

RESEARCH ARTICLE

Short-term Effects of Social Exclusion at Work and Worries on Sleep

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Abstract

The present study investigated short-term effects of daily social exclusion at work on various indicators of sleep quality and tested the mediating role of work-related worries using a time-based diary study with ambulatory assessments of sleep quality. Ninety full-time employees participated in a 2-week data collection. Multilevel analyses revealed that daily workplace social exclusion and work-related worries were positively related to sleep fragmentation in the following night. Daily social exclusion, however, was unrelated to sleep onset latency, sleep efficiency and self-reported sleep quality. Moreover, worries did not mediate the effect of social exclusion at work on sleep fragmentation. Theoretical and practical implications of the results are discussed. Copyright © 2012 John Wiley & Sons, Ltd.

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Keywords

social exclusion; worries; sleep quality; ambulatory assessment

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Introduction

It is well recognized that occupational stress has become a major problem in modern organizations (Kompier, 2006) and that occupational stress may lead to ill health in the long run (cardiovascular disease, Belkic, Landsbergis, Schnall, & Baker, 2004, and burnout, Schaufeli & Bakker, 2004). Impaired recovery has been considered one of the critical links between acute reactions to daily stressors and the development of chronic health impairments (Geurts & Sonnentag, 2006). On the basis of the idea that sleep plays a particularly prominent role in the recovery process, previous research has examined sleep in the context of work stressors and ill health. In line with this assumption, various studies have shown that work-related stress is negatively related to sleep quality (Åkerstedt et al., 2006) and that disturbed sleep is positively linked to psychological and physiological health impairments (Drake, Roehrs, Richardson, Walsh, & Roth, 2004). However, four important limitations of previous research about the relationship between work stressors and sleep need to be addressed. Firstly, previous research used mainly cross-sectional designs (Åkerstedt et al., 2004), which strongly limits insight into the direction of the proposed effects. Secondly, most studies focused on chronic work conditions over fairly long periods of time as opposed to investigating episodic and immediate effects of work stressors (Åkerstedt, Fredlund, Gillberg,

& Jansson, 2002; Åkerstedt, Knutsson, et al., 2002). Third, the majority of studies focused on workload as a stressor and other important stressors, such as stressful interpersonal relationships at work, have been neglected (Åkerstedt, Fredlund, et al., 2002; Åkerstedt, Knutsson, et al., 2002). Finally, research has paid little attention to the mechanism of how work stressors may lead to sleep problems while collecting physiological indicators of sleep quality (Sonnentag, Binnewies, & Mojza, 2008). To address these issues, we examined short-term effects of daily social exclusion at work on various indicators of sleep quality and tested the mediating role of work-related worries using a time-based diary study with ambulatory assessments of sleep quality.

Work stressors and sleep

Recovery as a 'process of psychophysiological unwinding after effort expenditure' (Geurts & Sonnentag, 2006, p. 248) is considered a vital link between reactions to stressful work characteristics and the development of health impairments in the long run (Geurts & Sonnentag, 2006). In line with this assumption, several studies have demonstrated that work stressors are associated with cardiovascular diseases (Belkic et al., 2004), burnout (Schaufeli & Bakker, 2004) and various psychosomatic health complaints (Mikkelsen & Einarsen, 2002). As a central part of recovery, sleep quality is said to be

important in preventing long-term negative effects of stress on health. Poor sleep quality, including fragmented sleep (increased amount of awakenings), inefficient sleep (reduced percentage of time spent sleeping) and increased sleep onset latency (increased time needed to fall asleep), has been associated with a variety of negative consequences, including health impairments such as elevated risk of myocardial infarction, coronary heart disease, muscle pain, headaches and gastrointestinal problems (Kuppermann et al., 1995; Schwartz et al., 1999). The causes of low sleep quality are various; however, evidence is increasing that work stress may play an important role in the development of disturbed sleep quality. According to the effort-recovery theory (Meijman & Mulder, 1998), work stressors cause normally short-lived and fully reversible physiological load reactions. Under certain circumstances, however, e.g. when the individual is confronted with particularly stressful work conditions, the recovery process may be incomplete (Geurts & Sonnentag, 2006). As a consequence of incomplete recovery, short-term work-related load reactions may turn into adverse and more chronic problems, such as prolonged fatigue, chronic tension and sleep impairments (Åkerstedt, 2006; Härmä, 2006; Sluiter, Frings-Dresen, van der Beek, & Meijman, 2001; Van Hooff et al., 2005). For a long time, the field of work stress has been dominated by a few prominent models, particularly the Demands–Control model (Karasek & Theorell, 1990). Accordingly, studies about the effect of workload and decision latitude are numerous, and sleep quality has often been studied as an outcome of workload. In two cross-sectional studies, Åkerstedt and colleagues showed that high work demands and low decision latitude were related to disturbed sleep (Åkerstedt, Fredlund, et al., 2002; Åkerstedt, Knutsson, et al., 2002; Åkerstedt et al., 2004). Interestingly, although interpersonal stressors are considered as particularly stressful (Bolger, DeLongis, Kessler, & Schilling, 1989) and although they seem to be particularly important for the development of ill health (Zapf & Frese, 1991), relatively little research has examined the role of interpersonal stressors at work over a long period. In the present study, we focused on social exclusion at work as a specific type of interpersonal stressor.

Social exclusion at work

Social exclusion at work may take many forms, including giving someone the ‘silent treatment’, ignoring them and outright rejection (Leary, 2001). Drawing on the definition of workplace ostracism (Hitlan, Clifton, & DeSoto, 2006) and on previous work by Leary (2001), we define workplace social exclusion as the general perception of an individual of being excluded, rejected or ignored by another individual at the workplace that hinders their ability to establish or maintain positive interpersonal relationships.

Most studies investigating the consequences of social exclusion on well-being used experimental study designs

with students as participants (Twenge, Baumeister, Tice, & Stucke, 2001; Williams, 1997; Williams & Jarvis, 2006). Relatively little attention was given to workplace social exclusion, however, with the exception of Hitlan et al. (2006) and Ferris, Brown, Berry, and Lian (2008) who showed in cross-sectional studies that chronic workplace social exclusion is related to impaired psychological health.

One explanation for the strong and harmful effects of social exclusion on individuals is offered by the need-to-belong theory (Baumeister & Leary, 1995). In accordance with this theory, human beings have a pervasive drive to form and maintain positive and significant interpersonal relationships. According to our definition, social exclusion at work prevents individuals from establishing or maintaining positive interpersonal relationships. Besides the drive to form and maintain positive interpersonal relationships, a positive self-evaluation and a positive evaluation by others are strong motives for individuals (Epstein, 1998). Accordingly, threats to social esteem play a major role in the experience of stress (Lazarus, 1999; see also the concept of ‘Stress as Offense to Self’ (SOS) by Semmer, Jacobshagen, Meier, and Elfering, 2007).

By thwarting belonging and self-esteem goals, workplace social exclusion promotes a variety of negative emotions (e.g. anxiety) as well as several psychological and somatic health complaints (Baumeister, DeWall, Ciarocco, & Twenge, 2005; Baumeister & Leary, 1995). Ferris et al. (2008) and Hitlan et al. (2006) showed that workplace social exclusion is related to impaired psychological well-being, e.g. anxiety and depression. Moreover, Cacioppo et al. (2002) showed that lonely individuals evince poorer sleep quality. Furthermore, workplace bullying, which often includes acts of social exclusion, has also been associated with disturbed sleep quality (Niedhammer, David, Degioanni, & Drummond, 2009).

In sum, there is some evidence that chronic social exclusion and isolation may lead to impaired health and poor sleep quality. In the following section, we explain why worries about work might mediate the influence of work stressors in general and social exclusion in particular on sleep.

Worries about work

Previous research suggests that individuals faced with stressful work conditions take longer to unwind physiologically, because they fail to switch off cognitively and engage in more ruminative thinking after work (Brosschot, Gerin, & Thayer, 2006; Cropley & Purvis, 2003). Worries refer to unproductive, repetitive thought processes (Muris, Roelofs, Meesters, & Boomsma, 2004). Worries can be defined as a chain of thoughts and images that are negatively affect-laden and relatively uncontrollable. Worries further represent the attempt to engage in mental problem solving of an issue whose outcome is uncertain but which embraces

the possibility of a negative end. Thus, worries are closely related to the fear process (Borkovec, Ray, & Stöber, 1998). Worries have a preparatory function, anticipating stress and making the organism ready for a stressful situation by maintaining or activating physiological parameters (Brosschot et al., 2006). Worries are a common response to stress at work serving as a stressor in itself and mediating the effects of psychosocial stressors on health (Brosschot et al., 2006). Thus, worries cover the immediate psychosocial and physiological components of daily stressors in prolonged physiological activation. By anticipating and prolonging physiological reactions to stress, worries can harm sleep quality (Brosschot, van Dijk, & Thayer, 2007). In other words, when faced with stressors such as social exclusion at work, individuals may start to worry about their work situation, which hinders a cognitive switch-off and in a last step harms sleep quality. There is already some research on work stress, worries and sleep quality. Åkerstedt, Fredlund, et al. (2002) and Åkerstedt, Knutsson, et al. (2002) examined the multivariate relationship between disturbed sleep and different work-related and lifestyle factors. In a cross-sectional study, they concluded that the inability to stop worrying during free time may be an important link in the relation between stress and sleep impairments. Although informative regarding chronic stressors, this research says nothing about the effect of daily stressors. In general, knowledge on the short-term effects of daily stressors at work and sleep quality still lacks clarity. There is a need for more research about the existing mechanisms in relation to day-to-day work-related stressors, worries and physiological parameters of sleep quality in naturalistic settings (Åkerstedt, Kecklund, & Axelsson, 2007; Brosschot et al., 2007; Intille et al., 2003).

Short-term effects of episodic social exclusion at work

Most studies investigating the effect of work stressors on recovery focus on chronic work conditions over fairly long periods of time as opposed to investigating episodic and immediate effects of work stressors. Such studies do not directly link specific work conditions with sleep quality but rather test whether people who report high work stressors experience lower sleep quality months to years later. In contrast, short time-frames link work conditions and sleep quality more closely. Even though daily and discrete work stressors have been neglected for so long, it is reasonable to assume that daily social exclusion at work has immediate effects. These effects may be short-lived, but they may also affect after-work time by spilling over into the evening, thereby impairing recovery processes such as sleep (Cropley, Dijk, & Stanley, 2006). As Geurts and Sonnentag (2006) argue, recovery is considered a vital link in the development of ill health, and according to Cropley et al. (2006), sleep is one of the most important

recovery mechanisms available to humans. Thus, to prevent the development of health impairments in the long run, it is particularly necessary to study the short-term effects of work stressors on sleep.

The present research

In this research, we examined the short-term effects of social exclusion at work on sleep quality and tested whether worries about work mediate the negative effect of social exclusion on sleep quality. Although sleep quality is an accepted construct, it represents a complex phenomenon that is difficult to define and measure objectively (Buysse, Reynolds, Monk, Berman, & Kupfer, 1988). Sleep quality includes a variety of aspects, such as sleep onset latency, sleep efficiency and sleep fragmentation, and also includes more purely subjective aspects. Although there are several methods available for studying sleep quality, most studies on work stress and sleep concentrate on only one sleep parameter or rely only on subjective sleep quality reports. Because the exact elements that compose sleep quality and their importance may vary between individuals and the type of study performed, it is important to measure sleep quality in a broad sense. In our study, we therefore used three different parameters to assess sleep quality objectively, namely sleep onset latency, sleep efficiency and sleep fragmentation. To further triangulate the measure of sleep quality, we also measured subjective sleep quality. Thus, the present research extends previous studies on work stressors and sleep in several ways. Firstly, in contrast to most previous research that used cross-sectional study designs and focused on chronic work conditions, we used data from a time-based diary study over 2 weeks and tested short-term effects of daily and discrete work stressors on sleep. Secondly, we used a multifaceted sleep quality measure including objective and subjective sleep quality indicators. Thirdly, we extended previous research by examining the effect of social exclusion at work, a work stressor that has been neglected in previous occupational stress research. Fourthly, by testing the mediating role of worries, we examined the potential mechanism of how daily work stressors may harm sleep quality. In sum, we tested three hypotheses. Daily workplace social exclusion (Hypothesis 1) and daily worries (Hypothesis 2) are positively related to impaired sleep quality during the following night. The effect of daily workplace social exclusion on sleep quality is mediated by work-related worries (Hypothesis 3) (see Figure 1).

Material and methods

Participants and design

Participants were recruited via personal advertisement by three Master's degree students. As compensation for participants' time and to encourage participation, we offered them individual feedback about their work situation and well-being at the end of the study.

After participants gave their consent to participate, survey packages were handed that included instructions about the use of the daily surveys and the ambulatory assessment, as well as a general questionnaire, diary booklets and the Sensewear Armband. In face-to-face meetings, research assistants instructed participants to fill in the general questionnaire before the diary study began and to fill in diaries daily over two consecutive working weeks: before going to work, after quitting the workplace and before going to bed. Furthermore, participants were instructed to wear the ambulatory assessment device continuously. To ensure participants' anonymity and to match the collected data, participants were asked to fill in a personal code on the questionnaire and the diaries. At the end of the study, survey packages were collected by the same research assistants.

Participants first completed a general questionnaire to assess demographic variables. At the beginning of the following week, participants began completing time-based daily surveys and using continuous ambulatory assessment for two consecutive working weeks (including weekends). Only data from work days were included in the analysis, however.

Materials

General questionnaire

Before diary measures started, participants filled in a general questionnaire including questions about demographic background, e.g. gender and age, chronic social exclusion at work, shift work and employment rate.

Diary

Time-based diaries were used to assess daily workplace social exclusion, daily worries and daily self-reported sleep quality. Participants completed diaries three times a day: before going to work, shortly after leaving the workplace and before going to sleep. Self-reported sleep quality was assessed in the morning, workplace social exclusion was assessed shortly after departure from the workplace and worries were assessed before going to sleep.

Workplace social exclusion

Ratings on workplace social exclusion were scored on a seven-item scale based on Leary, Tambor, Terdal, and Downs (1995). The scale used statements such as 'Today at work, I felt like an outsider' or 'Today at work, I had the impression that others avoided me'. The items were scored on a five-point scale ranging from *strongly disagree* (1) to *strongly agree* (5). Internal consistency was 0.80 (range 0.76–0.85).

Worries

Work-related worries during the evening were measured with five items. The items used were 'Today, after leaving work, I worried about making mistakes at work', 'Today, after leaving work, I worried about experiencing

unpleasant interpersonal situations at work', 'Today, after leaving work, I worried about making myself unpopular at work', 'Today, after leaving work, I worried that everything would go wrong at work', 'Today, after leaving work, I worried about being excluded at work'. The items were scored on a five-point scale ranging from *strongly disagree* (1) to *strongly agree* (5). Internal consistency was 0.82 (range 0.81–0.87).

Subjective sleep quality

In the morning, sleep quality was measured by a single item from the measure devised by Buysse et al. (1988): 'How would you evaluate this night's sleep?' The response format ranged from *very bad* (1) to *very good* (4).

Sleep actigraphy

The use of activity-based sleep assessment has gained considerable attention among sleep researchers. The cost-effectiveness of actigraphs and the opportunity to conduct longitudinal daily naturalistic studies of the sleep-wake system, as well as the reliability and the clinical validity of the method, may well lead to the increased use of actigraphs (Otte, Payne, & Carpenter, 2011). The term actigraphy refers to the use of miniature computerized devices to monitor and collect sleep data generated by movements (Sadeh & Acebo, 2002). The actigraph used in the present study was Body Media's Sensewear Armband. The Sensewear Armband is a multi-accelerometer device similar to a regular actigraph. Every minute, twin-axis oscillometric sensors assess body movements, surface body temperature, galvanic skin response and heat flux. The collected data were analysed with BodyMedia software. This software estimates sleep phases and wake phases using computer algorithm-defined thresholds of activity, and hence, sleep onset latency, sleep efficiency and sleep fragmentation as indicators of disturbed sleep quality can be derived (Littner et al., 2003). BodyMedia's sleep algorithm was developed using techniques from statistical machine learning (Germain, Buysse, & Kupfer, 2006). The algorithm created is based on the principle that there are reduced movements during sleep phases and increased movements during wake phases (Sunseri et al., 2011). In a study by Germain et al. (2006), the algorithm correctly identified 93% of all sleep epochs and 83% of all wakefulness epochs. Thus, the algorithm can be accepted as reliable.

Participants wore the armband on the non-dominant arm throughout the entire study participation. The actigraph could be removed when they took a shower. Otherwise, the actigraphs were worn continuously for 24-h periods without removal for 2 weeks. Naps during the day were not included in the analysis, so we only included the data of recorded nights.

In our study, we used several indicators such as sleep onset latency, sleep efficiency and sleep fragmentation during the night as indicators of disturbed sleep quality. Sleep onset latency was coded as the time

participants needed to fall asleep after going to bed. Sleep efficiency is defined as the percentage of time spent asleep between sleep onset and last awakening in the morning. Additionally, we coded sleep fragmentation as the number of awakenings that lasted 5 min or longer and that were preceded and followed by at least 15 min of uninterrupted sleep (see Sadeh, Keinan, & Daon, 2004). We controlled our data for inaccurate measures (participants taking off the actigraphs or malfunction of the actigraphs) by evaluating visual graphs produced by the software and by evaluating the exported Excel tabs and coded them as missing data.

Control variables

Because activity amounts differ depending on age and gender (Åkerstedt, Fredlund, et al., 2002; Åkerstedt, Knutsson, et al., 2002), we entered age and gender as control variables in the analyses. During their study participation, participants reported no night shifts. Because shift work has a negative effect on sleep in general, we controlled for whether participants sometimes had shift work on person level. Furthermore, employment rate (full time versus part time) was also entered as a control variable on person level. Use of medication and alcohol consumption were entered as control variables in the analyses on daily level. Use of medicaments was assessed with the single item: 'Did you use any medicaments today?' Participants could answer with *no* (0) or *yes* (1). Alcohol consumption was assessed using the single item: 'Did you consume alcohol today?' to which the participants could answer *no* (0) or *yes* (1). To take into account between-persons differences, we also controlled for chronic social exclusion at work, which was measured with the general questionnaire. We used the same scale as for the daily measures (Leary et al., 1995); however, this time, the statements referred to more enduring, chronic social exclusion ('In general, I feel like an outsider at work'). Internal consistency was 0.68. Moreover, we controlled for the preceding measure of the outcome variable (autocorrelation; sleep quality of the previous day). Finally, because the number of awakenings is likely to increase depending on the time spent asleep, we included sleep duration of each night in the analysis to assess the number of awakenings in relation to total sleeping time.

Ethics commission

The study was performed in consensus with the recommendations of the Declaration of Helsinki (World Medical Association, 2008) and was approved by the local ethics commission.

Procedure/analysis

Because the daily data (Level 1) were nested within persons (Level 2), we computed multilevel analysis using the HLM 6.08 program (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004). The focus of the analyses was the within-persons relationships between social

exclusion, worries and sleep impairments. With the exception of use of medication and alcohol consumption, which were dichotomous and were not centred, all Level 1 variables were group-mean centred. Thus, the effects of these variables can be interpreted relative to the persons' own mean across all days. Additionally, we also examined whether chronic level of social exclusion is related to sleep quality by including chronic social exclusion at work as a Level 2 (between-persons) predictor. The Level 2 variables' general social exclusion at work and age were grand-mean centred. Gender, shift work and full versus part time employment, which were dichotomous, were not centred. Sample size on Level 1 was between 819 (for sleep efficiency) and 966 (for use of medicaments); the sample size of Level 2 with 90 was nearly double the recommended minimum sample size of 50 (Maas & Hox, 2008). Owing to missing values, the size on Level 1 varies for the different variables. Note that one advantage of multilevel analysis over some Ordinary Least Squares (OLS) techniques is that it allows a varying number of observations (i.e. missing data). We used restricted maximum-likelihood procedure to estimate the parameters. Because the hypotheses were directional, one-tailed tests were used. Note that unstandardized coefficients are reported.

Results

The final sample consisted of 90 employees of several Swiss organizations. Participants held a variety of jobs, but most of them were employed in service jobs, e.g. as secretaries, nurses, call-centre agents. All participants had in common that they were employed in organizations constructed by teams of supervisors and colleagues. None of the participants had night shifts during their study participation. Of the participants, 37% were male; 18% of the participants had completed primary education (9 years), 47% had completed secondary education and 35% held a college or university degree. Average job tenure was about 5 years ($SD = 6.04$). Most participants worked full time. Means and standard deviations for the measures are presented in Table I. Before testing our hypotheses, we calculated Null Models to estimate the proportion of variance in the variables accounted for at the day and person level, respectively (Nezlek, 2001). The intraclass correlation obtained was 0.55 for social exclusion, 0.65 for worries, 0.80 for sleep fragmentation, 0.87 for sleep onset latency, 0.68 for sleep efficiency and 0.76 for daily self-reported sleep quality.

To test if social exclusion was negatively related to sleep quality during the following night (Hypothesis 1), we conducted separate multilevel regression analyses for the four indicators of sleep quality (see Tables II–V): Sleep onset latency, sleep efficiency, sleep fragmentation and self-reported sleep quality were regressed on social exclusion. In line with our assumption, social exclusion was positively related to sleep fragmentation ($\gamma = 0.23$, $p < 0.05$) in the following night. Unexpectedly, however, social exclusion was unrelated to sleep onset latency

Table 1. Descriptive statistics among the study variables

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
General measures (Level 2)																
1 Sex ^a	0.37	—	—	0.09	-0.15 [†]	0.30**	-0.02	-0.15 [†]	0.21	0.27**	0.19*	-0.08	-0.16 [†]	-0.13	0.05	0.05
2 Age	33.79	12.68	—	—	0.01	-0.32**	0.39**	-0.13	0.05	-0.12	0.12	0.00	-0.10	0.01	0.08	0.10
3 Shift work ^b	0.20	—	—	—	—	0.07	0.04	-0.06	-0.31**	-0.08	-0.03	0.16 [†]	-0.27**	-0.10	-0.03	-0.13
4 Employment rate ^c	0.78	0.42	—	—	—	—	-0.15 [†]	-0.09	0.02	-0.11	0.06	0.16 [†]	-0.26**	-0.10	0.01	-0.08
5 Social exclusion	1.37	0.44	—	—	—	—	—	-0.05	0.20*	0.01	-0.05	0.16 [†]	-0.16 [†]	-0.10	0.15 [†]	0.51**
Daily measure (Level 1)																
6 Medicaments ^d	0.03	—	—	—	—	—	—	—	-0.06	-0.01	-0.08	0.07	0.11	0.08	0.01	-0.12
7 Alcohol use ^e	0.15	—	—	—	—	—	—	-0.02 [†]	—	-0.08	0.21*	-0.04	0.12	-0.22*	-0.02	0.07
8 Sleep duration	6.41	1.73	—	—	—	—	-0.01	-0.06**	-0.06**	—	-0.12	0.15 [†]	0.41**	0.08	0.10	-0.04
9 Sleep fragmentation	1.32	1.33	—	—	—	—	-0.04	-0.04	-0.03	0.11**	—	0.07	-0.38**	-0.04	-0.09	-0.15 [†]
10 Sleep onset latency	12.91	15.03	—	—	—	—	0.05	-0.09**	-0.03	-0.03	-0.06*	—	-0.44**	-0.02	0.15 [†]	-0.08
11 Sleep efficiency	79.10	10.86	—	—	—	—	-0.10*	0.05 [†]	0.05 [†]	-0.38**	0.17**	0.03	—	0.17 [†]	-0.01	0.06
12 Sleep quality	3.10	0.74	—	—	—	—	-0.05	-0.01	-0.01	-0.09*	-0.03	-0.05 [†]	0.07 [†]	—	-0.11	-0.13
13 Worries	1.18	0.42	—	—	—	—	-0.02 [†]	-0.11**	-0.11**	-0.03	0.03	-0.01	-0.03	-0.00	—	0.51**
14 Social exclusion	1.21	0.43	—	—	—	—	-0.00	0.03	0.03	-0.02	0.05*	-0.02	0.01	0.02	0.24**	—

Note: Correlations below the diagonal are day-level correlations (N = 966). Correlations above the diagonal are person-level correlations (N = 90).

^a0 = female, 1 = male.

^b0 = no shift work, 1 = shift work.

^c0 = part time, 1 = full time.

^d0 = no medicaments, 1 = medicaments.

^e0 = no alcohol, 1 = alcohol.

***p* < 0.01; **p* < 0.05; [†]*p* < 0.10.

Table II. Multilevel estimates for models predicting sleep fragmentation

Variables	Null model		Model 1		Model 2		Model 3		Mediation	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	1.33**	0.07	1.22**	0.14	1.25**	0.16	1.23**	0.14	1.26**	0.16
Level 2 variables										
Sex ^a			0.28*	0.16	0.19	0.17	0.26 [†]	0.16	0.20	0.17
Age			0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Shift work ^b			0.11	0.20	0.27	0.22	0.09	0.20	0.27	0.22
Employment rate ^c			0.02	0.16	-0.03	0.18	0.02	0.16	-0.04	0.18
Social exclusion			-0.14	0.16	-0.00	0.17	-0.13	0.17	0.09	0.18
Level 1 variables										
Alcohol use ^d			0.07	0.15	-0.03	0.22	0.07	0.15	-0.02	0.21
Medicaments ^e			-0.29	0.30	-0.40	0.43	-0.30	0.30	-0.42	0.42
Sleep duration			0.11**	0.03	0.06 [†]	0.05	0.11**	0.03	0.07 [†]	0.05
Autocorrelation ^f			-0.05	0.04	-0.07 [†]	0.06	-0.05 [†]	0.04	-0.08 [†]	0.06
Social exclusion					0.23*	0.13			0.24*	0.13
Worries							0.23*	0.12	0.13	0.17

Note. Unstandardized coefficients are reported.

^a0 = female, 1 = male.

^b0 = no shift work, 1 = shift work.

^c0 = part time, 1 = full time.

^d0 = no alcohol, 1 = alcohol.

^e0 = no medicaments, 1 = medicaments.

^fSleep fragmentation previous night.

** $p < 0.01$; * $p < 0.05$; [†] $p < 0.10$, one-tailed.

Table III. Multilevel estimates for models predicting sleep onset latency

Variables	Null model		Model 1		Model 2		Model 3	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	12.89**	0.76	11.78**	1.84	9.78**	1.56	11.85**	1.86
Level 2 variables								
Sex ^a			-2.53 [†]	1.68	-3.44	1.62	-2.11	1.71
Age			0.02	0.07	0.01	0.01	0.00	0.07
Shift work ^b			-2.46 [†]	1.64	-2.18 [†]	1.74	-2.47 [†]	1.67
Employment rate ^c			3.77*	2.08	5.90**	1.85	3.50*	2.10
Social exclusion			2.54	2.02	3.14*	1.89	3.16 [†]	2.24
Level 1 variables								
Alcohol use ^d			-3.26*	1.47	-2.64 [†]	1.65	-3.39*	1.46
Medicaments ^e			2.34 [†]	2.90	2.58	4.90	4.37 [†]	2.85
Autocorrelation ^f			-0.12**	0.03	-0.13**	0.05	-0.12**	0.03
Social exclusion					0.30	2.41		
Worries							-0.80	1.00

Note. Unstandardized coefficients are reported.

^a0 = female, 1 = male.

^b0 = no shift work, 1 = shift work.

^c0 = part time, 1 = full time.

^d0 = no alcohol, 1 = alcohol.

^e0 = no medicaments, 1 = medicaments.

^fSleep onset latency previous night.

** $p < 0.01$; * $p < 0.05$; [†] $p < 0.10$, one-tailed.

($\gamma = 0.30, p > 0.05$), sleep efficiency ($\gamma = -0.31, p > 0.05$) and self-reported sleep quality ($\gamma = 0.04, p > 0.05$). Thus, our first hypothesis was only partially supported.

To test if work-related worries in the evening are negatively related to sleep quality (Hypothesis 2), sleep onset latency, sleep efficiency, sleep fragmentation and

Table IV. Multilevel estimates for models predicting sleep efficiency

Variables	Null model		Model 1		Model 2		Model 3	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	18.65**	0.68	14.51**	1.37	13.08**	1.30	14.55**	1.38
Level 2 variables								
Sex ^a			1.98 [†]	1.49	1.55*	1.62	2.19 [†]	1.54
Age			0.05 [†]	0.06	0.12*	0.07	0.05	0.06
Shift work ^b			4.45**	1.60	3.64*	1.64	4.35**	1.63
Employment rate ^c			3.02*	1.75	3.90*	1.75	3.00*	1.77
Social exclusion			2.33 [†]	1.45	2.46 [†]	1.73	2.93 [†]	1.58
Level 1 variables								
Alcohol use ^d			2.22**	0.89	1.43	1.64	2.02*	0.91
Medicaments ^e			-5.78**	1.57	-4.74**	1.79	-5.80**	1.56
Autocorrelation ^f			0.03	0.03	0.13**	0.04	0.03	0.04
Social exclusion					-0.31	1.52		
Worries							-1.45*	0.72

Note. Unstandardized coefficients are reported.

^a0 = female, 1 = male.

^b0 = no shift work, 1 = shift work.

^c0 = part time, 1 = full time.

^d0 = no alcohol, 1 = alcohol.

^e0 = no medicaments, 1 = medicaments.

^fSleep efficiency previous night.

** $p < 0.01$; * $p < 0.05$; [†] $p < 0.10$, one-tailed.

Table V. Multilevel estimates for models predicting self-reported sleep quality

Variables	Null model		Model 1		Model 2		Model 3	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	3.08**	0.05	3.19**	0.11	3.20**	0.12	3.15**	0.11
Level 2 variables								
Sex ^a			-0.17*	0.09	-0.22*	0.11	-0.17	0.09
Age			0.00	0.00	0.00	0.00	0.00	0.00
Shift work			-0.08	0.11	-0.14	0.13	-0.05	0.12
Employment rate			0.03	0.12	0.17	0.15	0.05	0.12
Social exclusion			-0.19*	0.10	-0.19*	0.11	-0.26**	-0.11
Level 1 variables								
Alcohol use			-0.07	0.08	-0.13	0.12	-0.08	0.08
Medicaments			-0.17	0.33	0.09	0.29	0.04	0.28
Autocorrelation			-0.80*	0.04	-0.12*	0.06	-0.10*	0.05
Social exclusion					0.04	0.15		
Worries							-0.05	0.06

Note. Unstandardized coefficients are reported.

^a0 = female, 1 = male.

^b0 = no shift work, 1 = shift work.

^c0 = part time, 1 = full time.

^d0 = no alcohol, 1 = alcohol.

^e0 = no medicaments, 1 = medicaments.

^fSelf-reported sleep quality previous night.

** $p < 0.01$; * $p < 0.05$; [†] $p < 0.10$, one-tailed.

self-reported sleep quality were regressed on worries. In line with our assumption, worries were positively related to sleep fragmentation ($\gamma = 0.23$, $p < 0.05$) and to sleep efficiency ($\gamma = -1.45$, $p < 0.05$) in the following

night. Unexpectedly, however, worries were unrelated to sleep onset latency ($\gamma = -0.80$, $p > 0.05$) and self-reported sleep quality ($\gamma = -0.05$, $p > 0.05$). Thus, our second Hypothesis was only partially supported.

Next, we examined whether the effect of workplace social exclusion on sleep quality is mediated by worries about work. Because social exclusion was only related to sleep fragmentation, we only examined this relationship in detail. According to Baron and Kenny (1986, p. 1176), a mediation has to meet the following conditions: '(a) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., Path a), (b) variations in the mediator significantly account for variations in the dependent variable (i.e., Path b), and (c) when Paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant (. . .)'. To test the first condition, we examined the effect of workplace social exclusion on worries (Path a). In line with our assumption, workplace social exclusion was positively related to worries ($\gamma = 0.29$, $p < 0.05$). The second condition concerns the effect of worries on sleep fragmentation (Path b). As noted above and in line with our assumption (Hypothesis 2), worries were positively related to sleep fragmentation. To test the third condition, we used a model with both social exclusion and worries as predictors. In this analysis, worries (i.e. mediator) were no longer significant ($\gamma = 0.13$, $p > 0.05$; see Table II). Moreover, the indirect effect of daily social exclusion via daily worries on sleep fragmentation—calculated with the Sobel test tool devised by Preacher and Leonardelli (2012)—was not significant ($z = 0.74$, $p > 0.05$). Thus, worries did not mediate the effect of social exclusion at work on sleep fragmentation (see Figure 2). Hence, our third hypothesis was not supported.

Notably, although it was not the focus of the hypotheses, which were on daily processes, there were additional significant associations of chronic social exclusion at work with sleep parameters. In multilevel regression models, chronic social exclusion at work was positively associated with sleep onset latency ($\gamma = 3.16$, $p < 0.10$) and negatively associated with self-reported sleep quality ($\gamma = -0.26$, $p < 0.01$).

Discussion

The goal of the present study was to contribute to the literature on recovery by investigating the neglected effects of episodic social exclusion at work within a diary study and to contribute to the understanding of the mechanisms involved in the relation between daily work stressors and sleep. Multilevel regression analyses

revealed that both daily workplace social exclusion and daily worries were positively related to fragmented sleep in the following night and that worries were negatively related to sleep efficiency. Contrary to our expectation, however, daily social exclusion at work and worries was not related to other sleep quality parameters, neither could we find any support for the idea that the effect of daily workplace social exclusion on sleep quality is mediated by worries.

We assumed that daily and discrete work stressors such as episodes of social exclusion at work might spill over into the evening and impair recovery processes and sleep quality. Geurts and Sonnentag (2006) argued that recovery is a vital link in the development of ill health. Thus, to prevent the development of more health impairments, it is important to study short-term effects of work stressors and their persistence after work.

The present study adds knowledge to the recent findings of Hitlan et al. (2006) and Ferris et al. (2008) who showed in cross-sectional studies that enduring workplace social exclusion was related to impaired psychological health. The current study further showed that not only enduring and chronic experience of social exclusion but also daily and discrete episodes of social exclusion are prospectively related to sleep impairments, which are antecedents of impaired health. Social exclusion threatens important needs and hence is one of the most pernicious work stressors known. According to the need-to-belong theory (Baumeister & Leary, 1995) and the SOS concept (Semmer et al., 2007), individuals strive for positive relationships, to perceive themselves as worthy and competent and to convince others of the same. Accordingly, by thwarting belonging and self-esteem goals, workplace social exclusion acts as a potent stressor, spilling over into the evening and leading to poorer sleep quality. Previous research on isolation and bullying, which are linked with social exclusion to some extent, has found evidence for this relationship (Cacioppo et al., 2002; Niedhammer et al., 2009). Our results point in the same direction, as we found a significant relationship between social exclusion at work and fragmented sleep the following night.

Contrary to our assumptions, daily fluctuations in social exclusion were unrelated to sleep onset latency, sleep efficiency and self-reported sleep quality. With regard to these unexpected findings, it is interesting to note that our results indicate that there are more inter-individual than intra-individual fluctuations in sleep quality (intraclass correlations between 0.76 and 0.87). This implies that sleep quality is more strongly affected by stable variables (e.g. personality or chronic work conditions) than by daily variables. In line with this, chronic social exclusion was positively related to sleep onset latency and negatively related to subjective sleep quality. This suggests that chronic social exclusion is a background condition that impairs sleep in the long run (see Grebner, Elfering, Semmer, Kaiser-Probst, & Schlapbach, 2004) and has an impact on daily well-being

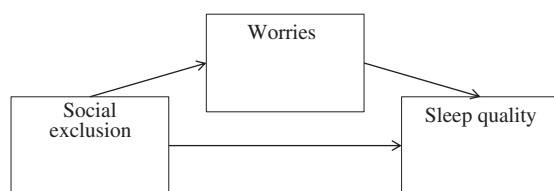


Figure 1. Hypothesized mediation model.

beyond the effects of daily events. Given that there is comparatively little daily intra-individual fluctuation in sleep quality, however, the significant effect of social exclusion on sleep fragmentation is particularly noteworthy. Additionally, Wesensten, Balkin, and Belenky (1999) reported in a review that sleep fragmentation systematically affects recuperation, independently of total sleep time. Furthermore, the percentage of sleep spent in Stage 1, which has little or no recuperative value, increased on fragmentation nights, even though total sleep time did not change (Wesensten et al., 1999). This suggests that, compared with other sleep quality parameters, sleep fragmentation is a milder form of sleep impairment, being initially largely unperceived for individuals. Therefore, because it is often not noticed, it is not closely related to self-reported sleep quality. Thus, our results indicate that daily social exclusion at work impairs largely unperceived sleep quality parameters such as sleep fragmentation, whereas enduring or chronic social exclusion at work affects perceived sleep quality parameters such as sleep onset latency and self-reported sleep quality. Future studies should provide further empirical evidence for this pattern.

We assumed that worries can lead to sleep impairments by anticipating and prolonging physiological reactions to stress and tested a mediation model (Brosschot et al., 2007). Empirical data, however, did not confirm a mediation model. As reported above, the low levels in social exclusion and worry levels may lead to an underestimation of the reported results. Even though the missing mediation is unexpected, it alternatively provides support for the unique effect of daily social exclusion at work on sleep. According to the effort-recovery theory (Meijman & Mulder, 1998), social exclusion at work leads to increased physiological (e.g. increased heart rate, cortisol excretion) load reactions. By thwarting belonging and self-esteem goals, workplace social exclusion is particularly stressful for individuals, maintaining the physiological systems activated and thus hindering successful recovery after work (Geurts & Sonnentag, 2006). Thus, social exclusion at work might lead to increased physiological arousal in the evening, independently of whether individuals worry or not. Although this study failed to show the proposed mediation effect, it showed unique associations of both social exclusion at work and worries with sleep fragmentation. In sum, our study showed the long arm of work: Social exclusion was associated with work-related worries after work and impaired sleep in the following night (Figure 2).

Study advantages and limitations

Our study has some advantages worthy of report. One major advantage is the use of a diary and an ambulatory design, which provided insight into the direction of the proposed effects. A second advantage is the focus on more

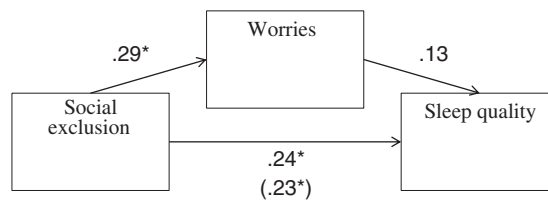


Figure 2. Mediation model. Unstandardized coefficients are reported. * $p < 0.05$

episodic and immediate effects of work stressors instead of chronic stressors and the focus on social exclusion as a stressful interpersonal relationship at work. However, our study also has some limitations that should be noted.

Firstly, methodological considerations regarding the use of actigraphy data should be taken into account. The use of activity-based sleep assessment has gained considerable attention among sleep researchers, owing to the cost-effectiveness of actigraphs, and the opportunity to conduct longitudinal research, and a naturalistic study of the sleep-wake system. Other researchers, however, warn of possible major limitations of the data obtained. They particularly call into question the reliability and validity of the actigraphy data gathered (Sadeh & Acebo, 2002). Even though the validity of the BodyMedia Sensewear Armband has been shown in the laboratory (Lotjonen et al., 2003), it has rarely been tested in a naturalistic setting. In a recent study, however, Kawada et al. (2011) compared Sensewear-detected rotational body movements at night with video recordings and showed 72% agreement without systematic deviation with equal percentages of undetected movements (15%) and false-positive detection of movements (14%). Moreover, a recent study by Wouwe, Valk, and Veenstra (2011) also showed Sensewear armbands to be sensitive, accurate and specific. Nevertheless, further validation of Sensewear actigraphy is called for, especially in naturalistic settings.

Secondly, in the present study, little is known about the experiences participants had after leaving the workplace. Social stressors at home, as well as social support or/and other experiences after work such as family demands, and the circumstances of private life (e.g. small children with an impact on parental sleep) may lead to a breach in the supposed process of social exclusion at work on sleep quality. Future research should therefore study employees' experiences and activities during off-job time in more detail.

Thirdly, participants of the present study had a higher education than we might expect in Swiss society. Previous research showed that people with higher education and occupational status report better health (Mackenbach, Kunst, Cavelaars, Groenhouf, & Geurts, 1997; Winkleby, Jatulis, Frank, & Fortman, 1992) and better work conditions (e.g. fulfilling, subjectively rewarding jobs, higher levels of social support; Ross & Wu, 1995) in general. Of particular importance for

the present study is that people of high occupational status reported the lowest prevalence of bullying, which is related to social exclusion, in a recent study of a representative sample of Danish workers (Ortega, Hogh, Pejtersen, & Olsen, 2009). All this suggests that our sample was rather healthy and exposed to relatively low levels of social exclusion: Results of the descriptive statistic confirmed this assumption; our participants reported low levels of psychosomatic complaints, social exclusion, worries and sleep fragmentation. Overall, this could have led to an underestimation of the examined effects.

Besides the limitations outlined above, further points should be noted. To our best knowledge, there exist no published measure about work-related worries that fits to our research question; hence, we constructed a new measure that should be further validated in future research. Moreover, social exclusion was measured with a scale devised by Leary et al. (1995) that was not explicitly designed to measure social exclusion at work. Although its face validity is high and the consistency was good in the present study, future research should use the Workplace Ostracism Scale of Ferris et al. (2008).

A further potential problem concerns the use of the paper-and-pencil daily survey. We used paper-and-pencil surveys to measure social exclusion at work and worries at bedtime. The use of such surveys, however, introduces some limitations. We instructed our participants to fill out the questionnaires at the required times to ensure a time lag between the measure of social exclusion at work and worries at bedtime. We also gave participants the opportunity to indicate if the questionnaire was filled out late. We cannot, however, rule out the possibility that participants wrongly indicated that they responded on time, which would limit our results. Electronic devices (for example, computers) would help to validate if surveys are completed at the specified times and would alleviate other paper and pencil diary issues (Bolger et al., 1989).

The bedtime diary assessment may also have forced participants to think about their work situations, leading thereby to false increased scores for worries. Thus, the reactivity of the sampling method—self-observation (social exclusion at work, worries about work) and ambulatory assessment—might have changed behaviour. One of the advantages of this study, however, is its combination of data from different sources, i.e. questionnaire self-report data and physiological data. Thus, the study avoids the problem of common method variance in assessment (Semmer, Grebner, & Elfering, 2004).

Practical implications and conclusion

Our results suggest that daily workplace social exclusion has negative effects on employees' well-being and on sleep, both of them being antecedents of ill health. Thus, to prevent long-term negative effects on sleep and health, social exclusion at work should be prevented or at least minimized. According to Dormann and Zapf (1999), social support can buffer the effects of social stressors on psychological health. Thus, by providing support to their employees and by acting as role models, supervisors can help to prevent negative long-term effects of social exclusion on health. As with mobbing, it is in organizations' best interests to take seriously the issue of workplace social exclusion by developing effective policies and by fostering a positive organizational culture.

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