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Health Psychology and Behavioral Medicine
An Open Access Journal

ISSN: (Print) 2164-2850 (Online) Journal homepage: http://www.tandfonline.com/loi/rhpb20

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To cite this article: Achim Elfering, Ivana Igic, Anita C. Keller, Laurenz L. Meier & Norbert K. Semmer (2016) Work-privacy conflict and musculoskeletal pain: a population-based test of a stress-sleep-mediation model, Health Psychology and Behavioral Medicine, 4:1, 70-90, DOI: 10.1080/21642850.2016.1168301

To link to this article: http://dx.doi.org/10.1080/21642850.2016.1168301

Published online: 19 Apr 2016.

HEALTH PSYCHOLOGY AND BEHAVIORAL MEDICINE, 2016
VOL. 4, NO. 1, 70–90
http://dx.doi.org/10.1080/21642850.2016.1168301

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Work-privacy conflict and musculoskeletal pain: a population-based test of a stress-sleep-mediation model

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ABSTRACT

Previous research has shown that work–privacy conflict (WPC) is associated with musculoskeletal pain (MSP), but the processes involved are unclear. This study simultaneously tested strain and sleep problems as mediators in three mediation paths (WPC →strain→MSP; WPC →sleep problems→MSP; and WPC →strain→sleep problems→MSP). Total mediation (including all three mediation paths) was expected to be stronger in older compared to younger participants, in participants doing shift work compared to those with regular work time, and in women compared to men. In a representative sample of the Swiss working population ($N = 3438$), WPC, strain, sleep problems, and MSP were assessed by self-report. A set of linear regressions and bootstrapping were used to test the indirect path coefficients. All three mediation paths were significant ($ps < .001$). The total indirect effect was stronger in women compared to men ($p = .036$) but mediation did not differ based on working schedules or age. However, tests of higher order moderated mediation showed that mediation was significantly higher in women aged 45 or older who did shift work than in all other combinations ($p = .036$). A process model postulating strain and sleep problems to mediate the association between WPC and MSP was empirically supported. Work redesign should reduce WPC in order to reduce strain, prevent sleeping problems, and reduce work-related MSP.

ARTICLE HISTORY
Received 14 January 2015
Accepted 15 March 2016

KEYWORDS
work–privacy conflict; moderated mediation; work stress; sleep; cumulative risk; work-related musculoskeletal disorders

Introduction

In Switzerland, back pain entails costs of 6–14 billion Swiss Francs, corresponding to 1.3–3.2% of the gross domestic product (Schweizerischer Nationalfonds, 2009). More specifically, low back pain is responsible for about 3.2 billion Swiss Francs in direct costs, which constitutes 6.1% of the total health care expenditure in Switzerland (Wieser et al., 2011). Intangible costs should not be underestimated either, even if they are difficult to estimate; they include psychosocial burdens, like job stress, suffering, family stress and economic

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stress, which all result in a reduced quality of life (Elfering & Mannion, 2008). Apart from the costs to individuals in terms of their quality of life, these economic costs call for a better understanding of the predictors of musculoskeletal pain (MSP), which constitutes the basis for prevention and intervention.

Biomechanical risk factors for the development of MSP at work include vibration, repetitive movements and remaining in static positions for hours. Being exposed to repetitive motions, excessive work load, vibrations, lifting and bearing heavy things increase the risk of developing musculoskeletal problems in general (Elfering & Mannion, 2008). The psychosocial aspects of work that contribute to MSP found in the literature include shiftwork, conflicting demands, time pressure, and static load (Elfering et al., 2002; Igic, Ryser, & Elfering, 2013).

Work–privacy conflict and strain as antecedents of MSP

The interaction of work and private life has not often been investigated as a psychosocial risk factor for MSP (Saastamoinen, Laaksonen, Leino-Arjas, & Lahelma, 2009), although recent meta-analyses have underlined its association with well-being and health (Amstad, Meier, Fasel, Elfering, & Semmer, 2011; Nohe, Meier, Sonntag, & Michel, 2015). Geurts et al. (2005) defined work–privacy conflict (WPC), which they call negative work–home interaction, as a process in which functioning (behaviour) at home is influenced by negative load reactions that have built up during work. Geurts et al. (2005) described negative interactions between life domains as resulting from insufficient recovery processes. When effort investment in one domain becomes excessive (e.g. work activities during organisational change, or household and care-giving activities when household members become ill) and the opportunity for recovery is insufficient, negative load reactions will develop and spill over into the other life domain. According to a study by Hämmig and colleagues, employees who were most frequently exposed to WPC were also at the highest risk for developing low back pain and neck/shoulder pain (Hämmig, Gutzwiler, & Bauer, 2009). Therefore, the current study hypothesises that more WPC will predict higher MSP (Hypothesis 1).

How does WPC influence MSP? It seems likely that there are mediating mechanisms involved. Thus, WPC is a common work stressor that often elicits work-related strain (Frone, Russell, & Cooper, 1997). Work strain characterises the psychological, behavioural, and physiological reaction to work demands, threats, and challenges (i.e. stressors) and includes feelings of exhaustion, and feeling stressed (Ganster & Rosen, 2013). Work strain, in turn, is related to musculoskeletal disorders via a variety of mechanisms that elicit muscle tension and induce MSP; these include both mental (e.g. pain-related fear or individual coping styles; Elfering, 2006; McFarlane, 2007) and physical (e.g. stress-induced increase in noradrenalin; Elfering, Grebner, Gerber, & Semmer, 2008; Elfering, Grebner, Semmer, & Gerber, 2002). Eatough, Way, and Chang (2012) found that strain mediated the association between work stressors and work-related musculoskeletal complaints. According to the 'Cinderella Hypothesis' (referring to Cinderella, who was first to rise and start work and last to end work and rest; Hägg, 1991), the small, low-threshold motor units are always recruited first, before large ones, and they remain activated until the complete relaxation of the muscle. These low-threshold motor units as part of a strain response to stressors (such as WPC, and strain-related increase of norepinephrine probably

augments the sensitivity of low-threshold motor units (Lundberg & Melin, 2002). Observational studies have linked work stressors, norepinephrine levels and MSP (Elfering, Grebner, Semmer, & Gerber, 2002; Elfering et al., 2008). Repeated or enduring WPC may keep low-threshold motor units active rather constantly while awake, and MSP is a frequent consequence of long-lasting elevated muscle tension at work and after work. Therefore, the current study hypothesises that strain mediates the association between WPC and MSP (WPC → strain → MSP; Hypothesis 2).

WPC and sleep problems as antecedents of MSP

Recent research from Work, Family and Health Network applied conservation of resources theory (Hobfoll, 1989) as a guiding theoretical framework for work–family conflict, strain, and sleep (Crain et al., 2014; Olson et al., 2015). Conservation of resources theory predicts strain to be a consequence of lacking resources, the threat of resource loss, or absence of resource gain after the investment of resources (Hobfoll, 1989). Resources may be external (e.g. the quality of work; a house, money), and personal resources (e.g. self-esteem, mastery, energy), which the individual tries to obtain, maintain, and defend. Crain et al. (2014) claimed that WPC frequently resulted in a loss of resources, 'primarily valued work roles, home roles, and time', and that such 'instances of resource loss are likely to result in strain and a lack of time that prevents individuals from attaining sufficient sleep quality and adequate amounts of sleep' (p. 157). One important aspect of WPC is that there often is simply not enough time for dealing with both work and family obligations (Amstad & Semmer, 2009) – time for work, private life, and sleep compete. One way to cope with WPC is to reduce sleeping time while being rather active just before going to sleep. Such coping behaviour may not just create shorter sleep time, but also may result in problems falling asleep and in a poor sleep quality because of engaging in activating and arousing activities near bedtime. For example, it has been shown that 'poor sleepers' engage in exciting, emotional and cognitive demanding activities near bedtime (Gellis & Lichstein, 2009). Sleep quality comprises the evaluation of the sufficiency of sleep, in addition to difficulty initiating or maintaining sleep at night, both of which have sometimes been referred to as insomnia symptoms. Sleep quantity (sleeping time) and sleep quality are interrelated. Sleep quality is higher when individuals go to bed at the same time regularly. Higher individual variability in total sleep time is linked to poorer sleep quality and health. The mechanism behind this is not very clear but inconsistent (i.e. variable) sleep patterns are thought to sustain insomnia, and having a more regular sleep pattern is a goal of insomnia therapy. A recent study showed that sleep quality partially mediated the effects of individual variability in total sleep time across days on well-being and health (Lemola, Ledermann, & Friedman, 2013). Thus, we hypothesise that WPC will predict poorer sleep.

A review on experimental studies of sleep deprivation and fragmentation showed hyperalgesia as a consequence in humans and animals (Karmann, Kundermann, & Lautenbacher, 2014). In nonexperimental studies, poor sleep predicts elevated psychosomatic complaints (Pereira & Elfering, 2014) and onset of back pain (Agmon & Armon, 2014). Recently, McBeth, Lacey, and Wilkie (2014) reported results concerning sleep and MSP in a population-based prospective cohort-study. In multivariate analysis, nonrestorative sleep was found to be the strongest predictor of new-onset MSP. By contrast, restorative sleep in individuals suffering from MSP was found to predict the resolution of MSP

(Davies et al., 2008). Therefore, we expect WPC → sleep problems → MSP will be a meaningful indirect path (Hypothesis 3).

Strain as antecedent of sleep problems

Consistent associations have been found between stress and sleep problems in epidemiological studies and in ambulatory assessment studies (Pereira, Gerhardt, Kottwitz, & Elfering, in press; Pereira, Semmer, & Elfering, 2014), but most of the in-depth knowledge comes from studies in rodents (Sanford, Suchecki, & Meerlo, 2015). The neurotransmitters and hormones involved in the stress response are also involved in sleep regulation, and 'the interaction between stress and sleep is implicated in a variety of disease processes and psychiatric disorders' (Sanford et al., 2015, p. 381). After stressful experiences, sleep contributes to restoration. For instance, extended rapid eye movement sleep phases seem to help in coping with emotional disturbances after a stress experience (Suchecki, Tiba, & Machado, 2012). Conversely, sleep seems to be impaired by stressors, with the kind of dysregulation with respect to awakenings and change of sleep phases depending on stressor characteristics: Unpredictable and uncontrollable stressors seem to cause the most severe dysregulation (Sanford et al., 2015). Unpredictability and uncontrollability are common causes of WPC, for instance, with regard to unpredicted work load that needs extra time, or uncontrollable commuting problems on the way home.

In the last decade, the association between work–family balance and sleep problems in employees has gained attention in research (e.g. Allen & Kiburz, 2012). Recently, Ng and Feldman (2014) showed in their US sample (but not their Singapore sample), both WPC and privacy–work conflict (PWC) to predict chronic insomnia. In another study, WPC was found to be a precursor of sleep problems and a mediator between business travelling demands and reduced sleep quality (Makela, Bergbom, Tanskanen, & Kinnunen, 2014).

WPC is related to strain (Amstad et al., 2011; Nohe et al., 2015) and strain-related physiological activation. A recent ambulatory diary study showed daily WPC preceded a subsequent increase in cardiovascular activation on four measurement times throughout the day, including immediately before going to bed (Shockley & Allen, 2013). According to Åkerstedt, Nilsson, and Kecklund (2009), such increased psychophysiological activation is incommensurate with deactivation, a main characteristic of sleep. Ruminative negative thoughts (including worry about fulfilling work and private roles) contribute to sustained activation. In two cross-sectional questionnaire studies, Berset and colleagues showed effort–reward imbalance and time pressure at work predicted sleep impairment; this association was mediated by work-related ruminative thoughts, preventing detachment from work in the evening (Berset, Elfering, Lüthy, Lüthi, & Semmer, 2011). Not surprisingly, therefore, the association between work–family balance and sleep problems in employees has gained attention in research in recent years (e.g. Allen & Kiburz, 2012). Using daily assessment of work stressors and actigraphy across working nights, Pereira, Meier, and Elfering (2013) showed social exclusion at work and subsequent strain-related worry were antecedents of poor sleep during the night. Ng and Feldman (2014) showed in their US sample (but not their Singapore sample), both WPC and PWC predicted chronic insomnia. In another study, WPC was found to be a precursor of sleep problems and a mediator between business travelling demands and sleep quality (Makela, Bergbom, Tanskanen, & Kinnunen, 2014).

Hence, in the current study, a multiple mediation path is expected with strain and sleep problems as mediators (WPC → strain → sleep problems → MSP; Hypothesis 4).

The current mediation model

In sum, the current conceptual model is based on an integration of two previously conceptualised and confirmed models: (1) the basic model of Hämmig, Knecht, Läubli, and Bauer (2011) who suggested stress mediates the effects of WPC on MSP (solid lines in Figure 1), and (2) the conceptual model postulating sleep complaints mediate the effects of work stressors on health (dashed lines in Figure 1, e.g. Elfering, Pereira, Grebner, & Müller, 2015; Yang & Park, 2015).

Age, shift work, and gender as moderators

Resources for coping with conflicting demands at work and in private life are lower, and sleep is less efficient and less tolerant of circadian phase shifts in older individuals than in younger ones (Vitiello, 2012). In a longitudinal study, mental stress, dissatisfaction with life, and sleep problems were significant predictors of low back pain only among 40–49-year-old workers (Miranda, Viikari-Juntura, Punnett, & Riihimaki, 2008). Health, strength, and fitness decrease while WPC is expected to increase due to trends towards later parenthood, age-related increase in eldercare demands (Smith, 2004), and the ageing workforce (Mermin, Johnson, & Murphy, 2007). Therefore, we expect mediation to be stronger in older than in younger individuals (Hypothesis 5).

There is also evidence that resources for coping with conflicting demands at work and in private life are lower, and sleep is poorer and more vulnerable, in individuals who do shift work compared to those who do not (Åkerstedt et al., 2009). Hence, we expect mediation to be stronger in individuals doing shift work than in individuals who do not (Hypothesis 6).

Many studies that compared working conditions and strain in men and women doing comparable work, with the same level of complexity, showed that women were more stressed due to their greater unpaid workload in private life and due to a greater responsibility for duties related to home and family (Lundberg & Frankenhaeuser, 1999). At the same time, sleep was reported to be poorer, more vulnerable and more closely associated with disease in women than in men (Suarez, 2008). Considering the effects of WPC, we therefore expect mediation to be stronger in women as compared to men (Hypothesis 7).

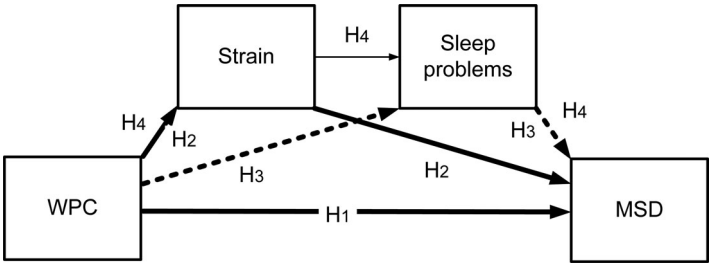

Figure 1. Hypothesised mediation model.

Method

Participants and procedure

This questionnaire study was conducted in February 2014. Data were collected electronically, based on a pool of 130,000 registered participants (Internet-Panel). The panel administrators recruited participants by phone and invited them via e-mail to answer the online questionnaire. Participants of the panel are representative for the Swiss population between 15 and 64 years. The sampling strategy aimed at working individuals from the German-, French-, and Italian-speaking parts of Switzerland. Current working status with a full or part-time schedule was an inclusion criterion; individuals who were exclusively in vocational training were excluded. The sampling goal was to have a representative sample of Swiss working individuals with respect to gender, age, language, and economic sector. Thus, based on the Swiss census data of 2012 (Swiss Federal Statistical Office, 2013), application of an interlock sampling strategy screened members of the Internet-Panel to fit into 90 cells (gender [2] X age [3 ranges] X language [3] X economic sector [5] = 90 cells). To fill the 90 cells representatively, 13,103 invitation emails were sent. Within three weeks, 4561 individuals agreed to participate (response rate of 35%) and were sent a link to the electronic questionnaire. Respondents had about 20 minutes to fill out the questionnaire. Of those who had agreed, 3758 individuals (82%) completed the questionnaire. These participants were rewarded with small incentives (e.g. book coupons worth approximately two Swiss Francs). Response pattern and timing analyses showed that 59 individuals had to be excluded because they ran through the questionnaire extremely fast or consistently responded using min/max response options. Thus, the final sample included 3699 individuals. Because of missing values the sample size for the analyses was 3438.

Self-report measures

Work–privacy conflict. A scale with four items asked about WPC (Geurts et al., 2005; e.g. 'Your work schedule makes it difficult for you to fulfil your domestic obligations'). Response options ranged from 1 (never) to 4 (always), and no explicit time frame was set. The short version used in the current study was developed and validated by Geurts in the context of the Psychological Contracts across Employment Situations Project (PSYCONES, 2004), based on her original 27 item questionnaire on work–home interaction. For the PSYCONES project, the items were translated into German and validated in a sample of 201 participants. The short scale on WPC comprised items #3, #5, #7, #8 from Table 1 listed in Geurts et al. (2005). Cronbach's alpha was satisfactory (.77).

Strain. A single item asked for strain in the last year ('How often did you experience stress in the last twelve months?'). The word 'stress' represents strain in German very well. The response options ranged from 1 (never) to 5 (always). The question had previously been validated in a large-scale population study in Switzerland (Grebner, Berlowitz, Alvarado, & Cassina, 2011).

Sleep problems. Three items from the Insomnia Severity Index (Bastien, Vallieres, & Morin, 2001) asked about the severity of sleep onset, sleep maintenance and early morning awakening problems ('Please rate the current [i.e. last two weeks] severity of your insomnia problem(s)'). Response options ranged from 0 (none) to 3 (severe). Cronbach's alpha was satisfactory (.74).

Table 1. Descriptive statistics of the variables investigated.

	# items	Range	% Yes	*M*	SD	Cronbach's alpha
WPC	4	0–3		0.58	0.55	.79
Strain	1	0–3		1.28	0.68	n.a.
Sleep problems	3	0–3		0.93	0.83	.74
MSP	3	1–5		2.40	0.86	.71
PWC	4	0–3		0.38	0.41	.74
Part time work (% of FTE)	1	0–100		86.0	22.7	n.a.
Children	1	Number		0.50	0.87	n.a.
Living with partner	1	0–1	76.5			n.a.
Time pressure at work	4	1–5		3.10	0.86	.83
Job control at work	6	1–5		3.85	0.86	.87
Shift work	1	0–1	20.5			n.a.
Age	1	Number		42.75	11.86	n.a.
Women	1	0–1	46.4			n.a.

Notes: $N = 3438$. FTE = full-time equivalent.

Musculoskeletal pain. Three items addressed pain in the neck, back, and joints (Bauer & Schmid, 2008): 'How often did you experience troubles in the following body regions in the last twelve months?' (1) neck or shoulder pain; (2) pain in the upper or lower back, (3) joints and bones. Response options ranged from 1 (never) to 5 (always). Cronbach's alpha was satisfactory (.71).

Control variables. PWC was included as a control variable in the mediation model to ensure the direction of cross-domain stressors was specific from work to family and not vice versa. Like the items on WPC, it was based on the scale by Geurts et al. (2005), developed and validated by Geurts in the PSYCONES project. The scale (called negative home-work interaction, comprised four (#10, #11, #12, and #13 from Table 1 listed in Geurts et al., 2005). A sample item is 'You have difficulty concentrating on your work because you are preoccupied with domestic matters'. Response options ranged from 1 (never) to 4 (always). Cronbach's alpha was satisfactory (.74). Further control variables were time pressure as a task stressor and job control as a task-related resource; they were included to test the specific effects of WPC (and not task-related work stressors and job control) on MSP. Time pressure is the most common task demand at work, and job control is an important task-related resource at work. Task demands and job control have both been shown to relate to sleep quality and MSP (Elfering & Mannion, 2008). For instance, Kalimo, Tenkanen, Harma, Poppius, and Heinsalmi (2000) found strong main effects for job demands and job control on self-reported insomnia in a large sample of male employees. Work environments with high job demands and low job control have been found to predict self-reported sleep complaints a year later (De Lange et al., 2009). Likewise, increases in schedule control have been related to increased sleep quality over a 6-month period (Moen, Kelly, Tranby, & Huang, 2011). In order to study WPC and its unique relation with sleep quality and MSP, we therefore controlled for time pressure and job control. Time pressure and job control were measured by the Instrument for Stress-Oriented Task Analysis (ISTA, Version 5.1; Semmer, Zapf, & Dunckel, 1995). Time pressure included four items (e.g. 'How often are you pressed for time?'). Job control was assessed with six items (e.g. 'Considering your work activity in general, how much opportunity is there for you to make your own decisions?'). The answering format ranged from 1 (very rarely/never) to 5 (very often/constantly). To control for individual demands and resources, we included single items asking about age, gender, number

of children, whether the work schedule includes shift work (yes/no), whether participants were living alone or with a partner, and whether participants worked a full schedule or part-time work (% of a full-time equivalent [FTE]). Age, gender, and work schedule were tested as moderator variables in moderator analyses.

Statistical analyses

The mediation tests were performed by multiple ordinary least squares regression analyses. Three mediations were tested simultaneously using path analysis (Figure 1; Mediation 1: WPC → strain → MSP; Mediation 2: WPC → sleep problems → MSP; Mediation 3: WPC → strain → sleep problems → MSP). The mediation tests were done using the MED3C SPSS macro written by Hayes and co-authors, which estimates total, direct, and indirect effects using a set of OLS regressions and bootstrapping to estimate the confidence intervals for indirect path coefficients (Hayes, Preacher, & Myers, 2011). Bootstrapping included 5000 samples. The MED3C SPSS macro permits the inclusion of control variables. We controlled for gender, age, PWC, part-time work, number of children, and living alone, as these variables are known to be associated with sleep and with MSP (see above). WPC has also been shown to correlate with other work stressors and with job control in a study by Jacobshagen, Amstad, Semmer, and Kuster (2005) and WPC retained its association with well-being after controlling for work stressors and job control. In the current study, we also wanted to focus on the unique contribution of WPC in predicting MSP. Therefore, we controlled for time pressure at work, job control, and shift work. Preacher, Rucker, and Hayes (2007) defined moderated mediation to occur when the strength of an indirect effect depends on the level of some variable, or in other words, when mediation relations are contingent on the level of a moderator. In our study gender, age, and shift work were tested as moderators of indirect effects. Indirect path strength was tested for differences between women and men, younger and older persons (older workers were defined as at least 45 years of age, World Health Organization, 2001), and persons doing shift work versus not. Indirect path regression coefficients were compared using the SPSS tool by Weaver and Wuensch (2013); the alpha level was 5%. Because hypotheses were directional, tests were one-tailed (Wonnacott & Wonnacott, 1984). Test on higher order mediated moderation that did not refer to directed hypotheses were two-tailed.

Results

Descriptive values of study variables are shown in Table 1 and correlations in Table 2. Correlations among WPC, strain, sleep problems, and MSP were all positive and significant (bold coefficients in Table 2), with effect sizes ranging from moderate to large (i.e. between .3 and .5; Cohen, 1977). The test of the path model confirmed that WPC predicted MSP controlling for potential confounders (Hypothesis 1, Figure 1). Without mediation, the path from WPC to MSP (c) was significant (Figure 2, $B = .29$, $p < .001$): taking mediation into account by including the three mediation paths reduced the association between WPC and MSP, but it still remained significant (Figure 2, $c' = .10$, $p < .01$). Thus, only partial mediation was observed.

Table 2. Pearson correlation matrix.

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	WPC	1												
2	Strain	**.50**	1											
3	Sleep problems	**.32**	**.40**	1										
4	MSP	**.26**	**.33**	**.36**	1									
5	PWC	.30	.27	.21	.21	1								
6	Part-time work (% of full work hours)	.12	.03	−.01	−.05	.02	1							
7	Children (#)	.04	.01	−.06	−.03	.05	−.12	1						
8	Living with partner (0 = no, 1 = yes)	.03	−.04	−.06	.01	−.06	−.09	.22	1					
9	Time pressure at work	.47	.40	.15	.14	.07	.17	.02	.03	1				
10	Job control at work	−.13	−.15	−.13	−.13	−.06	.04	.07	.10	−.08	1			
11	Shift work (0 = no, 1 = yes)	.13	.04	.05	.07	.03	−.02	−.01	−.01	.06	−.21	1		
12	Age	−.04	−.14	.09	.02	−.11	−.12	−.07	.15	.02	.21	−.02	1	
13	Sex (0 = m, 1 = f)	−.01	.09	.06	.14	.02	−.47	−.08	−.05	−.07	−.07	.03	−.06	1

Notes: $N = 3438$. Bold correlation coefficients indicate associations of focus variables in the mediation model. Correlation coefficients <.03 and >.03 are significant ($p < .05$, two-tailed).

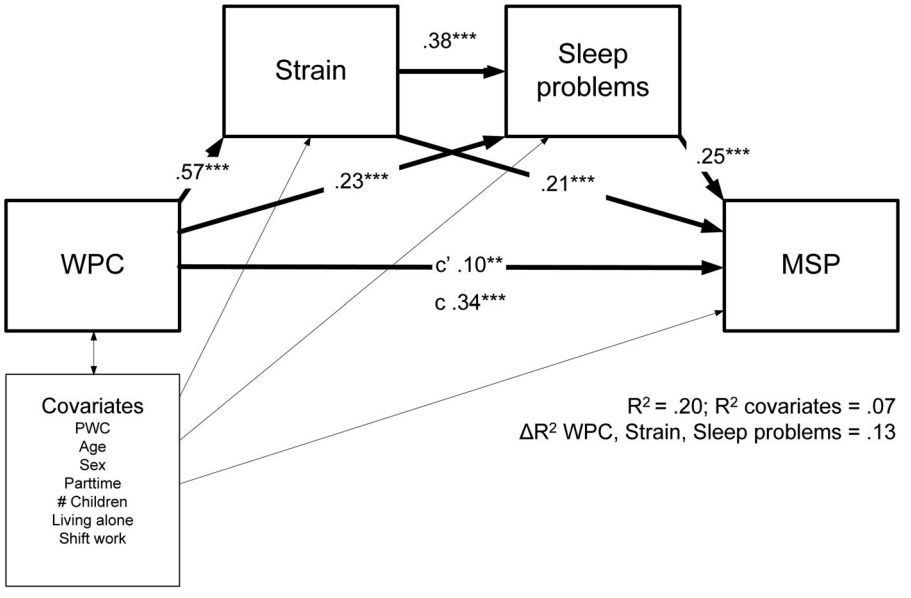

Figure 2. Mediation model of the link between WPC and MSP.

Mediation tests (Hypotheses 2–4)

The model is shown in Figure 2. The indirect path from WPC to MSP via strain was significant ($B = .09$, CI95 = .07 to .11), confirming Hypothesis 2. The other mediation hypothesis (Hypothesis 3) proposed WPC to predict MSP via sleep problems; this indirect path was also significant ($B = .06$, CI95 = .04 to .08). Finally, we proposed mediation via both mediators, that is, WPC predicting MSP via both strain and sleep problems (Hypothesis 4); that indirect path was also significant ($B = .04$, CI95 = .03 to .05). The variance in MSP that was explained by covariates was $R^2 = .10$. The mediation model consisting of WPC, strain, and sleep problems added considerably to the explanation of variance ($\Delta R^2 = .10$).

Mediation in older, compared to younger participants (Hypothesis 5)

Total mediation was not stronger for older as compared to younger participants (Figure 3). The test for differences in indirect path regression coefficients yielded no significant difference ($t(3,414) = -0.67$, $p = .255$).

Mediation in participants doing shift work, compared to participants who do not (Hypothesis 6)

Total mediation swas not stronger for participants who did shift work as compared to those who did not (Figure 3). The test for differences in independent regression coefficients yielded no significant difference ($t(3,414) = -1.55$, $p = .059$).

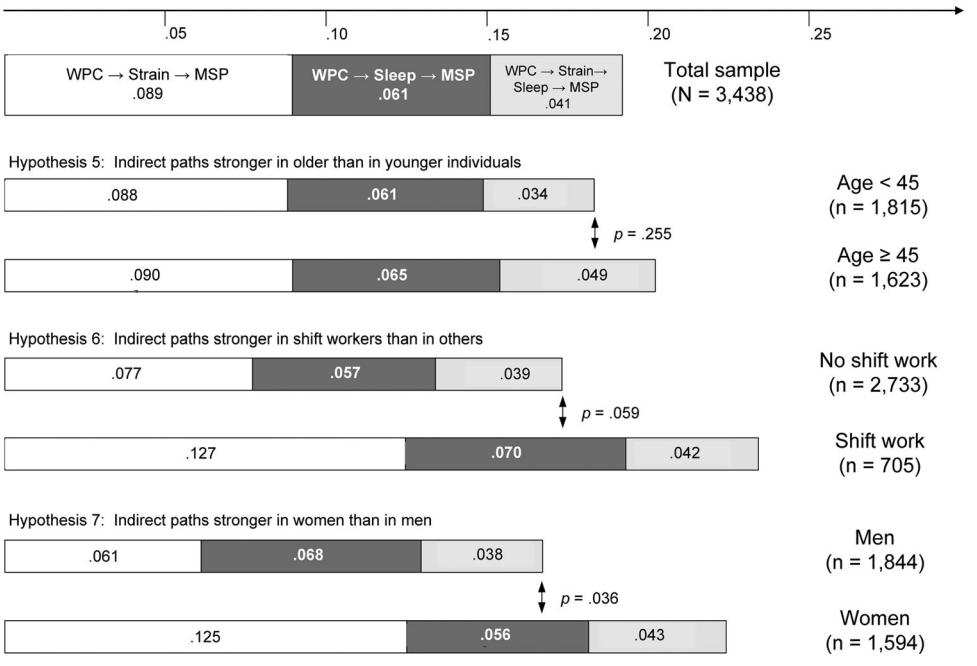

Figure 3. Differences in strength of the indirect paths in men versus women, older versus younger individuals and individuals working in shifts or not. Values are path coefficients.

Mediation in women, compared to men (Hypothesis 7)

As expected (Hypothesis 7), mediation was stronger in women ($B = .22$) than in men ($B = .17$), and the difference was significant ($t(3{,}414) = -1.80$, $p = .036$). As can be seen from Figure 3, the difference was due to a stronger path from WPC to MSP via strain in women as compared to men ($t(3{,}414) = -2.67$, $p = .004$).

Higher order moderated mediation

Figure 4 shows all eight combinations of the supposed moderator subgroups (Age X Shift work X gender). The Weaver and Wuensch (2013) test on differences in indirect path regression coefficients across eight groups indicated significant differences ($\chi^2(7) = 15.01$, $p = .036$, two-tailed). Detailed inspection revealed that mediation was stronger for women aged 45 or older who did shift work than for all seven other groups, which did not differ from each other ($\chi^2(6) = 2.28$, $p = .893$, two-tailed).

Discussion

The current study sought to examine the prediction of MSP by WPC as a work-related stressor. Confirming Hypothesis 1, WPC was positively related to MSP. This result is in line with studies showing that physical and psychosocial work characteristics are likely to enhance MSP (McBeth & Jones, 2007), and it confirms previous findings (Hämmig et al., 2011) showing that Swiss employees with high WPC had the highest risk for pain

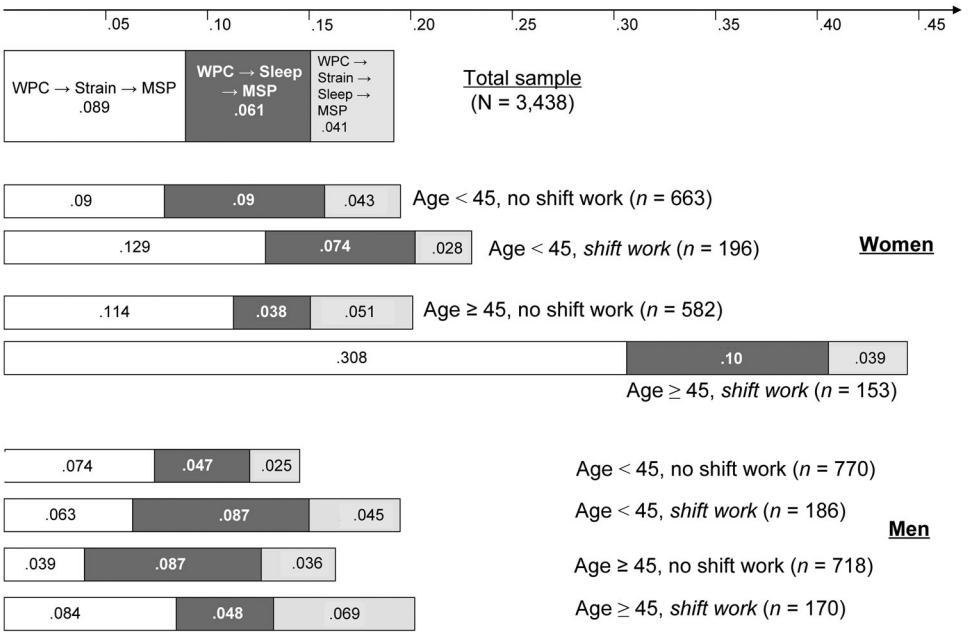

Figure 4. Differences in strength of the indirect paths in subgroups of younger versus older groups of men or women who do or do not work shift schedule.

in the back, shoulder and neck. The relations between WPC and MSP in the current study were moderate or even high – which is surprising because many other risk factors are also known to be involved (Elfering & Mannion, 2008). Our results are in line with those reported by the European Foundation for the Improvement of Living and Working Conditions, who found that only 15.6% of the working population with low WPC suffered from backache, but that this percentage rose up to 53.8% among workers who reported high WPC (Giaccone, 2007).

Nevertheless, one might propose that time pressure and time control are confounding variables that are related to MSP (Elfering et al., 2008) as well as to WPC, and therefore might explain the WPC–MSP relationship. Indeed, Table 1 shows that time pressure and time control (as part of job control) were significantly associated with WPC and MSP. However, mediation was significant although we adjusted for time pressure and job control. Moreover, we controlled for PWC, which further strengthens the inference that WPC acts as a work stressor.

The mediation hypothesis that WPC elicits strain and impairs sleep, and that both processes relate to MSP, was confirmed. Results support the view that WPC threatens recovery after work (Amstad & Semmer, 2009; Demerouti, Bakker, & Sanz-Vergel, 2013). Our study also supported the process model by Geurts and Sonnentag (2006), which postulates incomplete recovery as a link between acute work stressors and the development of health impairments. In addition, evidence is mounting that not only health-related costs, but also performance-related and safety-related costs arise from incomplete recovery after work (Semmer, Grebner, & Elfering, 2010). In addition, the significant path from WPC on sleep problems, which was independent of strain, may indicate a delayed in going to

bed and/or a heightened activity level, and time pressure before going to bed because so many things at home have to be done (see Crain et al., 2014).

Three potential moderators of mediation were analysed. Contrary to our expectation, the paths linking WPC, strain, sleep problems, and MSP were of comparable strength in younger and older participants; this lack of difference was due to the (unexpected) strength of mediation in younger participants. Indeed, we found full mediation in the younger group ($c' = .05$, $p = .179$), but only partial mediation among the older participants ($c' = .16$, $p = .001$). Thus, recovery is a key mediating factor even for young participants. A recent study showed WPC to be higher in individuals aged between 25 and 49 compared to younger and older working individuals (Huffman, Culbertson, Henning, & Goh, 2013). Between ages 25 and 49 individuals have to invest many resources at work and in private life in order to establish their position in professional and private life (Huffman et al., 2013). Indeed, a post-hoc test revealed no difference in mediation for those between 25 and 49 years when compared to the rest of the sample.

Moderated mediation was also not found for shift work; however, shift work was, together with age and gender, involved in a higher order moderated mediation. Women who were older than 45 and who worked shift schedules showed the strongest association between WPC and MSP, which was fully mediated ($c' = 0$). Older individuals are known to adapt more slowly to repeated night shifts than younger individuals, who delay their temperature phase and decreased sleepiness more than the older ones (Härmä, Hakola, Åkerstedt, & Laitinen, 1994). However, in the current study, among men, mediation for older shift workers did not differ for younger ones. There is evidence that self-selection into shift work among men might facilitate coping with changing sleep times because men with less rigid sleeping behaviour patterns are more likely to apply for shift work than men with rigid sleeping patterns (Knutsson & Åkerstedt, 1992). Women may often have to 'opt' for shift work in order to manage responsbilities for child-rearing or relatives or for financial reasons; less self-selection into shift work by women might therefore contribute to gender differences in mediation strength among male and female shift workers. The strength of the mediation in older women working shifts was nearly twice as strong as in the other groups. Whereas other combinations of gender, age, and shift work did not differ in moderated mediation, the stressor-strain-sleep-mediation model of WPC and MSP seems to reflect processes that are important in this subgroup of older women working shifts, perhaps indicating a potential threshold effect for the development of MSP. When individual resources associated with health begin to decline while shift work demands are high, strain and sleep problems relate to health problems, including musculoskeletal problems (Neil-Sztramko, Pahwa, Demers, & Gotay, 2014). Such an interactive cumulative disadvantage of WPC is, for instance, postulated by the 'cumulative advantage and disadvantage' (CAD) model (Dannefer, 2003); it implies that a decline in age-related resources while facing the challenges of shift work is associated with lower health. The CAD model predicts an inequality-generating process across the life course, which depends on key resources or rewards in social life (Dannefer, 2003). Recently, analyses of longitudinal data from the Swiss Household Panel ($N = 2327$ working respondents surveyed from 2004 to 2010) showed WPC moderated self-reported health trajectories over time: Especially the 'exhaustion after work' component within WPC accentuated the divergence of health trajectories, with rather stable health in the better educated, and more rapid decline of health in those with lower education (Cullati, 2014). Gender,

age at baseline and social class at baseline did not moderate health trajectories in these analyses. However, since Cullati (2014) did not test third-order moderation, a gender by age by WPC interaction effect on health trajectories might be present in that study, too.

Women tend to develop musculoskeletal complaints more rapidly than do men when WPC is high (Giaccone, 2007; Hämmig et al., 2009). Possible reasons for women's elevated sensitivity to WPC could be that employed women have to accommodate work and household or child-rearing responsibilities (Giaccone, 2007). This is an important finding, as the labour force participation of women has risen in Western societies; for example, in the USA, participation rates rose from 40% in 1990 up to 62% in 2000, and this percentage has certainly risen since then (Major & Germano, 2006). Looking at the factors that predict WPC, the literature mentions regular overtime, having a variable work schedule, and being in a management position as the most significant predictors for WPC for men. For women, the number of work hours per week, workload, having a variable work schedule and a high job status are strongly associated with WPC. These findings make sense, as the factors mentioned compete with private obligations and require much energy, leading to a role conflict between work and private life (Baltes & Heydens-Gahir, 2003). Gender differences in the association between WPC and health might also depend on the specific health indicator. A recent longitudinal study found that WPC was related to an increased risk for poor self-rated health among women, and problem drinking among men (Leineweber, Baltzer, Magnusson Hanson, & Westerlund, 2013).

Practical implications

In order to reduce WPC, which was found to be a significant predictor of back pain, Major, Klein, and Ehrhart (2002) proposed the implementation of part-time work. As part-time work decreases the number of working hours, conflict between work and privacy should be reduced, which helps to prevent the development of musculoskeletal complaints (van Rijswijk, Bekker, Rutte, & Croon, 2004; Wergeland et al., 2003). However, it has to be considered that working part-time is not a possibility for everyone because families with young children may need the income from full-time work (MacInnes, 2005). According to Morris (2008), there are a variety of further work–life interventions available, and numerous ways to implement them. Adjustments in working time can be additionally achieved by a family-related leave for reasons of sickness or school functions, or by paid time off. Financial assistance is another way to reduce WPC. Financial assistance can include credit unions, flexible spending accounts, or child care subsidies. Community-based programmes, like on-site or near-site childcare and elderly care, can also help prevent WPC. Reduced WPC not only has a positive effect on the employee due to lower levels of perceived stress, physical complaints, and improved job satisfaction and motivation, but also for the organisation, as it increases the productivity through better employee-performance readiness, increased concentration and focus, better teamwork, as well as reduced absenteeism and turnover (Morris, 2008). A recent intervention study that included randomised assignment to intervention groups found that increased schedule control and increased supervisor support for family and personal life significantly reduced WPC (Kelly et al., 2014). Supervisor support seems to be a crucial element, both as a factor in its own right (Kelly et al., 2014; Kossek, Hammer, Kelly, & Moen, 2014), and as

a factor that influences the use of benefits offered by organisations for improving work–family balance (Thompson, Beauvais, & Lyness, 1999).

Limitations

The main limitation of this study is its cross-sectional design. Preferably, the mediation should have been tested on longitudinal data. Longitudinal data would allow comparing the proposed mediation model with the alternative reversed causation model, according to which fatigue or impaired sleep caused by musculoskeletal problems would influence how we evaluate our environment (including WPC). Second, bias from common source variance may have boosted correlations in this study (cf. Semmer, Grebner, & Elfering, 2004). However, in analysing WPC, controlling for PWC also controls for the potential bias from response style (assuming it is the same in both measures of life-domain conflict). Third, the measure of shift work did not distinguish between kinds of shifts, shift rotation, etc. Fourth, the single-item measure of strain might be criticised for a lack of reliability. However, as Wanous, Reichers, and Hudy (1997) showed for job satisfaction, single items can be appropriate when measuring mid-range constructs that might be one-dimensional and can ask for an overall judgement, such as general job satisfaction, health, or stress experience. In line with this reasoning, Littman, White, Satia, Bowen, and Kristal (2006) reported good results for two single-item stress measures. Wanous and Reichers (1996) stated a second reason for the use of single items when face validity is a factor, that is, irritation from respondents regarding redundant items might contribute to a lower acceptance of the questionnaire, a point that is clearly relevant when a representative sample of the total working force is to be gained, as in the current study (see Fisher, Matthews, & Gibbons, 2016). Finally, the time frame of pain questions may have caused memory bias. Many questionnaires on pain address periods of time that seem to be rather large. On the other hand, weekly pain reports agree rather well with retrospective pain reports over several months (Brauer, Thomsen, Loft, & Mikkelsen, 2003). The wording of pain questions can be criticised for including the word 'troubles' which may not precisely characterise pain but dysfunction.

The study has strengths as well. First, the sample is representative for a countrie's working population. Second, the mediation chain investigated went beyond analyses that focus on one or the other mediator (i.e. strain or sleep), and it included analayses of moderated mediation.

Conclusion

The mediation effects we found confirmed that strain and sleep problems are very likely involved in processes that relate WPC and MSP. Our findings confirmed the view of Rook and Zijlstra (2006) that studies should investigate work, leisure, and sleep in order to understand the effects of work stressors on individual health.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The research reported in this article was supported by the Swiss Health Promotion Foundation.

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