1.34) and 2.34 (1.59–3.45), suffering from psychological problems, 1.27 (1.23–1.31) and 1.97 (1.37–2.85), having low job control, 1.27 (1.14–1.39) and 1.28 (1.23–1.33), having low decision latitude, 1.23 (1.15–1.30) and 1.33 (1.13–1.56), and experiencing low fairness at work, 1.19 (1.06–1.33) and 1.30 (1.18–1.45). Finally, significant adjusted ORs, exclusively on occurrence of sick leave >3 days, were found in 13 predictive factors, that is, being low educated, 1.85 (1.59–2.33), using alcohol, 1.24 (1.02–1.52), being fatigued all the time, 1.32 (1.04–1.69), enjoying low work time control, 1.15 (1.10–1.20), enduring psychological job demands, 1.15 (1.12–1.19), having low skill discretion, 1.11 (1.02–1.20), having low decision authority, 1.49 (1.04–2.13), being unsatisfied with the job, 1.92 (1.49–2.50), having a physically demanding job, 1.66 (1.45–1.90), experiencing a high need for recovery, 2.15 (1.01–4.62), suffering from treats or violence, 1.26 (1.10–1.44), being overcommitted, 1.15 (1.03–1.29), and a low level of unemployment in the community, 1.39 (1.03–1.89) (Tables 2 and 3).

3.3. Sensitivity analyses

We further examined the IORs and SORs attained by random effect pooling, according to geographical area,

measures of predictive factors, follow-up time, and minimum duration of sick leave to explore the influence of these parameters on the outcome estimates (Tables 2 and 3). Sensitivity analyses revealed statistically significant effects of the parameter “geographical area” in four random effect ORs, that is, the crude and adjusted ORs of psychological problems on occurrence of sick leave >3 days ($P = 0.078$ and $P = 0.003$, respectively); and the adjusted ORs of social support on occurrence of sick leave ≤3 days ($P = 0.006$), and occurrence of sick leave >3 days ($P = 0.053$). In eight random effect IORs and SORs, differences in “measures of predictive factors” might explain the heterogeneity in the associations. Because of a lack of observations per measurement, no specific P -values could be given. Sensitivity analyses revealed statistically significant effects of the parameter “follow-up time,” exclusively on occurrence of sick leave >3 days, in five random effect ORs, that is, the crude OR of education ($P = 0.018$), the adjusted OR of fatigue ($P = 0.037$), the crude OR of psychological problems ($P = 0.078$), the crude OR of physical demands ($P = 0.008$), and the adjusted OR of reorganization ($P = 0.002$). Finally, sensitivity analyses revealed statistically significant effects of the parameter “minimum duration of sick leave,” exclusively on occurrence of sick leave >3 days, in four random effect ORs, that is, the crude OR of education ($P = 0.017$), the adjusted OR of fatigue ($P = 0.031$), the crude OR of psychological problems ($P = 0.078$), and the adjusted OR of reorganization ($P = 0.029$) (Tables 2 and 3).

Table 2

Crude and adjusted intrastudy odds ratios (IOR) and summary odds ratios (SOR) for the influence of predictive factors on occurrence of sick leave (duration ≤ 3 days)

Predictive factors	Crude odds ratios/reference(s)	Adjusted odds ratios/reference(s) ^a
Sociodemographics		
Marital status (<i>married vs. unmarried</i>)		IOR 1.28 (1.14–1.44) ^{b/} Kivimaki et al., 2001 [24]
Health (behavior)		
Psychosomatic complaints (<i>no 0; yes 1</i>)		IOR 1.43 (1.08–1.90) ^{c,d/} Kivimaki et al., 2001 [24]
Smoking (<i>no 0; yes 1</i>)		IOR 0.91 (0.76–1.09) ^{b/} Kivimaki et al., 2001 [24]
Alcohol (<i>moderate vs. high</i>)		IOR 1.20 (0.96–1.52) ^{b/} Kivimaki et al., 2001 [24]
Physical exercise (<i>yes 0; no 1</i>)		IOR 1.19 (1.06–1.35) ^{b/} Kivimaki et al., 2001 [24]
Medication use (<i>no 0; yes 1</i>)	IOR 1.44 (1.32–1.58) ^{b/} Bourbonnais and Mondor, 2001 [18]	IOR 1.44 (1.32–1.58) ^{b/} Bourbonnais and Mondor, 2001 [18]
Mental health		
Burnout (<i>per SD</i>)	IOR 1.28 (1.23–1.34) ^{b/} Bourbonnais and Mondor, 2001 [18]	IOR 1.28 (1.23–1.34) ^{b/} Bourbonnais and Mondor, 2001 [18]
Psychological problems (<i>no 0; yes 1</i>)	IOR 1.28 (1.22–1.33) ^{b/} Bourbonnais and Mondor, 2001 [18]	SOR 1.27 (1.23–1.31) ^{b/} Bourbonnais and Mondor, 2001 [18], Kivimaki et al., 2001 [24]
Psychosocial work factors		
Job control (<i>very much 1; not at all 4</i>)	SOR 1.49 (1.04–2.08) ^{c,e/} North et al., 1996 [28], Vahtera et al., 2004 [32]	SOR 1.27 (1.14–1.39) ^{b/} Kivimaki et al., 2001 [24], North et al., 1996 [28], Vahtera et al., 2004 [32]
Work time control (<i>high vs. low</i>)		IOR 0.93 (0.83–1.23) ^{b/} Kivimaki et al., 2001 [24]
Psychological job demands (<i>low 1; high 4</i>)	SOR 0.83 (0.57–1.21) ^{c,d/} Niedhammer et al., 1998 [2], Melchior et al., 2003 [27], North et al., 1996 [28]	SOR 0.96 (0.71–1.30) ^{c,e/} Niedhammer et al., 1998 [2], Kivimaki et al., 2001 [24], Melchior et al., 2003 [27], North et al., 1996 [28], Vaananen et al., 2004 [31]
Job strain (<i>nonexposed vs. most exposed</i>)	IOR 1.20 (1.13–1.28) ^{b/} Bourbonnais and Mondor, 2001 [18]	IOR 1.20 (1.13–1.28) ^{b/} Bourbonnais and Mondor, 2001 [18]
Decision latitude (<i>high 1; low 4</i>)	IOR 1.59 (1.43–1.75) ^{b/} Niedhammer et al., 1998 [2], Melchior et al., 2003 [27]	IOR 1.23 (1.15–1.30) ^{b/} Niedhammer et al., 1998 [2], Melchior et al., 2003 [27]
Social support (<i>high 1; low 4</i>)	SOR 1.09 (0.92–1.28) ^{c,e/} Niedhammer et al., 1998 [2], Bourbonnais and Mondor, 2001 [18], Melchior et al., 2003 [27], North et al., 1996 [28], Rael et al., 1995 [29]	SOR 1.08 (0.98–1.18) ^{c,f/} Niedhammer et al., 1998 [2], Bourbonnais and Mondor, 2001 [18], Kivimaki et al., 2001 [24], Melchior et al., 2003 [27], North et al., 1996 [28], Rael et al., 1995 [29]
Fairness (<i>very much 1; not at all 5</i>)		IOR 1.19 (1.06–1.33) ^{b/} Vaananen et al., 2004 [31]
Treats/violence (<i>no 0; yes 1</i>)	IOR 1.13 (0.97–1.32) ^{c,e/} Kivimaki et al., 2000 [23]	IOR 1.09 (0.98–1.21) ^{c,e/} Kivimaki et al., 2000 [23]
Personal factors		
Life events (<i>not hard 1; extremely hard 3</i>)		IOR 1.14 (1.03–1.27) ^{b/} Kivimaki et al., 2001 [24]
Organizational factors		
Reorganization (<i>no 0; yes 1</i>)		IOR 1.32 (1.15–1.52) ^{b/} Vaananen et al., 2004 [31]

^a Adjusted summary effects were estimated using the most complete models, that is, all models were adjusted for demographic factors. Additional factors included in these associations were behavioral risks, health status, occupation, and baseline sickness absence.

^b Fixed effects modeling.

^c Random effects modeling.

^d Statistically significant effect of measures.

^e No statistically significant effect of included parameters.

^f Statistically significant effect of geographical area.

IORs and SORs attained by random effect pooling in which “measures of predictive factors” were a reason for heterogeneity, and in which no statistical effect of the parameters could be found, were further explored. As regards health-related factors, the observed heterogeneity in the adjusted OR of psychosomatic complaints, and occurrence of sick leave ≤ 3 days could be explained by the pooling of self-rated health and diagnosed illness. Separate pooling of these ORs resulted in 1.66 (1.45–1.91) and 1.25

(1.12–1.39), respectively. Also, a contrast is found in the results of physical exercise when looking at occurrence of sick leave > 3 days. Pooling men and women separately might solve the observed heterogeneity in the crude association, resulting in 1.47 (1.32–1.59) and 1.18 (1.11–1.28), respectively. Regarding psychosocial work factors, the heterogeneity in the crude OR of job control and occurrence of sick leave > 3 days could be explained because one of the included studies examined both self-rated and

Table 3

Crude and adjusted intrastudy odds ratios (IOR) and summary odds ratios (SOR) for the influence of predictive factors on occurrence of sick leave (duration > 3 days)

Predictive factors		Crude odds ratios/reference(s)		Adjusted odds ratios/reference(s) ^a
Sociodemographics				
Age (<40 vs. >40)	SOR	1.03 (0.97–1.09) ^b /Ala-Mursula et al., 2002 [16], De Croon et al., 2003 [19], Eriksen et al., 2003 [20], Krantz and Ostergren, 2002 [26]		
Sex (male 0; female 1)	IOR	0.83 (0.61–1.12) ^b /Eriksen et al., 2003 [20]		
Education (university vs. none)	SOR	1.61 (1.09–2.38) ^{c,d,e} /Ala-Mursula et al., 2002 [16], De Croon et al., 2003 [19], Krantz and Ostergren, 2002 [26]	IOR	1.85 (1.59–2.33) ^b /Godin and Kittel, 2004 [21]
Marital status (married vs. unmarried)	SOR	1.05 (1.01–1.10) ^b /Ala-Mursula et al., 2002 [16], De Croon et al., 2003 [19], Krantz and Ostergren, 2002 [26]	IOR	1.37 (1.15–1.64) ^b /Kivimaki et al., 2001 [24]
Health (behavior)				
Psychosomatic complaints (no 0; yes 1)	SOR	2.18 (1.75–2.72) ^b /Andrea et al., 2003 [17], Krantz and Ostergren, 2002 [26]	SOR	1.79 (1.54–2.07) ^{c,f} /Andrea et al., 2003 [17], Eriksen et al., 2003 [20], Kivimaki et al., 2001 [24], Vaananen et al., 2003 [30]
Smoking (no 0; yes 1)	IOR	1.31 (1.11–1.56) ^b /Ala-Mursula et al., 2002 [16]	IOR	1.08 (0.82–1.41) ^b /Kivimaki et al., 2001 [24]
Alcohol (moderate vs. high)	IOR	1.00 (0.85–1.16) ^b /Ala-Mursula et al., 2002 [16]	IOR	1.24 (1.02–1.52) ^b /Kivimaki et al., 2001 [24]
BMI (per SD)	IOR	1.54 (1.28–1.86) ^b /Ala-Mursula et al., 2002 [16]		
Physical exercise (yes 0; no 1)	IOR	1.32 (1.06–1.64) ^{c,g} /Ala-Mursula et al., 2002 [16]	SOR	0.95 (0.76–1.19) ^{c,f} /Hammer et al., 1981 [22], Baltes et al., 1999 [36]
Medication use (no 0; yes 1)	IOR	3.13 (1.71–5.72) ^b /Bourbonnais and Mondor, 2001 [18]	IOR	3.13 (1.71–5.72) ^b /Bourbonnais and Mondor, 2001 [18]
Prior absence (no 0; yes 1)	IOR	2.12 (0.99–4.53) ^{c,g} /De Croon et al., 2003 [19]		
Mental health				
Burnout (per SD)	IOR	2.34 (1.59–3.45) ^b /Bourbonnais and Mondor, 2001 [18]	IOR	2.34 (1.59–3.45) ^b /Bourbonnais and Mondor, 2001 [18]
Fatigue (no fatigue vs. always fatigued)	SOR	1.36 (1.07–1.72) ^{c,f} /Janssen et al., 2003 [1], Andrea et al., 2003 [17]	SOR	1.32 (1.04–1.69) ^{c,d,e} /Janssen et al., 2003 [1], Andrea et al., 2003 [17], Eriksen et al., 2003 [20]
Psychological problems (no 0; yes 1)	SOR	2.70 (0.85–8.55) ^{c,h,d,e} /Andrea et al., 2003 [17], Bourbonnais and Mondor, 2001 [18]	SOR	1.97 (1.37–2.85) ^{c,h} /Andrea et al., 2003 [17], Bourbonnais and Mondor, 2001 [18], Kivimaki et al., 2001 [24], Vaananen et al., 2003 [30]
Psychosocial work factors				
Job control (very much 1; not at all 4)	SOR	1.43 (1.08–1.92) ^{c,g} /De Croon et al., 2003 [19], North et al., 1996 [28], Vahtera et al., 2004 [32]	SOR	1.28 (1.23–1.33) ^b /Ala-Mursula et al., 2002 [16], Godin and Kittel, 2004 [21], Kivimaki et al., 2001 [24], North et al., 1996 [28], Vahtera et al., 2004 [32]
Work time control (high vs. low)	SOR	1.22 (1.15–1.28) ^b /Ala-Mursula et al., 2002 [16], Eriksen et al., 2003 [20]	SOR	1.15 (1.10–1.20) ^b /Ala-Mursula et al., 2002 [16], Kivimaki et al., 2001 [24]
Psychological job demands (low 1; high 4)	SOR	1.15 (0.92–1.44) ^{c,f} /Andrea et al., 2003 [17], De Croon et al., 2003 [19], Eriksen et al., 2003 [20], Krantz and Ostergren, 2002 [26], Melchior et al., 2003 [27], North et al., 1996 [28], Vahtera et al., 2004 [32]	SOR	1.15 (1.12–1.19) ^{c,f} /Ala-Mursula et al., 2002 [16], Andrea et al., 2003 [17], Godin and Kittel, 2004 [21], Kivimaki et al., 2001 [24], Melchior et al., 2003 [27], North et al., 1996 [28], Vaananen et al., 2004 [31], Vahtera et al., 2004 [32], Verhaeghe et al., 2003 [33]
Job strain (nonexposed vs. most exposed)	SOR	1.48 (1.09–2.01) ^b /Bourbonnais and Mondor, 2001 [18], Krantz and Ostergren, 2002 [26]	SOR	1.27 (0.78–2.09) ^{c,f} /Bourbonnais and Mondor, 2001 [18], Verhaeghe et al., 2003 [33]
Skill discretion (high 1; low 4)		1.18 (1.03–1.33) ^b /Vahtera et al., 2004 [32]	SOR	1.11 (1.02–1.20) ^b /Vaananen et al., 2003 [30], Vahtera et al., 2004 [32]
Decision authority (high 1; low 4)	SOR	1.27 (1.12–1.45) ^b /Eriksen et al., 2003 [20], Vahtera et al., 2004 [32]	SOR	1.49 (1.04–2.13) ^{c,f} /Vaananen et al., 2003 [30], Vahtera et al., 2004 [32]
Decision latitude (high 1; low 4)	SOR	1.49 (1.39–1.61) ^b /Niedhammer et al., 1998 [2], Andrea et al., 2003 [17], Krantz and Ostergren, 2002 [26], Melchior et al., 2003 [27]	SOR	1.33 (1.13–1.56) ^{c,f} /Niedhammer et al., 1998 [2], Ala-Mursula et al., 2002 [16], Melchior et al., 2003 [27], Verhaeghe et al., 2003 [33]

Social support (<i>high 1; low 4</i>)	SOR	1.22 (1.08–1.39) ^{c,f} /Andrea et al., 2003 [17], Bourbonnais and Mondor, 2001 [18], Eriksen et al., 2003 [20], Krantz and Ostergren, 2002 [26], Melchior et al., 2003 [27], North et al., 1996 [28], Rael et al., 1995 [29], Vahtera et al., 2004 [32]	SOR	1.08 (1.00–1.16) ^{c,h} /Andrea et al., 2003 [17], Bourbonnais and Mondor, 2001 [18], Eriksen et al., 2003 [20], Godin and Kittel, 2004 [21], Kivimaki et al., 2001 [24], Melchior et al., 2003 [27], North et al., 1996 [28], Rael et al., 1995 [29], Vaananen et al., 2003 [30], Vahtera et al., 2004 [32], Verhaeghe et al., 2003 [33]
Job satisfaction (<i>very satisfied 1; dissatisfied 5</i>)	IOR	1.45 (1.03–2.04) ^b /Andrea et al., 2003 [17]	IOR	1.92 (1.49–2.50) ^b /Andrea et al., 2003 [17]
Physical demands (<i>low vs. high</i>)	SOR	1.45 (1.17–1.80) ^{c,d} /De Croon et al., 2003 [19], Eriksen et al., 2003 [20], Vahtera et al., 2004 [32]	IOR	1.66 (1.45–1.90) ^b /Vahtera et al., 2004 [32]
Need for recovery (<i>low vs. high</i>)	IOR	1.85 (0.95–3.59) ^{c,g} /De Croon et al., 2003 [19]	IOR	2.15 (1.01–4.62) ^b /De Croon et al., 2003 [19]
Fairness (<i>very much 1; not at all 5</i>)	IOR	1.30 (1.12–1.54) ^b /Eriksen et al., 2003 [20]	IOR	1.30 (1.18–1.45) ^b /Vaananen et al., 2004 [31]
Treats/violence (<i>no 0; yes 1</i>)	IOR	1.52 (1.36–1.70) ^b /Kivimaki et al., 2000 [23]	IOR	1.26 (1.10–1.44) ^b /Kivimaki et al., 2000 [23]
Personal factors				
Life events (<i>not hard 1; extremely hard 3</i>)			IOR	1.09 (0.93–1.29) ^b /Kivimaki et al., 2001 [24]
Domestic responsibility (<i>low vs. high</i>)	IOR	1.19 (0.62–2.28) ^b /Hammer et al., 1981 [22]		
Organizational factors				
Overcommitment (<i>no 0; yes 1</i>)			IOR	1.15 (1.03–1.29) ^b /Godin and Kittel, 2004 [21]
Unemployment (<i>no 0; yes 1</i>)	IOR	1.58 (1.36–1.84) ^{c,g} /Knutsson and Goine, 1998 [25]	IOR	0.72 (0.53–0.97) ^{c,g} /Knutsson and Goine, 1998 [25]
Reorganization (<i>no 0; yes 1</i>)	IOR	1.09 (1.02–1.18) ^b /Kivimaki et al., 2000 [23]	SOR	1.25 (0.94–1.68) ^{c,d,e} /Godin and Kittel, 2004 [21], Kivimaki et al., 2000 [23], Vaananen et al., 2004 [31]
Company size (<i><10 vs. >100</i>)	IOR	2.52 (1.19–5.37) ^b /De Croon et al., 2003 [19]		

^a Adjusted summary effects were estimated using the most complete models, that is, all models were adjusted for demographic factors. Additional factors included in these associations were behavioral risks, health status, occupation, and baseline sickness absence.

^b Fixed effects modeling.

^c Random effects modeling.

^d Statistically significant effect of follow-up time.

^e Statistically significant effect of minimum duration of sick leave.

^f No statistically significant effect of included parameters.

^g Statistically significant effect of measures.

^h Statistically significant effect of geographical area.

organizational-rated job control in both men and women. Excluding this study from the overall pooling reveals an OR of 1.25 (1.10–1.41). Similarly, the heterogeneity in the crude association between psychological job demands and occurrence of sick leave ≤ 3 days can be attributed to the pooling of both self-reported and external-reported job demands. Separate pooling of these ORs resulted in 0.97 (0.89–1.06) and 0.56 (0.48–0.66), respectively. The heterogeneity in the crude OR of need for recovery and occurrence of sick leave > 3 days could be explained by the pooling of two different classifications of need for recovery, specifically low versus medium and low versus high need for recovery. Separate pooling of these ORs resulted in 1.21 (0.64–2.30) and 2.42 (2.38–2.46), respectively. Of the remaining randomly pooled ORs, no specific reason of the observed heterogeneity could be found (Tables 2 and 3).

4. Discussion

4.1. General findings

In this meta-analysis, a thorough summary of studies exploring predictive factors for sickness absence due to psychosocial health complaints is given. Two-third of the presented effect sizes could be determined using fixed effect pooling, that is, differences in study characteristics did not significantly influence the outcomes. In approximately 60% of the randomly determined effect sizes, possible explanations for heterogeneity could be revealed. The main results indicate that being unmarried, experiencing psychosomatic complaints, using medication, having a burnout, suffering from psychological problems, having low job control, having low decision latitude, and experiencing no fairness at work are significant predictors for occurrence of sick leave, both uncertified short spells (≤ 3 days) and certified sick leaves (> 3 days). Given the comprehensiveness of our analysis, we are unable to give a complete review of all predictive associations within the limits of this paper. We will however discuss the rationale of using psychosocial health complaints as a cause of sickness absence, interpret some noteworthy outcomes, present limitations, and give recommendations for clinicians and policymakers.

4.2. Psychosocial health complaints

This meta-analysis attempted to focus on studies regarding predictors of sickness absence due to psychosocial health complaints, rather than studies related to all-causes sickness absence. Though, not a single study uses the definition “psychosocial health complaints” to label their main outcome. The rationale for still performing this meta-analysis concerns the necessity of early identifying employees at risk for this specific type of sickness absence because they encounter more difficulties in returning to the

workplace than other absentees. Also, the time period necessary to develop psychosocial health complaints of such a level that a rather healthy employee is unable to work differs from the necessary time period employees with somatic problems, such as musculoskeletal, cardiovascular, or respiratory complaints, encounter. Herewith, there might be a significant difference between predictive factors for sickness absence due to psychosocial health complaints and those found in employees at risk for sickness absence due to abovementioned conditions. As a result of the exclusion of studies on predictors of sickness absence due to explicit somatic conditions, the probability of including studies with primarily “psychological” and “social” causes in apparently healthy employees increases. Even though the exclusion of all-causes sickness absence studies cannot be guaranteed, the homogeneity of the remaining set of studies improves. This selection method might be considered as erroneous but is thought to be the most optimal manner to retrieve studies on the association between predictive factors and sickness absence due to psychosocial health complaints.

4.3. Interpretation of findings

As regards demographic factors, a slightly increased, but statistically insignificant and inconclusive SOR in the fixed effect pooling of age and occurrence of sick leave was found in this meta-analysis. This could be a consequence of the dissimilarity in the association. On the one hand, the incidence of sickness absence and the number of absences per person are highest among young workers. On the other hand, a positive correlation between age and the presence of chronic diseases, and consequently sickness absence, exists [34]. A decreased insignificant crude OR was found on the association between sex and sickness absence due to psychosocial health complaints. This might seem counterintuitive, because women have a higher rate of absence and more days of sickness absence than men [26]. However, the effect was insignificant. So, no conclusions can be drawn from this result. Regarding health-related factors, risk behaviors such as smoking, high alcohol use, and high BMI are well-known predictors of sickness absence [35]. Notwithstanding a few insignificant ORs, the results of this meta-analysis support this hypothesis, that is, these behaviors are significantly predictive for both occurrence of sick leave ≤ 3 days and occurrence of sick leave > 3 days. Mental health problems, such as fatigue, burnout, and psychological problems, are main causes of extended sick leaves from work. Specifically, the results of this meta-analysis demonstrate statistically significant increased effects on sickness absence due to psychosocial health complaints. There are several reasons why, for example, fatigue may be an important predictive factor for this type of sickness absence. Firstly, there is a high prevalence of fatigued cases in the working population. Secondly, the fatigue state was found to be rather robust. Thirdly, fatigue

can be a disabling condition. Finally, fatigue is an important symptom of psychosocial health complaints [1]. To continue with psychosocial work factors, both statistically significant and insignificant results are found, mostly in the expected direction. A slightly decreased, but statistically insignificant OR of work time control (high vs. low) is found in the fixed effect pooling of this predictive factor and occurrence of sick leave ≤ 3 days. The results on occurrence of sick leave > 3 days are significant and in the opposite, expected direction. These findings are supported by a recent meta-analysis suggesting that flextime scheduling, providing employees with control over the starting and ending times of a workday, is associated with lower absenteeism [36]. In addition, sickness absence due to psychosocial health complaints is associated with job strain that results from the combination of high psychological demands and low decision latitude at work [37]. The results of this meta-analysis support this theory. As regards personal factors, a large body of research suggests that there is a link between stressful life events and sickness absence [35]. Such life events are a potential source of psychological problems (anxiety, mental distress, low sense of coherence), and in this meta-analysis significantly predictive for occurrence of sick leave ≤ 3 days. To conclude with organizational factors, increased statistically significant results are found for excessive commitment, reorganization, and company size. These predictive factors for sickness absence have received little research attention [38]. However, an empirical study on the longitudinal effect of organization size on absenteeism found that as the companies grew in size, absence became higher [39]. The results of this meta-analysis are in line with these previous findings.

4.4. Limitations

Although we have made an accurate summary of predictive factors for sickness absence due to psychosocial health complaints, there still remain limitations that merit discussion. Sickness absence has a multifactor etiology, and numerous factors have proved to be associated with sickness absence [2]. Consequently, comprehensiveness of a meta-analysis is difficult to reach and is subject to the existence of heterogeneity. It was not possible to infer a homogeneous association between all the predictive factors and this specific type of sickness absence. Further, some selected studies in this meta-analysis are based on the same population sample. Still, we decided to include those related studies because they present predictive factors that differ from each other to such an extent that entering these separate studies in the meta-analysis is considered necessary. For example, two studies are based on the Whitehall II cohort [28,29], of which one sought to examine the association between psychosocial work environment and rates of sickness absence. Specifically, the predictive factors, job control, job demands, and social support were examined in this study. As regards “social support,” the role of clerical and office

support were subjects of interest. The other study investigated the predictive factors, social support and material problems. In particular, this study was aimed at three types of support, that is, confiding/emotional, practical, and negative aspects of support. Despite the fact that the same sample was used, independent associations between specific predictive factors and sickness absence were investigated. These associations individually contribute to the results of this meta-analysis and were therefore essential for inclusion. However, a distinction was made between related studies with different predictive factors that are used in different sections of the meta-analysis, and related studies with different follow-up times or other parameter estimates. These studies were combined before inclusion in the meta-analysis. In definitions of meta-analysis, results can be pooled if at least two studies reported data on the relation between a specific predictive factor and sickness absence due to psychosocial health complaints. Nevertheless, many results of this meta-analysis appear to be based on one study only. To be complete, we decided to present IORs when different categories or strata of a specific predictive factor for sickness absence could be pooled. The number of references in Tables 2 and 3, and the additional IOR or SOR, indicate on how many studies a pooled result is based, and consequently how to interpret these findings. Furthermore, all studies in this meta-analysis were prospective cohort studies. By predicting sickness absence due to psychosocial health complaints 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 predictive factors on sickness absence more plausible. Nevertheless, the possibility of bidirectional or solely reverse causation cannot be ruled out [18]. This is because part of the relationship between predictive factors and sickness absence may still be explained by a cross-sectional relationship at baseline between specific predictive factors and sickness absence history [1]. Further, this meta-analysis only included studies that provided sufficient data to (re)calculate an OR and its corresponding SE on the association between particular predictive factors and sickness absence due to psychosocial health complaints. Inclusion of studies presenting correlations was considered, so as to calculate an average measure on the association. However, the correlation is not a valid measure of relationships in absence data because they do not follow a normal distribution. Consequently, the number of studies eligible for inclusion was reduced. Also, we have made the choice to use a threshold of 3 days to distinguish medically uncertified and certified sickness absence. We consider the variety between studies being dealt with through inclusion of the study characteristic “minimum duration of sick leave” in the sensitivity analyses. In addition, health status can be considered as an intermediate variable in the causal pathway leading to sickness absence. As a consequence, the inclusion of health may be questionable as a predictive factor. However, only studies that directly assessed the causal

pathway between (mental) health and sickness absence due to psychosocial health complaints were included in this meta-analysis. In Section 3 (Results), presentation of the findings was limited to the adjusted ORs, whereas both crude and adjusted outcomes were presented in the tables. These overall findings were presented to signify the effect of confounding factors, for which necessarily was corrected. Moreover, the assessment of qualitative items by two reviewers resulted in the identification of some study characteristics to be included in the sensitivity analyses. The major possibility of fixed effect pooling and the recognition of reasons for heterogeneity in several randomly pooled effect sizes demonstrated that differences between studies, in terms of, for example, measurements of sickness absence and population characteristics, were controlled for. Finally, we did not attempt to uncover unpublished observations, and excluded studies that did not meet the predetermined criteria. Publication bias, which we have not statistically or visually identified, might arise by excluding these studies.

4.5. Recommendations and conclusion

Predictors of sickness absence due to psychosocial health complaints can be identified in a homogeneous manner; though, the exclusion of all-causes sickness absence studies could not be guaranteed. Still, the findings provide imperative leads to public health interventions to successfully improve psychosocial health and to reduce sickness absence. For instance, clinicians and policymakers should support exercising and reduce job strain to effect occurrence of sick leave ≤ 3 days and pay attention to alcohol use and the extent of unemployment in the community to influence occurrence of sick leave > 3 days. Consideration of a large number of these factors could possibly reduce the economic and social impact and modify the public health consequences of sickness absence due to psychosocial health complaints.

References

- [1] Janssen N, Kant I, Swaen GMH, Janssen PPM, Schröer CAP. Fatigue as a predictor of sickness absence: results from the Maastricht cohort study on fatigue at work. *Occup Environ Med* 2003;60(Suppl 1): i71–6.
- [2] Niedhammer I, Bugel I, Goldberg M, Leclerc A, Gueguen A. Psychosocial factors at work and sickness absence in the Gazel cohort: a prospective study. *Occup Environ Med* 1998;55:735–41.
- [3] 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.
- [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] 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.
- [6] Luz J, Green MS. Sickness absenteeism from work—a critical review of the literature. *Public Health Rev* 1997;25:89–122.
- [7] Duijts SFA, Kant I, Landeweerd JA, Swaen GMH. Prediction of sickness absence: the development of a screening instrument. *Occup Environ Med* 2006;63:564–9.
- [8] Schaufeli WB, Kompier MA. Managing job stress in the Netherlands. *Int J Stress Manage* 2001;8:15–34.
- [9] Borritz M, Rugulies R, Christensen KB, Villadsen E, Kristensen TS. Burnout as a predictor of self-reported sickness absence among human service workers: prospective findings from three year follow up of the PUMA study. *Occup Environ Med* 2006;63:98–106.
- [10] Kant I, Bultmann U, Schroer C, Beurskens A, Amelsvoort Lv, Swaen G. An epidemiological approach to study fatigue in the working population: the maastricht cohort study. *OEM* 2003;60(Suppl 1):i32–9.
- [11] Hensing G, Alexanderson K, Allebeck P, Bjurulf P. How to measure sickness absence? Literature review and suggestion of five basic measures. *Scand J Soc Med* 1998;26:133–44.
- [12] Tan FE, Zeegers MP. An asymptotically unbiased estimator of exposed versus non-exposed odds ratio from reported dose-response data. *Stat Methods Med Res* 2001;10:311–23.
- [13] Zeegers MP, Jellema A, Ostrer H. Empiric risk of prostate carcinoma for relatives of patients with prostate carcinoma: a meta-analysis. *Cancer* 2003;97:1894–903.
- [14] Stata. In: Stata statistical software: Release 9.0. College station, TX: Stata Corporation; 2005.
- [15] Brockwell SE, Gordon IR. A comparison of statistical methods for meta-analysis. *Stat Med* 2001;20:825–40.
- [16] Ala-Mursula L, Vahtera J, Kivimaki M, Kevin MV, Pentti J. Employee control over working times: associations with subjective health and sickness absences. *J Epidemiol Community Health* 2002;56:272–8.
- [17] Andrea H, Beurskens AJHM, Metsemakers JFM, van Amelsvoort LGPM, van den Brandt PA, van Schayck CP. Health problems and psychosocial work environment as predictors of longterm sickness absence. *Occup Environ Med* 2003;60:295–300.
- [18] Bourbonnais R, Mondor M. Job strain and sickness absence among nurses in the province of Quebec. *Am J Ind Med* 2001;39:194–202.
- [19] De Croon 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;55:331–9.
- [20] Eriksen W, Bruusgaard D, Knardahl S. Work factors as predictors of sickness absence: a three month prospective study of nurses' aides. *Occup Environ Med* 2003;60:271–8.
- [21] Godin I, Kittel F. Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism. *Soc Sci Med* 2004;58:1543–53.
- [22] Hammer TH, Landau JC, Stern RN. Absenteeism when workers have a voice: the case of employee ownership. *J App Psychol* 1981;66: 561–73.
- [23] Kivimaki M, Elovainio M, Vahtera J. Workplace bullying and sickness absence in hospital staff. *Occup Environ Med* 2000;57:656–60.
- [24] Kivimaki M, Sutinen R, Vahtera J, Räsänen K, Töyry S, Ferrie JE, et al. Sickness absence in hospital physicians: 2 year follow up study on determinants. *Occup Environ Med* 2001;58:361–6.
- [25] Knutsson A, Goine H. Occupation and unemployment rates as predictors of long term sickness absence in two Swedish counties. *Soc Sci Med* 1998;47:25–31.
- [26] Krantz G, Ostergren PO. Do common symptoms in women predict long spells of sickness absence? A prospective community-based study on Swedish women 40 to 50 years of age. *Scand J Public Health* 2002;30:176–83.
- [27] Melchior M, Niedhammer I, Berkman LF, Goldberg M. Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort. *J Epidemiol Community Health* 2003;57:285–93.
- [28] North FM, Syme SL, Feeney A, Shipley M, Marmot M. Psychosocial work environment and sickness absence among British civil servants: the Whitehall II study. *Am J Public Health* 1996;86:332–40.
- [29] Rael EG, Stansfeld SA, Shipley M, Head J, Feeney A, Marmot M. Sickness absence in the Whitehall II study, London: the role of social

- support and material problems. *J Epidemiol Community Health* 1995;49:474–81.
- [30] Vaananen A, Toppinen-Tanner S, Kalimo R, Mutanen P, Vahtera J, Peiro JM. Job characteristics, physical and psychological symptoms, and social support as antecedents of sickness absence among men and women in the private industrial sector. *Soc Sci Med* 2003;57:807–24.
- [31] Vaananen A, Kalimo R, Toppinen-Tanner S, Mutanen P, Peiro JM, Kivimaki M, et al. Role clarity, fairness, and organizational climate as predictors of sickness absence: a prospective study in the private sector. *Scand J Public Health* 2004;32:426–34.
- [32] Vahtera J, Pentti J, Kivimaki M. Sickness absence as a predictor of mortality among male and female employees. *J Epidemiol Community Health* 2004;58:321–6.
- [33] Verhaeghe R, Mak R, Maele GV, Kornitzer M, Backer GD. Job stress among middle-aged health care workers and its relation to sickness absence. *Stress and Health* 2003;19:265–74.
- [34] Steers RM, Rhodes SR. Knowledge and speculation about absenteeism. San Fransisco: Jossey-Bass; 1984.
- [35] Kivimaki M, Vahtera J, Elovainio M, Lillrank B, Kivimaki MV. Death or illness of a family member, violence, interpersonal conflict, and financial difficulties as predictors of sickness absence: longitudinal cohort study on psychological and behavioral links. *Psychosom Med* 2002;64:817–25.
- [36] Baltes B, Briggs TE, Huff JW. Flexible and compressed workweek schedules: a meta-analysis of their effects on work-related criteria. *J App Psychol* 1999;84:496–513.
- [37] Karasek R, Theorell T. Healthy work: Stress, productivity and the reconstruction of working life. New York: Basic Books; 1990.
- [38] Markham SE. Declining organizational size and increasing unemployment rates: predicting employee absenteeism from within- and between plant perspectives. *Acad Manage J* 1991;34:952–65.
- [39] Allen PT. Size of workforce, morale and absenteeism: a re-examination. *Brit J Ind Relat* 1982;20:83–100.