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Social Stressors at Work, Sleep, and Recovery

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Abstract Many employees in service work are required to work on Saturdays, recovering during work-free Sundays and working again Mondays. We examined the effects of social stressors at work on recovery status at Sunday noon and Monday noon, and investigated if sleep quality mediates the negative effects of social stressors at work on recovery. From Saturday until Monday morning, 41 participants wore actigraphs to measure sleep duration and sleep fragmentation. Social stressors at work were assessed by self-reported questionnaires administered on Saturday. Recovery status was reported Sunday noon and Monday noon. Hierarchical regression analysis revealed that social stressors at work were negatively related to recovery status on Sunday and on Monday. Supporting our assumptions, more social stressors at work predicted higher sleep fragmentation in the night to Monday. A mediation effect of sleep quality, however, was not found. Theoretical and practical implications of these results are discussed.

Keywords Social stressors · Diary · Sleep actigraphy · Sleep duration · Sleep fragmentation

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Introduction

Evidence increases that the interface between work and private life is of special relevance for employees' mental health and well-being. Studies of work-family conflict (Amstad et al. 2011), and work-family cross-over (Bakker et al. 2008) have broadened our understanding of occupational health. Work stressors may impair the family life of individuals who work on Saturdays, especially on Sundays when employees need to detach from work in order to restore their capacity for the next working week. However, other than work-family conflict, recovery during Sundays has not received much attention so far, although impeded recovery processes are said to be the crucial link in the development of ill-health in the long run (Geurts and Sonnentag 2006). Sleep plays a particularly prominent role in the research on recovery; studies have shown that work-related stressors are positively linked to sleep impairments (e.g., Ekstedt et al. 2006; Lallukka et al. 2011; Litwiller 2014) and that sleep impairments are positively linked to ill-health (e.g., Drake et al. 2005). In a recent study, healthy men and women received viral exposure; it was tested whether sleep, measured by actigraphy, predicted the incidence of colds (Prather et al. 2015). Actigraphy-assessed shorter sleep duration was associated with an increased likelihood of developing a clinical cold (Prather et al. 2015).

Some important limitations of the previous research need to be addressed, however. Firstly, studies have mostly neglected the role of Sundays in recovering from work-related job stressors. Secondly, studies have concentrated on workload, thereby neglecting social stressors at work. Thirdly, they have mainly used cross-sectional designs, and self-reported measurements of sleep impairments. In this paper, we will describe the present study that addresses all these issues.

Recovery and Sleep

Recovery as a process of psychophysiological unwinding after effort expenditure (Geurts and Sonnentag 2006; Meijman and Mulder 1998) is considered to be the vital link between acute daily reactions to stressful work characteristics and the development of health impairments in the long run (Geurts and Sonnentag 2006). As a central part of recovery, sleep is said to be extremely important in preventing the long-term negative effects of stress on psychological and physiological health. The assumption that work-related stress is linked to impaired sleep has already found some empirical evidence (e.g., Ekstedt et al. 2006; Lallukka et al. 2011). A theoretical framework for this relationship is provided by the effort-recovery theory and by the conceptual approach of incomplete recovery by Geurts and Sonnentag (2006). According to the effort-recovery theory (Meijman and Mulder 1998), a job demands require physical and psychological efforts on the part of individuals. Those efforts lead to physiological (e.g., increased heart rate), and psychological (e.g., ruminative thoughts) load reactions. Under normal conditions, these acute reactions to stress are short-lived and fully reversible within a short period of time (Meijman and Mulder 1998). That is, when individuals are no longer exposed to work-related demands, such as during leisure Saturdays and/or leisure Sundays, psychobiological systems may stabilise again at baseline level, leading to recovery (Meijman and Mulder 1998; Sonnentag 2001). Leisure Sundays seem to be important for recovery from work demands: work on Sundays at least once a month has been shown to be associated with reported health impairments (Wirtz et al. 2011). It is unclear whether working on Saturdays imposes a comparable risk. For many individuals, a leisure Sunday may be sufficient for recovery and, as a result, fatigue and other negative effects of stressful work characteristics are reduced (e.g., Sonnentag 2001).

However, under particularly stressful conditions, such as conflicts with supervisors, the recovery process may be incomplete, the psychophysiological systems remaining activated during Sundays (Geurts and Sonnentag 2006). Social stressors during the working week may represent particularly stressful situations, leading to incomplete recovery even throughout Sundays. When work starts again on Monday with incomplete recovery during Sunday, an accumulative process may have been started that results in chronic health problems (Geurts and Sonnentag 2006).

Work during Saturdays is common in service work at supermarkets and restaurants; many employees work on Saturdays, have non-work Sundays and start again on Mondays. With only Sunday to recover, work stressors are more likely to cause incomplete recovery on Sundays and Mondays. To our knowledge, no study on sleep-related recovery has focused on employees who regularly work on Saturdays.

Social Stressors at Work

In accordance with the human need-to-belong theory, human beings have a pervasive drive to form and maintain positive and significant interpersonal relationships (Leary and Baumeister 2000). Furthermore, according to Leary and Baumeister (2000) humans are social beings, and the extent to which one feels accepted and esteemed by others is of great importance for well-being. Social stressors at work, in the sense of social animosities, conflicts, unfair behaviour, and a negative group climate may represent a threat to that drive (Leary and Baumeister 2000; Dormann and Zapf 2002). Thus, social stressors at work can be considered to be particularly strong and stressful to individuals. Social stressors may lead to a sustained psychophysiological activation (e.g. rumination, and increased heart rate) even during off-work periods, such as during Sundays. The psychophysiological activation as a response to stressful work conditions may, however, be incommensurate with the deactivation that is a main characteristic of sleep. Empirical research has shown that interpersonal conflicts may be associated with increased sleep disturbance (Brissette and Cohen 2002). A recent meta-analysis on work conditions and sleep (Litwiller 2014) reported a significant association between sleep quality and workplace bullying ($\rho = -0.23$, $k = 3$), and between sleep quality and workplace violence ($\rho = -0.20$, $k = 2$). A recent systematic review on social stressors and sleep found 14 studies (Pereira et al. in press), ten of which reported correlations between these variables. The weighted mean correlation of these ten studies was $\rho = 0.21$ (CI 95 = 0.12–0.31). Thus, there is a meaningful relationship between social stressors at work and impaired sleep. Summing up, there is already some empirical evidence that social stressors at work may impair sleep. However, this research should be added to by studies involving ambulatory sleep recording in naturalistic settings.

The Present Study

In this ambulatory assessment study, we examined the effects of social stressors at work on recovery and on sleep quality during Sunday and on the following Monday. Sleep quality was measured objectively by ambulatory recording of sleep duration and sleep fragmentation, as indicated by awakenings (Pereira and Elfering 2014; Pereira et al. 2014). We further tested if sleep quality mediates the negative effects of social stressors at work on recovery. This study aimed to contribute to recovery research within occupational health psychology in three ways: firstly, by

investigating the effects of social stressors at work on recovery from a working Saturday to a work-free Sunday. Secondly, by testing if social stressors at work are negatively related to sleep quality during Saturday night and Sunday night by using ambulatory-gathered data in a naturalistic setting. Thirdly, by investigating sleep quality as a mediator in the relationship between social stressors at work and impaired recovery. We tested the following three hypotheses:

Social stressors at work are negatively related to recovery status on Sunday and Monday (H1a–H1b).

Social stressors at work are positively related to sleep quality (sleep duration and awakenings) during Saturday and Sunday night (H2a–H2b).

The relationship of social stressors at work to recovery during Saturday night and Sunday night is mediated by sleep quality during the respective nights (H3a–H3b).

Materials and methods

Participants and Design

Data collection took place in 2009–2010 and included the collection of diary and ambulatory data throughout Saturday until Monday. Complete data were available for 41 individuals. To be included in the study, participants had to be full-time workers of various jobs involving interaction with customers (i.e., employed in restaurants, supermarkets, etc). They were recruited via personal advertisements by the first author. Forty-one participants agreed to participate in the study; the participation rate was about 67 %. Thirty-three per cent did not want to participate in the study because of intensive workload and time pressure. The study began on a Saturday and ended on a Monday. Note that our participants worked in the service sector; because Saturday is the most important workday for supermarkets and restaurants, our participants did not have two consecutive days off work. Instead they worked on Saturday, had a day off on Sunday, and worked again on Monday. To compensate for working on Saturday, they had another day off during the week (Tuesdays, Wednesdays, Thursdays, or Saturdays).

The study was performed in consensus with recommendations outlined by the World Medical Association in the Declaration of Helsinki (2008), and with all requirements defined by the Swiss Society of Psychology. As compensation for participants' time, and to encourage participation, we offered them individual feedback about their sleep quality at the end of the study.

Participants were on average 33 years old (range 20–55, $SD = 9.16$), and 62 % of the participants were female. Of the 41 participants included in the analysis, 34 % had children (range 2–28 years old), only seven of the participants had children younger than 18. Mean job tenure was 6 years (range 4 months–28 years, $SD = 5.84$).

Materials

Questionnaire

Before diary measures started, participants filled in a questionnaire including questions about social, and demographic background, and work conditions (i.e., social stressors at work). This general questionnaire was filled in on Saturday.

Social Stressors at Work

The scale "social stressors at work", developed by Frese and Zapf (1987), was used to measure interpersonal tensions with colleagues and supervisors (e.g., conflicts, personal animosities or unfair behaviour). The introduction given to the participants was "The following questions are about the social working climate in general in the last 30 days." The scale consists of 10 items. Item examples are, "one has to pay for the mistakes of others", "with some colleagues there is often conflict."), using a 5-point scale (ranging from 1 = *not at all*, to 5 = *very much*). The social stressors scale has been used frequently since its development by Dormann and Zapf (1999) and and shows validity with regard to job characteristics and health variables. Furthermore, Dormann and Zapf (1999) claimed that '…the scale is not affected by verbal fluency, social desirability, and political attitudes' (p. 877). Cronbach's alpha was $\alpha = 0.87$. The mean social stressors score in the last 30 days was 1.98 ($SD = 0.66$). Scores on social stressors at work were noted on Saturday after participants finished work.

Diary

Diaries were used to assess daily changes in recovery. Diaries had to be filled in daily, at the latest at noon.

Recovery

Recovery status was measured by a single item (Grebner et al. 2005), scored from 1 = *exceedingly bad*, to 7 = *exceedingly good*, with smiles as response options. The statement was: "At this moment I feel recovered from work". The mean score on recovery on Sunday was 4.8 ($SD = 0.93$); the mean score on recovery on Monday was 4.7 ($SD = 1.22$). There is evidence that recovery status can be addressed reliably by single items (van Hooff et al. 2007). A fairly similar single item measure ("how fatigued

do you currently feel?") was successfully validated (van Hooff et al. 2007).

Sleep Actigraphy

In the current study, we used actigraphs to continuously assess sleep duration and sleep awakenings during nights. Actigraphy refers to methods using miniaturised, computerised, wristwatch-like devices to monitor, and collect data generated by movements (Sadeh and Acebo 2002). Actigraphy is based on the principle that there are reduced movements during sleep phases and increased movements during wake phases (Sunseri et al. 2011). Several researchers have stated that actigraphy is a reliable and valid measure for sleep measurement in normal and healthy adult populations (e.g., Littner et al. 2003).

In the present study, each participants wore a Sensewear armband (BodyMedia Inc, Pittsburgh) from Saturday until Monday. Every minute, 2-axis oscillometric sensors assessed body movements, as well as other physiological signals, including surface body temperature, galvanic skin response (e.g., Elfering and Grebner 2011), and heat flux. Sensewear armbands include a multi-accelerometer similar to other actigraphs. However, since Sensewear armbands are worn on the upper arm, as opposed to the wrist (as worn by other actigraphs), Sensewear armbands tend to minimise extraneous movement noise (Sunseri et al. 2011). The collected data were analysed with BodyMedia software; this can estimate sleep and wake phases using computer algorithm-defined thresholds of activity. Estimated sleep parameters such as total sleep time, the number and frequency of sleep disruptions and awakenings can be derived (Littner et al. 2003). BodyMedia's sleep algorithm was developed using techniques from statistical machine learning (Germain et al. 2006). The sleep algorithms used are not based solely upon acceleration as with actigraphs, but incorporate data from multiple sensors, thereby enhancing accuracy (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. According to the authors, BodyMedia's algorithm identified sleep and wakefulness with moderate to high sensitivity, specificity, and accuracy. A recent study conducted by Wouwe et al. (2011) revealed Sensewear armbands to be sensitive, specific, and accurate.

In our study we used the sleep duration [hours] and the number of awakenings during the nights as an indicator of sleep quality (cf. Pereira et al. 2013). In accordance with other research (e.g., Sadeh et al. 2004) sleep awakenings were coded 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 (Pereira and Elfering 2014).

Control Variables

Because activity amounts differ depending on age and gender (Åkerstedt et al. 2002; Sadeh and Acebo 2002), we entered age, and gender as control variables into the analyses.

Procedure

Mediation analysis has been found to be an adequate test when current work stressors are supposed to impair next day recovery status and sleep is supposed as the main recovery process involved, (Pereira et al. 2013). To test our hypotheses, we performed hierarchical regression analyses predicting sleep duration, number of recorded awakenings and recovery status. To carry out the mediation analysis, we followed the approach suggested by Baron and Kenny (1986), according to whom three regressions should be calculated. To test for mediation, firstly, the mediator (sleep duration or awakenings) was regressed on the independent variable (social stressors at work); secondly, the dependent variable (recovery) was regressed on the independent variable; and thirdly, the dependent variable was regressed on both the independent variable and on the mediator. In the case of mediation, the first two regression analyses should show significant predictions in the proposed direction, and the third regression should show significant prediction of the mediating variable, while the previously significant relationship between the independent and dependent variables is no longer significant.

The mediation hypotheses were tested for the night from Saturday when participants had worked, on the work-free Sunday (social stressors at work as measured on Saturday = independent variable; sleep duration and awakenings during the night from Saturday to Sunday = mediator variables; recovery at Sunday noon = dependent variable). Mediation hypotheses were then tested for the night from the work-free Sunday on the working Monday (social stressors at work as measured on Saturday = independent variable; sleep duration and awakenings in the night from Sunday to Monday = mediator variables; recovery at Monday noon = dependent variable).

Owing to missing values, the sample size varies for the different analyses. All of the present study's hypotheses were directional; thus alpha was set to 0.05, one-tailed.

Results

Correlations

Means, standard deviations, and intercorrelations are displayed in Table 1. Saturday night's sleep duration was

Table 1 Summary of intercorrelations, means, and standard deviations for the used variables

Variable		*M*	*SD*	Correlation								
				1	2	3	4	5	6	7	8	9
1.	Sleep duration Saturday to Sunday	6.55	1.50	–								
2.	Awakenings Saturday to Sunday	3.29	2.17	0.14	–							
3.	Sleep duration Sunday to Monday	5.57	1.38	0.35*	−0.37**	–						
4.	Awakenings Sunday to Monday	2.66	1.73	0.09	0.32*	−0.06	–					
5.	Recovery Sunday	4.80	0.93	0.18	0.06	−0.08	−0.14	–				
6.	Recovery Monday	4.70	1.22	0.03	0.10	−0.06	−0.22	0.52**	–			
7.	Gender	–	–	−0.01	0.06	−0.37**	−0.10	0.13	−0.19	–		
8.	Age	33	9.16	0.12	0.05	0.06	−0.13	−0.21	−0.16	−0.16	–	
9.	Social stressors	1.98	0.66	0.08	0.17	−0.24	0.23	−0.26	−0.18	0.13	−0.21	–

Intercorrelations, means, and standard deviations for the used variables

* $p < 0.05$, ** $p < 0.01$, one-tailed, $N = 39$–41

significantly correlated with Sunday night's sleep duration ($r = 0.35$, $p < 0.05$). Saturday nights' awakenings were negatively correlated to Sunday night's sleep duration ($r = -0.37$, $p < 0.01$), and positively correlated to Sunday night's awakenings ($r = 0.32$, $p < 0.05$). Sunday's recovery was positively correlated to Monday's recovery ($r = 0.52$, $p < 0.01$).

Regression Analyses

Regression Analyses Predicting Self-Reported Recovery on Sunday

Social stressors at work were negatively related to self-reported recovery at Sunday noon ($\beta = -0.31$, $t(37) = -1.95$, $p < 0.05$, second regression model in Table 2). Neither indicator of sleep quality during the night from Saturday to Sunday was related to social stressors at work (sleep duration: $\beta = 0.11$, $t(37) = 0.65$, *ns*; awakenings: $\beta = 0.20$, $t(37) = 1.21$, *ns,* first regression model in Table 2). Recovery status at Sunday noon was better with longer sleep durations ($\beta = 0.28$, $t(37) = -1.76$, $p < 0.05$, third regression model in Table 2). Recovery status at Sunday noon was not related to the number of awakenings in the preceding night ($\beta = 0.14$, $t(37) = 0.86$, *ns*, third regression model in Table 2). Because social stressors at work were not significantly associated with sleep duration or sleep awakenings on Saturday night, the mediation hypothesis of sleep duration during Saturday was rejected. Social stressors and sleep duration were unique predictors of recovery at Sunday noon. Sleep awakenings did not mediate the association between social stressors and recovery on Sunday because awakenings and social stressors were unrelated.

Regression Analyses Predicting Self-Reported Recovery on Monday

Social stressors at work were negatively related to self-reported recovery on Monday ($\beta = -0.33$, $t(36) = -2.05$, $p < 0.05$, second regression model in Table 3). Sleep duration during the night from Sunday to Monday was not related to social stressors at work, while awakenings were positively associated with social stressors at work (sleep duration: $\beta = -0.10$, $t(37) = -0.63$, *ns*; awakenings: $\beta = 0.29$, $t(37) = 1.77$, $p < 0.05$, first regression model in Table 3). Recovery status at Monday noon was not related to sleep duration during the preceding night ($\beta = 0.01$, $t(37) = 0.04$, *ns*, third regression model in Table 3). Recovery status at Monday noon was not significantly related to the number of awakenings in the preceding night ($\beta = -0.18$, $t(37) = 1$, *ns*, third regression model in Table 3). Because social stressors at work were not significantly associated with sleep duration on Sunday night, the mediation hypothesis of sleep duration during Sunday was rejected. Social stressors and awakenings were significantly associated, but when the recovery status at Monday noon was regressed on social stressors at work and awakenings, the latter was not found to be a significant predictor. Thus, the mediation was not found (see third regression model in Table 3).

Discussion

The goal of the present study was to extend previous research on sleep, and recovery from work-related stressors. The current study adds to the literature on recovery during weekends by shedding light on the large group of

Table 2 Summary of hierarchical regression analyses testing duration of sleep and awakenings during the night after work on Saturday to Sunday to mediate the association of social stressors at work (measured at Saturday) with recovery on Sunday noon

	(a) Sleep duration				(b) Awakenings			
	ß	*SE*	*t*	R^2	*ß*	*SE*	*t*	R^2
(1) Regressing duration/awakenings (mediator) on social stressors at work (independent variable)				0.03				0.04
Sex[a]	−0.08	0.52	−0.44		0.01	0.76	0.41	
Age	0.11	0.03	0.68		0.07	0.04	0.39	
Social stressors at work	0.11	0.36	0.65		0.20	0.52	1.21	
(2) Regressing recovery at *Sunday* noon (dependent variable) on social stressors at work (independent variable)				0.08				0.15
Sex[a]	0.16	0.32	1.01		0.16	0.32	1.01	
Age	0.22	0.02	−1.36		0.22	0.02	−1.36	
Social stressors at work	−0.31	0.21	1.95*		−0.31	0.21	1.95*	
(3) Regressing recovery at Sunday noon (dependent variable) on both social stressors at work (independent variable) and duration/awakenings (mediator)				0.23				0.17
Sex[a]	0.16	0.31	1.02		0.18	0.32	1.07	
Age	−0.27	0.02	−1.68		−0.23	0.02	−1.39	
Social stressors	−0.36	0.21	2.25*		−0.34	0.22	−2.07*	
Sleep duration/awakenings	0.28	0.28	1.76*		0.14	0.07	0.86	

ß standardised regression coefficient, *SE* standard error of estimation, *t* test of significance for standardised regression coefficient, R^2 variance explained

* $p < 0.05$, one-tailed

[a] 0 = female, 1 = male

employees in the service sector who have to work Saturdays. Multiple linear regression analyses revealed that social stressors were significantly associated with decreased recovery scores on Sunday as well as on Monday. This result strengthens the assumption that work stressors may lead to an incomplete recovery, even during periods of rest from work such as those on Sundays. During Sunday, psychophysiological activation may be sustained even when workers are no longer exposed to any job demand or stressor, for example, due to perseverative cognitions, as shown recently by a study on helicopter pilots (Radstaak et al. 2014). Future studies should compare the relationship between social stressors at work and recovery on non-working Sundays both with preceding working Saturdays and also with preceding work-free Saturdays.

In line with hypothesis H2b, social stressors at work were significantly related to sleep awakenings during the night to Monday. However, this relationship was not significant for the night to Sunday and sleep duration in both nights was not associated with social stressors. Contrary to what we had expected, our results indicated that social stressors at work did not predict awakenings on Saturday night. Unlike Sunday night, that reflects the start of the new working week, Saturday night seems to be embedded in leisure time. Rook and Zijlstra (2006) provide a preliminary explanation of why social stressors only impaired Sunday night's sleep by suggesting that the effects of recovery begin to wane on Sunday evening; "…this could point in the direction of an anticipation of work demands: people start thinking of their work on Sunday evening, and start to worry, which subsequently affects their sleep quality" (Rook and Zijlstra 2006, p. 234). Furthermore, Åkerstedt et al. (2002) found that not being able to stop thinking in the evening is a strong predictor of sleep impairments. Our results point in the same direction; during the period from Sunday night until Monday morning, people may have started to ruminate about their work situation especially regarding social conflicts at work. Our results are in line with those of Brosschot et al. (2005), who suggest that a stressor leads to prolonged physiological activation when people have ruminative thoughts about the stressors. Unfortunately, we did not measure work-related worrying on Sunday evening and no post hoc test of this proposed association was possible. Thus, future studies on work stressors, sleep, and recovery during Sundays should test whether Sunday evening ruminating about social stressors at work affects sleep quality from Sunday to Monday.

Contrary to our expectation, sleep awakenings did not mediate the relationship of social stressors with recovery. Although the proposed mediation of sleep awakenings

Table 3 Summary of hierarchical regression analyses testing duration of sleep and awakenings in night from Sunday to Monday mediate the association of social stressors at work (measured at Saturday) with recovery on Monday noon

	(a) Sleep duration as mediator				(b) Awakenings as mediator			
	ß	*SE*	*t*	R^2	*ß*	*SE*	*t*	R^2
(1) Regressing duration/awakenings (mediator) on social stressors at work (independent variable)				0.21				0.10
Sex[a]	−0.43	0.43	−2.81		−0.15	0.58	−0.91	
Age	−0.02	0.03	−0.13		−0.13	0.03	−0.79	
Social stressors at work	−0.10	0.30	−0.63		0.29	0.40	1.77*	
(2) Regressing recovery at *Monday* noon (dependent variable) on social stressors at work (independent variable)				0.17				
Sex[a]	0.23	0.42	1.43		0.23	0.42	1.43	
Age	−0.15	0.02	−0.90		−0.15	0.02	−0.90	
Social stressors at work	−0.33	0.28	−2.05*		−0.33	0.28	−2.05*	
(3) Regressing recovery at *Monday* noon (dependent variable) on both social stressors at work (independent variable) and sleep duration/awakenings (mediator)				0.17				0.20
Sex[a]	0.24	0.46	1.32		0.22	0.43	1.32	
Age	0.15	0.02	−0.89		−0.15	0.02	−0.92	
Social stressors	−0.33	0.29	−2.01*		−0.29	0.30	−1.72	
Sleep duration/awakenings	0.01	0.16	0.04		−0.18	0.12	−1.04	

ß standardised regression coefficient, *SE* standard error of estimation, *t* test of significance for standardised regression coefficient, R^2 variance explained

* $p < 0.05$, one-tailed

[a] 0 = female, 1 = male

could not be supported, social stressors at work were shown to predict awakenings during Sunday night and recovery during weekends and on Monday. More awakenings during Sunday night in those who reported more frequent social stressors at work might indicate a long-term risk to recuperation processes. A recent ambulatory study with three sleep polysomnography recordings at home and diaries across 6 weeks showed habitual stress correlated with the mean number of sleep awakenings ($r = -0.36$, $p < 0.05$; Åkerstedt et al. 2014). Wesensten et al. (1999) reported in a review that sleep fragmentation is negatively related to recuperation. Furthermore, the percentage of sleep spent in Stage 1, which has little or no recuperative value, increased during fragmentation nights, even though total sleep time did not change (Wesensten et al. 1999). Compared with sleep duration, sleep fragmentation might be a milder form of sleep impairment, being initially largely unperceived in individuals.

This is, to our best knowledge, the first ambulatory field study testing psychophysiological sleep function and recovery during Sunday and on the following Monday in the service sector that involves working on Saturday. Thereby, the association of self-reported social work stressors with actigraphy-based awakenings could not be biased by common method variance (Semmer et al. 2004). Although stress, recovery, and sleep are salient research topics (e.g. Brissette and Cohen 2002), previous studies including these variables have been predominantly laboratory or cross-sectional studies; objective measurements of sleep during weekends in a naturalistic setting had been neglected. Thus, this field study extends knowledge on this topic.

Weaknesses and Strengths of the Study

This study had several limitations. One weakness was the rather small sample size; the final sample consisted of 41 participants. Furthermore, the inclusion of only 1 weekend might limit the generalisability of the results and the Sunday data after working Saturday should be compared with Sunday data after leisure Saturdays in further studies.

So far, the validity of activity monitoring has been shown in the laboratory (Lotjonen et al. 2003) but rarely in real life. However, a recent study conducted by Kawada et al. (2011) shows very promising results. The researchers compared Sensewear-detected rotational body movements at night with video recordings, and showed 72 % agreement without systematic deviation with equal percentages of undetected movements (15.3 %) and false-positive detection of movements (13.5 %). A recent study conducted by Wouwe et al. (2011) also showed Sensewear armbands to be sensitive, accurate and specific.

Nevertheless, further validation of Sensewear actigraphy seems necessary. Finally, the study is correlational and alternative explanations involving third variables can not be excluded.

Conclusions

Our actigraphy-based results showed that social stressors at work predicted sleep fragmentation during the night from Sunday to Monday. Furthermore, more frequent social stressors at work predicted lower recovery status on a non-working Sunday and working Monday. Primary prevention should increasingly address the interpersonal side of work to reduce the psychological costs of work (Semmer et al. 2010). Field studies on occupational health should include actigraphy more often because this may help in the understanding of insufficient recovery processes; ambulatory field data settings should complement laboratory research (Klumb et al. 2009). Indeed, research on work stressors' influences on sleep should address not only workday nights but also weekend nights and those during vacation.

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