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Bidirectional relations between work-related stress, sleep quality and perseverative cognition☆

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ABSTRACT

Objective: In this longitudinal two-wave study, bidirectional relations between work-related stress and sleep quality were examined. Moreover, it was investigated whether perseverative cognition is a potential underlying mechanism in this association, related to both work-related stress and sleep quality.
Methods: A randomly selected sample of Dutch employees received an online survey in 2012 and 2013. Of all invited employees, 877 participated in both waves. Structural equation modeling was performed to analyze the data.
Results: We found evidence for reversed relations between work-related stress and sleep quality. Specifically, when controlling for perseverative cognition, work-related stress was not directly related to subsequent sleep quality, but low sleep quality was associated with an increase in work-related stress over time. Moreover, negative bidirectional associations over time were found between perseverative cognition and sleep quality, and positive bidirectional associations were found between work-related stress and perseverative cognition. Lastly, a mediation analysis showed that perseverative cognition fully mediated the relationship between work-related stress and sleep quality.
Conclusion: The study findings suggest that perseverative cognition could be an important underlying mechanism in the association between work-related stress and sleep quality. The bidirectionality of the studied relationships could be an indication of a vicious cycle, in which work-related stress, perseverative cognition, and sleep quality mutually influence each other over time.

Introduction

Roughly one out of three individuals in Western countries reports sleep problems [1,2]. The negative effects of poor sleep quality on health and work performance have been established in many studies [3–8]. Other research has focused on a wide variety of possible factors causing poor sleep quality [9].

One of the potential causes of longer periods of disturbed sleep is chronic work-related stress [10]. Levi and Levi [11] define work-related stress as emotional, cognitive, behavioural, and physiological reactions to negative attributes of work, a state characterized by high levels of arousal and distress. Although working is inevitably associated with short-term stress-related load effects (e.g., fatigue, negative affect, elevated heart rate), these effects will cause no harm and will not disturb sleep, as long as they return to baseline levels during off-job periods. Sufficient recovery from work-related stress is jeopardized, however, when bodily stress systems (e.g., hypothalamo-pituitary-adrenocortical system, sympathetic-adrenal-medullary system) remain activated during off-job time ("sustained activation") [12]. This prolonged stress-activation leads to bodily wear and tear ("allostatic load") that can eventually cause serious disease [13]. In line with this, recent studies show that work-related stress without sufficient recovery seems to be a serious risk factor for sleep [10,14–16].

Sleeping is at the same time one of the most crucial opportunities to recover from work stress [15,17]. Sleep is essential for restoration of bodily processes (e.g., endocrine effects, glucose changes), which seem to counteract the negative impact of daily stress [18]. Longitudinal research designs are needed to find more valid evidence for the assumed relationship between work-related stress and sleep quality, but until now this type of research is scarce. The current study aimed to fill this gap by using a longitudinal full-panel design (with a one-year time

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lag) measuring both sleep quality and work-related stress at two points in time.

The first aim of this study was to examine whether work-related stress predicts poor sleep quality. Based on previous research [10,18], we hypothesized that work-related stress is associated with decreased sleep quality one year later (Hypothesis 1: normal causation). Additionally, it seems plausible [15,17] that poor sleep quality is associated with work-related stress one year later. In line with the stressor creation hypothesis [19,20], poor sleep quality may evoke new stressors (e.g., interpersonal conflicts due to irritation), which in turn may increase stress. Hence, we tested whether poor sleep quality is associated with increased work-related stress one year later (Hypothesis 2: reversed causation).

Next to work-related stress and sleep quality, we also included measures of work-related perseverative cognition (PC). PC is defined as "repeated or chronic activation of the cognitive representation of one or more psychological stressors" [21, p.114]. It is believed to be a major cause of prolonged physiological activation and of impaired recovery and sleep [10,22]. Field research has shown that particularly work-related PC is accountable for prolonged physiological activation [23]. Work-related PC is characterized by repetitive thoughts about issues associated with work [24]. Research has consistently shown that work-related PC is related to sleep problems [25–27]. Hence, the second aim of this study was to longitudinally examine to what extent PC intervenes in the relationship between work-related stress and poor sleep quality. Building on previous research, we expected that work-related stress is associated with increased PC one year later (Hypothesis 3: normal causation), and that PC, in turn, is accountable for poorer sleep quality one year later (Hypothesis 4: normal causation). We also examined possible reversed causation, that is, poor sleep quality is associated with an increase in PC one year later (Hypothesis 5: reversed causation). Lastly, we expected that PC is related to an increase in work-related stress one year later (Hypothesis 6: reversed causation).

Method

Design and participants

This study employed a two-wave full panel design with a time lag of 13 months. Employees who had completed the Netherlands Working Conditions Survey 2010 [NWCS, 28] were invited for a longitudinal follow-up study in 2012 and 2013. The NWCS is a yearly survey conducted among a large, randomly selected sample of Dutch employees. It provides insight into the quality of working life and employee health. All participants who completed the online version of the NWCS in 2010 and agreed to participate in a follow-up study (N = 5504) received an online questionnaire in October 2012 (Wave 1 in this study) and in November 2013 (Wave 2 in this study). Each wave included two reminders (after one and three weeks, respectively). Of all invited employees, 2633 individuals participated in the first follow-up wave (response rate of 48%) and 1393 of these participated in the second follow-up wave (response rate of 53%, see Fig. 1). Only participants who worked at least 24 h a week on both time points were included in this study. We used this criterion because we wanted to guarantee substantial exposure to work. After applying this inclusion criterion 1106 participants remained. Next, all participants who performed night work were excluded, after which the sample consisted of 929 participants. We decided to exclude night workers since night workers have very different sleeping patterns compared to the general workforce [29]. Fifty-two participants did not fill out one or more of the relevant scales (i.e., work-related stress, PC, sleep quality), and were therefore excluded from the analyses. To verify that the missing data were randomly distributed, we performed the Little's Missing Completely at Random (MCAR) test. This test was not significant, indicating random distribution of the missing data. Consequently, it was deemed acceptable to indeed exclude all participants with missing data. The final sample consisted of 877 participants with data on both measurement points. Comparing this sample to the initial sample (N = 5,504) in terms of gender, age, and educational level, differences in age (M_{final} = 44.4; SD = 10.6 vs. $M_{initial}$ = 40.0; SD = 12.2; d = 0.39) and educational level (60.9% with high education in final sample vs. 39.5% in initial sample; d = 0.44) were detected. Moreover, non-response analyses comparing the final sample to all participants from Wave 1 (N = 2,633) did not reveal significant differences between respondents and non-respondents with regard to any of the background or study variables (i.e., d <0.20). Thus, except for the background variables age and educational level, our final sample appears to be similar to the initial sample and follow-up sample, with the initial sample being representative for the Dutch working population. The majority of participants in the study sample were male, aged between 40 and 59 years, and relatively highly educated (see Table 1 for an overview of study sample characteristics). All participants provided informed consent.

Measures

Inspired by Elo, Leppännen, and Jahkola [30], who developed a one-item measure to assess stress symptoms, we self-constructed the item "How much stress do you generally experience due to your work?" to measure *work-related stress* in this study. The response scale was based on the Dutch grading system, which is the standard in the Netherlands, and ranged from 1 (no stress at all) to 10 (very much stress).

Work-related perseverative cognition was assessed with three items of the Dutch Questionnaire on the Experience and Evaluation of Work (VBBA), which has been validated and is extensively used in scientific research [31,32]. Exact wording of the items was "When I leave my work, I continue to worry about work problems", "I can easily detach myself from my work" (reverse coded), and "During my free time, I often worry about my work". The response scale for all items was a 4-point scale (1 = never, 2 = sometimes, 3 = often, 4 = always). The scale score was determined by calculating the mean of the three items. Reliability analysis revealed Cronbach's alpha coefficients of 0.74 at Time 1 (T1) and 0.77 at Time 2 (T2).

Subjective sleep quality was assessed with the Jenkins Sleep Scale (JSS) [33]. This scale consists of four items, which check the occurrence of the following sleep complaints during the past four weeks: (i) difficulty initiating sleep, (ii) awakening during the night, (iii) difficulty maintaining sleep including waking up too early, and (iv) non-restorative sleep. All items were scored on a 6-point scale (0 = not at all, 1 = 1–3 days, 2 = 4–7 days, 3 = 8–14 days, 4 = 15–21 days, 5 = 22–28 days). The mean scale score was calculated, higher scores indicating lower sleep quality. Cronbach's alpha for the JSS was 0.78 at T1 and 0.79 at T2.

Control variables: *Gender* and *age* have been shown to be related to sleep [34,35]: sleep problems are more common in women and increase with age. Moreover, gender differences have also been shown regarding PC as women are more likely to ruminate than men [36–38]. Therefore, all analyses were controlled for gender (1 = male, 2 = female) and age (in years). Since individuals with higher education more often hold high status jobs than individuals with lower educational level and are likely to experience more work-related stress and negative work-home spillover [39,40], *educational level* was also included as a control variable (recoded: 1 = 'low educational level', i.e., no education, primary school or lowest level of secondary school; 2 = 'moderate educational level', i.e., secondary school and intermediate vocational education; 3 = 'high educational level', i.e., higher education as for example a university degree).

Statistical analyses

After computing descriptive statistics and correlations, Structural Equation Modeling (SEM) was performed using LISREL version 9.1