

ORIGINAL RESEARCH

Mental and physical health-related functioning mediates between psychological job demands and sickness absence among nurses

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Abstract

Aims. To investigate whether health-related functioning mediates the effect of psychological job demands on sickness absence in nurses.

Background. Nurses face high job demands that can have adverse health effects resulting in sickness absence.

Design. Prospective cohort study with 1-year follow-up.

Methods. Data for 2964 Norwegian nurses were collected in the period 2008–2010. At baseline, psychological job demands were measured with the Demand–Control–Support Questionnaire. Health-related functioning was assessed by the Mental Composite Score and the Physical Composite Score of the SF-12 Health Survey (2nd version). Sickness absence (no = 0, yes = 1) was self-reported at 1-year follow-up. Interaction and mediation analyses were conducted stratified by tenure (<1-year, 1–2 years, 3–6 years, >6 years) as a registered nurse.

Results. A total of 2180 nurses (74%) with complete data were eligible for analysis. A significant three-way interaction between job demands, control and support was found in newly licensed nurses (tenure <1-year). Baseline psychological job demands were positively associated with sickness absence at 1-year follow-up. This association was substantially weakened when Mental Composite Score and Physical Composite Score were introduced as mediator variables, indicating a partial mediation effect that was particularly pronounced in newly licensed nurses. Psychological job demands did not modify the effect of health-related functioning on sickness absence.

Conclusion. Both mental and physical health-related functioning mediated between psychological job demands and sickness absence. Nurse managers should pay attention to health-related functioning, because poor health-related functioning may predict sickness absence, especially in newly licensed nurses.

Keywords: absenteeism, mediation analysis, mental health, nurses, nursing, physical health, SF-12, sickness absence

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Why is this research needed?

- Sickness absence is high among nurses, contributes to existing nursing staff shortages and adversely affects the efficiency and quality of nursing care.
- More insight is needed into pathways between job demands and sickness absence to reveal ways to prevent sickness absence among nurses.

What are the key findings?

- Mental health-related functioning and physical health-related functioning independently mediated between job demands and sickness absence, particularly in newly licensed nurses.
- Job demands did not modify the effect of health-related functioning on sickness absence among nurses.

How should the findings be used to influence policy/practice/research/education?

- Nurse supervisors and managers should pay attention to nurses' mental and physical health and functioning in work.
- Social support and supervision at the workplace may help newly licensed nurses cope with high psychological job demands.

Introduction

In the last decades, work conditions have changed considerably and exposures to psychosocial risk factors have increased (Niedhammer *et al.* 2012, Parent-Thirion *et al.* 2012). Psychological job demands are one of the main psychosocial risks in work and refer to the aspects of a job that require sustained mental or emotional effort. Although not necessarily negative, psychological job demands can provoke strain and stress reactions when they require too much effort. If sustained, psychological job demands may result in sickness absence (Niedhammer *et al.* 2012), which is a temporary paid leave or absence from work due to illness or injury. Sickness absence is a substantial problem, especially in nursing care where absence levels are higher than in other healthcare professions (Mao *et al.* 2006). Sickness absence contributes to existing nursing staff shortages and jeopardizes the efficiency and quality of care (Lang *et al.* 2004, Kane *et al.* 2007).

To prevent sickness absence, it may be appealing to reduce job demands in nursing care. However, nurses' job demands are likely to increase rather than decrease due to an ageing population and, consequently, higher numbers of people with chronic illnesses needing nursing care. If we also consider the existing nursing staff shortages and difficulties of retaining qualified nursing staff (Lavoie-Tremblay *et al.* 2008) leading to increased ratios of nursing staff to patients (Lang *et al.* 2004), it will be difficult to reduce nurses' job demands. Therefore, we have to look for alternatives to prevent sickness absence among nurses. Resources such as autonomy in work and social support at the workplace have been found to buffer the effects of high job demands (Clausen *et al.* 2012, Willemse *et al.* 2012, Rodwell & Munro 2013). To explore additional ways of preventing sickness absence under conditions of increasing demands, we need more insights into the pathway between job demands and sickness absence, which was the rationale for this study.

Background

Two major models have described job demands within the context of exposures to psychosocial risk factors in work. The Effort–Reward Imbalance model states that stress reactions occur when effort expended at work is not matched by rewards in terms of pay, self-esteem or sense of achievement (Siegrist 1996). The Demand–Control (DC) model contrasts the psychological demands in work with the level of decision latitude in work (Karasek 1979). The strain hypothesis poses that the combination of high job demands and low job control results in psychological stress and strain reactions. In such conditions, employees are at risk of accumulating unhealthy stress levels and developing a range of related disorders, particularly cardiovascular disease and mental health problems (Kivimaki *et al.* 2006, Stansfeld & Candy 2006, Nieuwenhuijsen *et al.* 2010).

Later, Johnson and Hall (1988) noted that support received from supervisors and colleagues buffered the impact of job demands and control on health outcomes. Therefore, they proposed to extend the DC-model with social support at the workplace, resulting in the Demand–Control–Support (DCS) model. The predictions of the DCS model strongly resemble those of the DC-model, demonstrating that the strain hypothesis applies under conditions of low job support.

Demerouti *et al.* (2001) further elaborated the DCS model by introducing broad categories of work characteristics that include not only quantitative job demands, control and support as in the DCS model but also a range of other demands (e.g. role clarity, role conflict, collaboration at the workplace and work–home interference) and resources (e.g.

performance feedback, personal ambitions and job perspectives). However, Demerouti's Job Demands Resources (JDR) model does not assume a three-way interaction between demands, resources and social support at the workplace. As we were interested in both two-way and three-way interactions, we chose the DCS model as a framework for our study.

In a review of 41 studies published between 1979–1997, Van der Doef and Maes (1999) showed that the findings of 28 cross-sectional studies supported the interactions between job demands, job control and job support as hypothesized by the DCS model's strain hypothesis. Häusser *et al.* (2010) reviewed 83 studies published in the period from 1998–2007 and found support for interactions between job demands and job control in cross-sectional studies, but not in longitudinal studies. De Lange *et al.* (2003) found three-way interactions supporting the strain hypothesis in 8 of 19 longitudinal studies.

The DCS model has been widely used in nursing research for conceptualizing occupational stress. It was shown that psychological job demands are related to emotional exhaustion (Ter Doest *et al.* 2006), anxiety and depression (Jeurissen & Nyklíček 2001), low job satisfaction (Ter Doest *et al.* 2006, Penz *et al.* 2008) and reduced well-being (Pisanti *et al.* 2011, Rodwell & Munro 2013) among nurses and healthcare workers. Job control was generally found to be beneficial for nurses' well-being and job satisfaction (Bakker *et al.* 2005, Akerboom & Maes 2006, Ter Doest *et al.* 2006, Schmidt & Diestel 2011) and is negatively associated with psychological distress and emotional exhaustion (Jeurissen & Nyklíček 2001, Bakker *et al.* 2005, Schmidt & Diestel 2011). Similarly, social support has been negatively associated with emotional exhaustion and distress (Proost *et al.* 2004, Van den Berg *et al.* 2006) and positively with well-being and job satisfaction among nurses (Van den Berg *et al.* 2006).

Although it is well known that job demands affect people's health and impaired health status is associated with sickness absence, only a few studies have used the DCS model as a framework to investigate the direct prospective pathway from psychological job demands to sickness absence in nurses (Verhaeghe *et al.* 2003, 2006). We found no reports in the literature on the *indirect* pathway from job demands via health status to sickness absence. Sickness absence is a complex phenomenon that is not only directly associated with illness but also involves health-related behaviours. Steers and Rhodes (1984) proposed a process model arguing that sickness absence results from interactions between personal characteristics, work situation and sociocultural environment. Fichman (1984) added that people at any given point in time have motives both for going to work and for

not going to work. These motives are driven by work adjustment latitude and work attendance pressures (Johansson & Lundberg 2004). Several investigators argue that sickness absence is a type of withdrawal behaviour (Kristensen 1991, Kohler & Matthieu 1993, Hackett & Bycio 1996). Thus, sickness absence depends not only on an individual's health status but also on how the individual copes with illness.

Illness affects an individual's domestic as well as work functioning. The extent to which physical health and pain restrict an individual's usual daily activities (including work) is regarded as physical health-related functioning (Ware *et al.* 1996, 2002). Alternatively, mental health-related functioning represents the extent to which mental health and emotional problems limit daily activities and social participation. Several investigators have reported that health-related functioning, particularly the avoidance of activities, was more strongly associated with sickness absence than illness in itself. For example, Jensen *et al.* (2010) found that sickness absence levels were higher in Danish healthcare workers with back pain and high levels of avoidance behaviour than among employees with back pain and low levels of avoidance. Avoidance behaviour was also found to increase the likelihood of sickness absence among Australian nurses and midwives with back pain (Dawson *et al.* 2011).

The study

Aim

Based on the DCS model as a framework, we hypothesized that high psychological job demands impair mental, but not physical health-related functioning, consequently increasing the risk of sickness absence. To test this hypothesis, we investigated the indirect pathway between psychological job demands and sickness absence and the mediating effect of both mental and physical health-related functioning. Alternatively, illness might adversely affect one's health-related functioning to such an extent that the individual can no longer cope with the usual (i.e. not necessarily high) job demands and calls in sick. In that case, psychological job demands would act as an effect-modifier of the association between health-related functioning and sickness absence. The aim of the present study was to investigate the mediating effects of health-related functioning as well as effect-modification by psychological job demands in pathways to sickness absence.

Design

Secondary analyses of data retrieved from the longitudinal SURvey of Shift work, Sleep and Health (SUSSH), which

has been described previously (Saksvik-Lehouillier *et al.* 2012, Roelen *et al.* 2013).

Sample

For SUSSH, 5400 RN working at least 50% of a full position were randomly selected from the membership records of the Norwegian Nurses Organization. An additional sample of 2741 nurses, who were newly licensed in the period 2008–2009, were recruited in 2009.

Data collection

Data were collected with a questionnaire, which could be returned in prepaid envelopes to the Department of Public Health and Primary Health Care of the University of Bergen. The initial sample of 5400 RN received a baseline questionnaire in the period November 2008–March 2009. The additional sample of 2741 newly licensed nurses received the baseline questionnaire in the period November 2009–May 2010. Reminders were sent after one and two months if nurses did not answer.

Sociodemographic variables

The baseline questionnaire addressed sociodemographic variables, such as age, gender, marital status (living alone/cohabiting) and care for children (no/yes), as well as some basic work variables, such as tenure (<1, 1–3, 3–6, >6 years) as an RN, workplace setting (general nursing, psychiatric care, nursing homes, home care, other), position (<50%, 50–75%, 76–100% of full position) and work schedule (daytime, night time, 2-shift, 3-shift).

Baseline instruments

Job demands were measured with the Demands–Control–Support Questionnaire (Sanne *et al.* 2005). The job demands scale consisted of five items: ‘Does your job require you to work very fast?’, ‘Does your job require you to work very hard?’, ‘Does your job require too great a work effort?’, ‘Do you have sufficient time for all your work tasks?’ and ‘Do conflicting demands often occur in your work?’. These five items were answered on a 4-point Likert scale: ‘yes, often’ (=4), ‘yes, sometimes’ (=3), ‘no, seldom’ (=2) and ‘no, almost never’ (=1). From the responses, a sum score was calculated (range 5–20) so that higher scores represented higher psychological job demands.

Job control was measured with a total of six items, of which four items addressed skill discretion (e.g. ‘Does your job require skills?’ or ‘Do you have the opportunity to learn new things in your job?’), and two items decision authority

(‘Can you decide how to carry out your work?’ and ‘Can you decide what should be done in your work?’). We decided not to use skill discretion and decision authority separately in the analyses as the latter with two items had an internal consistency as low as $\alpha = 0.41$. Job support was assessed by six items on work atmosphere, collegiality and support at the workplace, for example: ‘There is a pleasant atmosphere at my workplace’, ‘There is good collegiality at work’, ‘I get along well with my supervisor’. Job control and job support were also scored on 4-point Likert scales with sum scores ranging from 6–24 where higher sum scores represented higher levels of job control and support.

Health-related functioning from the nurses’ point of view was measured with version two of the Short Form-12 (Ware *et al.* 1996, 2002). This Short Form, known as SF-12v2[®], includes eight subscales addressing physical functioning, physical role limitations, bodily pain, general health, mental health, vitality, social functioning and role limitations due to emotional problems. The SF-12v2[®] can provide estimates for all eight subscales, but interest more often focuses on two summary scales: the Physical Composite Score (PCS) and the Mental Composite Score (MCS). The PCS and MCS scores are calculated using all SF-12v2[®] items, but with different weights (Ware *et al.* 1996). The PCS weights physical functioning, physical role limitations and bodily pain more heavily, whereas MCS gives greater weight to mental health, social functioning and emotional role limitations. According to the algorithm in the SF-12v2[®] manual, a linear *t*-score transformation was applied so that both the PCS and MCS have a range from 0–100, a mean of 50 and a standard deviation of 10 (Ware *et al.* 2002). Higher PCS and MCS scores reflect better health-related functioning. Scores >50 represent health-related functioning above mean based on US population norms, whereas a score <50 indicates health-related functioning below mean.

Sickness absence at follow-up

The 2964 (36%) responders at baseline received a follow-up questionnaire 1-year later with questions on sickness absence, which was defined as either self-certified or medically certified absence from work due to one’s own illness, excluding absence related to children or other family members. At follow-up, nurses self-rated sickness absence in the past 12 months as ‘no’ or ‘yes’.

Ethical considerations

The study was approved by the Regional Committee for Medical and Health Research Ethics in Western Norway.

Data analysis

All statistical analyses were performed in SPSS for Windows (version 20; IBM SPSS Statistics, Amsterdam, the Netherlands). The psychological job demands sum score was included as a continuous independent variable in a logistic regression analysis with sickness absence as a dichotomous (no = 0, yes = 1) outcome variable. Linearity of relations of job demands, MCS and PCS with sickness absence was checked and confirmed.

Confounder analyses

Baseline background variables (age, gender, marital status, care for children, work setting, position and work schedule) were used for confounder analysis. A variable was regarded as a confounder if the regression coefficient of psychological job demands changed $\geq 10\%$ after adding the variable to the regression model (Twisk 2006).

Interaction analyses

On the basis of DCS model, which assumes a buffering effect of job control and job support, we tested two-way (demands \times control) as well as three-way (demands \times control \times support) interactions. The duration of exposure to job demands might be important when addressing interactions between work characteristics. Therefore, the interaction analyses were stratified by tenure as an RN. Tumber *et al.* (2001) reported that associations between psychological job demands and sickness absence differ between workplace settings, but we found no significant interaction ($P = 0.79$) between job demands and healthcare setting in preliminary analysis.

To investigate whether psychological job demands modified the effect of health-related functioning on sickness absence, we investigated the regression coefficients of interaction terms in two logistic regression models. One model included job demands, MCS and the interaction term MCS \times demands. The other model included job demands, PCS and the interaction term PCS \times demands. Both models had sickness absence as outcome variable.

Mediation analyses

A variable may be considered a mediator (M) if it carries the influence of a given independent variable (X) to a given outcome variable (Y), i.e.: $X \rightarrow M \rightarrow Y$ (MacKinnon *et al.* 2007). Baron and Kenny (1986) proposed the following four steps to distinguish between moderation (i.e. effect-modification) and mediation:

Step 1: Demonstrate significant association $X \rightarrow Y$ (direct effect);

Step 2: Demonstrate that the effect of X on Y controlled for M is smaller than the direct effect of X;

Step 3: Demonstrate that X significantly affects M ($X \rightarrow M$);

Step 4: Demonstrate that M significantly affects Y ($M \rightarrow Y$), controlling for X.

Mediation was investigated with models addressing the pathway $X \rightarrow M$ by least squares linear regression analysis and both pathways $M \rightarrow Y$ and $X \rightarrow Y$ by logistic regression analysis, stratified by tenure as proxy for the duration of exposure to job demands. Results of regression analyses are presented in regression coefficients (b) and related standard errors (SE).

The product of coefficients to evaluate the mediation effect posed a problem, because least squares linear regression coefficients are differently scaled than logistic regression coefficients (MacKinnon & Dwyer 1993, MacKinnon *et al.* 2007, Ianobucci 2012). Therefore, significance of mediation was investigated using the z -test for categorical outcome variables proposed by Ianobucci (2012). Significance was concluded for z -statistics exceeding 1.96, corresponding with $P < 0.05$.

Validity and reliability

All instruments and scales used in this study have been validated in previous research. Norwegian versions of the instruments and scales have shown acceptable psychometric properties in terms of validity and reliability (Saksvik-Lehouillier *et al.* 2012).

The Job Content Questionnaire (JCQ) is the most widely used questionnaire for assessing job demands, job control and job support (Karasek & Theorell 1990, Karasek *et al.* 1998). The DCSQ used in this study is a short (17-item) version of the original 26-item JCQ. The DCSQ includes all original JCQ demand and control items, but fewer job support items. Principal component analysis of the DCSQ supported the assumed three-dimensional subscale structure, which corresponded almost perfectly with the JCQ dimensions (Sanne *et al.* 2005). Inter-correlations between DCSQ subscales were weak, varying from 1% shared variance between job demands and job control to 6% shared variance between job demands and job support. Sanne *et al.* (2005) reported internal consistencies $\alpha = 0.73$, $\alpha = 0.74$ and $\alpha = 0.83$ for the job demands, job control and job support scales,

respectively. In the present study, we found scale reliabilities $\alpha = 0.79$, $\alpha = 0.57$ and $\alpha = 0.83$, respectively.

The SF12v2[®] is derived from the SF-36 Health Survey, which is one of the most widely used generic instruments to measure physical and mental health-related functioning. Relative to the original SF-12, the SF-12v2[®] has improved wording to make the items more familiar and less ambiguous. Moreover, the five-level response choices in place of dichotomous response choices has reduced ceiling and floor effects in the two role functioning scales of the first SF-12 version. SF-12v2[®] has a better layout so that it is easier to read and complete, thus reducing missing responses. In the UK, SF12v2[®] PCS and MCS scores were found to be highly correlated (PCS: $\rho = 0.94$ and MCS: $\rho = 0.96$) with related SF-36 scales, both in a community sample and across a variety of patient groups (Jenkinson & Layte 1997).

Results

Of 2964 nurses participating at baseline, 2295 (response rate 77%; 2082 women and 213 men) returned the follow-up questionnaire 1-year later. They ranged in age from 21–63 years (mean 31.8 years) and had a mean psychological job demands sum score of 14.1 (SD 2.6) at baseline, which was lower (t -test $p < 0.01$) than the sum score of 14.5 (SD 2.6) found at baseline for the 669 nurses who were lost to follow-up. Job control (t -test $P = 0.11$) and job support (t -test $P = 0.19$) did not differ between participating nurses and those lost to follow-up. Participating nurses had an average PCS score of 50.4 (SD 6.5) and an MCS score of 48.0 (SD 8.9) compared with 49.9 (SD 7.0) and 47.3 (SD 9.3), respectively, in nurses lost to follow-up, although these differences were not statistically significant (t -test $P = 0.06$ and $P = 0.08$ respectively).

Of the participating nurses, 115 (6%) had missing data; the remaining 2180 nurses with complete data were eligible for analysis. Their baseline characteristics are presented stratified by tenure in Table 1. As expected, newly licensed nurses (tenure <1 year) were younger, more often single and less often had children at home than nurses of higher tenure. The proportions of male nurses and nurses working only daytime were higher among nurses with a tenure >6 years compared with newly licensed nurses. Job demands (ANOVA $P = 0.06$), job control (ANOVA $P = 0.41$) and job support (ANOVA $P = 0.11$) did not differ significantly across tenure categories. Nurses with a tenure >6 years reported better physical health-related functioning as reflected by a higher PCS score (ANOVA $P = 0.02$), which might indicate a 'healthy worker effect' implying that the healthiest nurses stay in nursing jobs

longer than those with physical health problems. Mental health-related functioning did not differ significantly (ANOVA $P = 0.43$) across tenure categories. At follow-up, 1732 (79%) nurses reported sickness absence and 448 (21%) no sickness absence in the past year.

Baseline job demands were positively ($b = 0.081$, SE 0.019) related to sickness absence at 1-year follow-up and baseline job support negatively ($b = -0.045$, SE 0.015). Thus, higher levels of psychological job demands and lower levels of social support at the workplace increased the odds of sickness absence among nurses. The regression coefficients of job demands were significantly reduced after adjustment for either MCS or PCS (Table 2). After including both MCS and PCS in the regression model, the coefficient of job demands shrank to 0.056.

The interaction analyses showed that two-way interactions between job demands and job control were not significant (Table 3). The three-way interaction between job demands, job control and job support was significant in newly licensed nurses (tenure <1-year), but not in nurses of higher tenure.

Effect-modification by job demands

Interactions between job demands and either MCS ($P = 0.38$) or PCS ($P = 0.94$) were non-significant (Table 4). In other words, psychological job demands did not moderate the effect of MCS or PCS on sickness absence.

Mediation by health-related functioning

Mediation analysis of the indirect pathway showed that both MCS and PCS significantly mediated part of the effect of psychological job demands on sickness absence. The mediation test showed that MCS was a significant mediator of the pathway between psychological job demands and sickness absence in nurses with tenure <1-year and in those with tenure >6 years (Table 4). PCS was a significant mediator between job demands and sickness absence only in nurses with a tenure <1-year (Table 5).

Discussion

The effect of psychological job demands was partially mediated by both mental and physical health-related functioning. When stratifying for tenure as a proxy for the duration of exposure to job demands, mental health-related functioning was a significant mediator in newly licensed nurses with a tenure <1-year and in nurses registered for >6 years, while physical health-related functioning was a significant mediator only in newly licensed nurses. Mediation was not

Table 1 Baseline characteristics of the study population ($n = 2180$).

	Tenure as a registered nurse								All	
	<1 year ($n = 627$)		1–2 years ($n = 537$)		3–6 years ($n = 486$)		>6 years ($n = 530$)		($n = 2180$)	
	n (%)	mean (SD)	n (%)	mean (SD)	n (%)	mean (SD)	n (%)	mean (SD)	n (%)	mean (SD)
Age		28.5 (7.4)		29.4 (7.5)		32.5 (7.5)		37.8 (7.2)		31.9 (8.3)
Gender										
Women	575 (92)		486 (91)		451 (93)		466 (88)		1978 (91)	
Men	52 (8)		50 (9)		35 (7)		65 (12)		202 (9)	
Marital status										
Cohabiting	387 (62)		356 (67)		379 (78)		411 (78)		1533 (71)	
Living alone	239 (38)		179 (33)		106 (22)		116 (22)		640 (29)	
Care for children										
Yes	154 (25)		165 (32)		244 (52)		338 (67)		901 (43)	
No	453 (75)		347 (68)		222 (48)		169 (33)		1191 (57)	
Work setting										
Somatic care	327 (54)		337 (64)		389 (80)		418 (80)		1471 (69)	
Psychiatric care	53 (9)		58 (11)		75 (16)		81 (15)		267 (12)	
Nursing homes	100 (16)		58 (11)		7 (1)		5 (1)		170 (8)	
Home care	91 (15)		53 (10)		4 (1)		4 (1)		152 (7)	
Other	39 (6)		17 (3)		9 (2)		18 (3)		83 (4)	
Position										
<50%	46 (7)		36 (7)		6(1)		13 (3)		101 (5)	
50–75%	339 (55)		273 (51)		190 (39)		177 (37)		979 (45)	
76–100%	240 (38)		226 (42)		289 (60)		338 (64)		1093 (50)	
Work schedule										
Daytime	7 (1)		10 (2)		20 (4)		88 (17)		125 (6)	
1-shift	58 (10)		44 (7)		41 (8)		45 (9)		188 (9)	
Rotating 2-shift	251 (40)		174 (33)		109 (23)		111 (21)		645 (30)	
Rotating 3-shift	281 (45)		285 (54)		299 (62)		264 (50)		1129 (52)	
Other rotating shifts	27 (4)		19 (4)		12 (3)		20 (4)		78 (4)	
Job demands (range 5–20)		14.0 (2.7)		14.4 (2.8)		14.1 (2.8)		14.0 (2.6)		14.1 (2.8)
Job control (range 6–24)		17.7 (2.1)		17.7 (2.0)		17.6 (2.0)		17.8 (2.2)		17.7 (2.1)
Job support (range 6–24)		17.8 (3.8)		17.5 (3.8)		17.3 (3.6)		17.6 (3.5)		17.6 (3.7)
Physical health-related functioning (range 0–100)		50.3 (5.5)		50.1 (6.4)		50.2 (7.5)		51.2 (6.9)		50.4 (6.5)
Mental health-related functioning (range 0–100)		48.5 (8.9)		47.8 (8.8)		47.7 (9.1)		48.2 (8.9)		48.0 (8.9)

complete, which indicated that factors other than health-related functioning play a role in the pathway to sickness absence (Farrell & Stam 1988, Kohler & Matthieu 1993, Harrison & Martocchio 1998, Steel 2003, Johansson & Lundberg 2004, Dahle & Petersen 2005). The results of this study indicated that health-related functioning mediated part of the effect of psychological job demands on sickness absence, while interaction analysis showed that psychological job demands did not significantly modify the effect of health-related functioning on sickness absence.

Further interaction analyses showed no significant two-way interactions between psychological job demands and job control. It should be noted here that the job control scale in our study had a low Cronbach's alpha of 0.57, indicating a debatable internal consistency of the scale (Cortina 1993). Karasek and Theorell (1990) originally conceptualized job control as a mix of an employee's authority to make decisions (decision authority) and the range of skills used in the job (skills discretion), which are two theoretically distinct components (De Jonge *et al.* 2000a, 2010). The broad

Table 2 Confounder analysis.

Logistic regression model	Job demands	Job control	Job support	Mental Composite Score	Physical Composite Score
Bi-variate (unadjusted) analysis	0.081 (0.019)	-0.001 (0.025)	-0.045 (0.015)	-0.033 (0.007)	-0.034 (0.009)
Adjusted for age, gender, marital status and care for children	0.081 (0.021)	-0.002 (0.026)	-0.048 (0.015)	-0.033 (0.007)	-0.037 (0.010)
Adjusted for work hours/week, shift schedule and tenure	0.080 (0.020)	-0.003 (0.026)	-0.045 (0.015)	-0.032 (0.007)	-0.034 (0.009)
Adjusted for workplace setting	0.078 (0.022)	-0.014 (0.026)	-0.049 (0.015)	-0.032 (0.007)	-0.035 (0.009)
Adjusted for job demands	Not analysed	-0.003 (0.025)	-0.032 (0.015)	-0.031 (0.007)	-0.032 (0.009)
Adjusted for job control	0.080 (0.019)	Not analysed	-0.046 (0.015)	-0.033 (0.007)	-0.034 (0.009)
Adjusted for job support	0.068 (0.020)	0.012 (0.026)	Not analysed	-0.030 (0.007)	-0.033 (0.009)
Adjusted for job demands, control and support	0.068 (0.020)	0.011 (0.026)	-0.033 (0.016)	-0.030 (0.007)	-0.031 (0.009)
Adjusted for mental health-related functioning (MCS)	0.058 (0.021)	0.009 (0.026)	-0.029 (0.015)	Not analysed	-0.045 (0.010)
Adjusted for physical health-related functioning (PCS)	0.064 (0.020)	-0.003 (0.025)	-0.042 (0.015)	-0.038 (0.007)	Not analysed
Adjusted for MCS and PCS	0.056 (0.020)	0.010 (0.026)	-0.020 (0.015)	Not analysed	Not analysed
Full model*	0.050 (0.021)	0.027 (0.027)	-0.015 (0.017)	-0.035 (0.007)	-0.043 (0.010)

*The full model included job demands, job control, job support, MCS and PCS.

The Table shows logistic regression coefficients (standard errors) of associations with sickness absence at follow-up; according to Twisk (2006), variables were considered as confounders if the regression coefficient changed $\geq 10\%$ when adding the variable to the regression model.

Table 3 Interaction between work characteristics.

	Interaction	
	Two-way	Three-way
Tenure		
<1 years	0.75 (0.48)	0.16 (0.07)*
1-2 years	0.47 (0.58)	0.01 (0.07)
3-6 years	0.38 (0.52)	0.06 (0.09)
>6 years	0.35 (0.57)	0.17 (0.08)
All	0.17 (0.25)	0.02 (0.04)

*Significant interaction.

The Table shows the regression coefficients (standard errors) of two-way interaction between job demands and job control, as well as three-way interaction between job demands, job control and job support, stratified by tenure.

conceptualization of job control might be a reason for not finding buffering effects (De Jonge *et al.* 2010, Schmidt & Diestel 2011).

While the two-way interactions between job demands and job control were not significant, three-way interactions between job demands, job control and job support were significant in newly licensed nurses. Considering the number of interaction analyses, we have to take into account the possibility of chance capitalization. Nevertheless, there is no harm in recommending nurse managers to provide

Table 4 Effect-modification by job demands.

	MCS \times job demands		PCS \times job demands	
	b (SE)	P	b (SE)	P
Tenure				
<1 years	-0.05 (0.08)	0.49	-0.01 (0.05)	0.87
1-2 years	0.10 (0.07)	0.15	-0.07 (0.05)	0.15
3-6 years	0.01 (0.02)	0.94	-0.01 (0.05)	0.88
>6 years	-0.05 (0.07)	0.47	-0.03 (0.05)	0.63
All	-0.00 (0.00)	0.38	0.00 (0.01)	0.94

The Table shows the regression coefficients (standard errors) of interaction terms in logistic regression analysis with psychological job demands, mental (MCS) and physical (PCS) health-related functioning as independent variables and sickness absence as outcome variable, stratified by tenure.

newly licensed nurses with adequate social support and supervision at the workplace, especially if they experience high psychological job demands.

Indirect pathway: mediation by health-related functioning

Both mental and physical health-related functioning partially mediated the effect of psychological job demands on sickness absence. Mediation was significant despite the fact

Table 5 Mediation by health-related functioning.

Tenure	Mental health-related functioning				Physical health-related functioning			
	Step 1	Step 2	Step 3 <i>b</i> (SE)	Step 4 <i>b</i> (SE)	Step 3 <i>b</i> (SE)	Step 4 <i>b</i> (SE)	Mediation test <i>P</i>	Mediation test <i>P</i>
<1 year	0.137 (0.039)**	0.110 (0.040)**	-0.475 (0.135)**	-0.061 (0.014)**	-0.241 (0.085)**	-0.057 (0.017)**	<0.01	0.02
1-2 years	0.027 (0.040)	0.011 (0.042)	-0.497 (0.133)**	-0.030 (0.014)*	-0.196 (0.102)	-0.052 (0.021)*	0.07	0.15
3-6 years	0.025 (0.043)	0.017 (0.044)	-0.437 (0.146)**	-0.027 (0.015)	-0.166 (0.126)	-0.028 (0.018)	0.13	0.37
>6 years	0.083 (0.040)*	0.067 (0.043)	-0.493 (0.142)**	-0.042 (0.015)**	-0.204 (0.117)	-0.041 (0.019)*	0.03	0.20
All	0.068 (0.020)**	0.050 (0.021)*	-0.427 (0.069)**	-0.040 (0.007)**	-0.211 (0.053)**	-0.043 (0.010)**	<0.01	<0.01

*Significant at 5% level and **Significant at 1% level.

The Table shows regression coefficients (*b*) and standard errors (SE) of the four steps of mediation analysis. Step 1: *b* (SE) of job demands in relation to sickness absence, controlling for job control and support. Step 2: *b* (SE) of job demands, controlling for job control, job support and both mental and physical health-related functioning. Step 3: *b* (SE) of job demands in relation to mediator (i.e. either mental or physical health-related functioning), controlling for job control and support. Step 4: *b* (SE) of mediator variable in relation to sickness absence, controlling for job demands, control and support. The Table also shows the *P*-values of the mediation test, which were considered significant for *P* < 0.05.

that mediation by mental health-related functioning was controlled for physical health-related functioning and *vice versa*, indicating that mediating effects of mental and physical health-related functioning were independent. We had expected a mediating effect of mental health-related functioning. Previously, Hockey (1997) proposed a cognitive-energetic framework where employees face a trade-off between performance and psychological efforts. If psychological demands are high, performance may be compensated by extra psychological effort, consequently draining an employee's energy, leading to exhaustion and reduced vitality. Prolonged or repeated exposure to high psychological demands and insufficient recovery might cause a cumulative process where initially reversible psycho-physiological reactions transfer into mental illness and sickness absence in the long term (Geurts & Sonnentag 2006).

Unexpectedly, we found significant mediation by physical health-related functioning, even if mental health-related functioning was controlled for. The independent mediation effects might be explained by assuming that physical health-related functioning mediates between psychological job demands and somatic sickness absence, whereas mental health-related functioning mediates between psychological job demands and mental sickness absence. We could not investigate these alternative mediation effects, because the causes (mental or physical) of sickness absence were not available from SUSSH.

An alternative explanation for the independent mediation may be that high psychological job demands foster psychosomatic health complaints (De Jonge *et al.* 2000b). In a two-wave survey among Dutch healthcare employees, it was shown that employees who experienced high job demands at baseline had more psychosomatic complaints at two-year follow-up, especially when job control was low (De Jonge *et al.* 2010). In a similar vein, Fjell *et al.* (2007) found strong associations between high psychological job demands and self-reported musculoskeletal pain in a cross-sectional survey among Swedish public sector employees. Bodily pain and other psychosomatic complaints are likely to deteriorate physical functioning and physical role functioning, which may explain why physical health-related functioning partially mediated the effect of psychological job demands on sickness absence.

Mediating effects were particularly significant in newly licensed nurses. Previous studies have reported that newly licensed nurses experience high job demands and pressures (Duchscher 2001, Casey *et al.* 2004, Bowles & Candela 2005, Unruh & Nooney 2011) and face long shifts and overtime work (Kovner *et al.* 2007). Nursing education may not adequately prepare nurses for their jobs, so that feelings of stress, lack of self-confidence and disillusionment

might result (Duchscher 2001). Casey *et al.* (2004) reported that newly licensed nurses may not feel skilled, comfortable and confident for up to 1-year after graduation. Halfer and Graf (2006) found that their perceptions of job characteristics improved significantly over 18 months, which might explain why the mediation effect of health-related functioning was not significant among the more tenured nurses. However, these results should be interpreted with caution because we may have failed to detect significant mediation in higher tenure categories due to lack of statistical power (Fritz & MacKinnon 2007).

Limitations of the study

The methodology of mediation analysis used in this study is an important tool for addressing mechanisms underlying observed associations and for improving causal inferences (Hafeman & Schwartz 2009), although problems with statistical power is one of the criticisms of the mediation test (Fritz & MacKinnon 2007, MacKinnon *et al.* 2007). Psychological job demands and sickness absence were measured with two different questionnaires with 1-year in between, thus limiting common method bias (Podsakoff *et al.* 2003). Health-related functioning was measured with the same questionnaire and at the same time point as psychological job demands. Common method bias may have overestimated associations between psychological job demands and health-related functioning. The use of self-reported sickness absence data can be considered a limitation of the study because self-reported sickness absence may be recall-biased. We dealt with this problem by using the occurrence (no/yes) of sickness absence at follow-up as outcome measure. Voss *et al.* (2008) found 91% agreement between recorded and self-reported occurrence of sickness absence over a period of 12 months in a sample of 4869 Swedish public sector employees.

Another limitation of the present study concerns the low response rate (36%) at baseline, which could have introduced selection bias into the population from the start, implicating that the results may not generalize to other nursing populations (Roelen *et al.* 2013). Furthermore, selective loss to follow-up of nurses experiencing high psychological job demands may have attenuated associations between psychological job demands and sickness absence, although differences in psychological demands sum score were small (14.1 in participating nurses vs. 14.5 in nurses lost to follow-up).

In the present study, we used a scale that measures generic psychological job demands (Sanne *et al.* 2005). Previously, Sundin *et al.* (2008) described additional demands

related to the interaction with and care for patients and relatives. Such a specific scale might better capture job demands of nurses and might be more strongly related to sickness absence among nurses (Sundin *et al.* 2011). On the other hand, although being a generalist model, the DCS model is one of the most used frameworks to define psychosocial work conditions and investigate the health effects of psychosocial risk exposures. Its structure often raises questions in nurse populations, but the DCS dimensions have been shown to be predictive of health outcomes in nurses (Bonnetterre *et al.* 2008).

Conclusion

The effect of psychological job demands on sickness absence in nurses was partially mediated by health-related functioning. Job demands did not modify the effect of health-related functioning on sickness absence.

Nurse managers should pay attention to nurses' mental and physical functioning at work, especially among newly licensed nurses. Sickness absence may be prevented if impairments in physical and mental functioning are recognized and dealt with in an early stage. Because both mental and physical health-related functioning partially mediated the effect of psychological job demands on sickness absence independently of each other, physical exercise programmes might be as useful as cognitive programmes to protect nurses from negative health effects of high psychological job demands (Van Rhenen *et al.* 2005, 2007).

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Author contributions

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