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Work environment, overtime and sleep among offshore personnel

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ABSTRACT

Personnel working on North Sea oil/gas installations are exposed to remote and potentially hazardous environments, and to extended work schedules (typically, 14 × 12 h shifts). Moreover, overtime (additional to the standard 84-h week) is not uncommon among offshore personnel. Evidence from onshore research suggests that long work hours and adverse environmental characteristics are associated with sleep impairments, and consequently with health and safety risks, including accidents and injuries. However, little is known about the extent to which long hours and a demanding work environment combine synergistically in relation to sleep.

The present study sought to address this issue, using survey data collected from offshore day-shift personnel ($N = 551$). The multivariate analysis examined the additive and interactive effects of overtime and measures of the psychosocial/physical work environment (job demands, job control, supervisor support, and physical stressors) as predictors of sleep outcomes during offshore work weeks. Control variables, including age and sleep during leave weeks, were also included in the analysis model.

Sleep duration and quality were significantly impaired among those who worked overtime (54% of the participants) relative to those who worked only 12-h shifts. A linear relationship was found between long overtime hours and short sleep duration; personnel who worked >33 h/week overtime reported <6 h/day sleep. Significant interactions were also found; sleep duration was negatively related to job demands, and positively related to supervisor support, only among personnel who worked overtime. Poor sleep quality was predicted by the additive effects of overtime, low support and an adverse physical environment. These findings highlight the need to further examine the potential health and safety consequences of impaired sleep associated with high overtime rates offshore, and to identify the extent to which adverse effects of overtime can be mitigated by favourable physical and psychosocial work environment characteristics.

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1. Introduction

Extensive research, both prospective and cross-sectional, implicates short sleep hours and poor sleep quality in a range of adverse health and safety outcomes at work, including occupational injuries and accidents (e.g. Salminen et al., 2010; Uehli et al., 2014); sickness absence (Lallukka et al., 2013); impaired performance (Williamson and Feyer, 2000); fatigue (Åkerstedt et al., 2014); and chronic health problems (Nishikitani et al., 2005). These findings highlight the importance of identifying work conditions that may give rise to sleep impairments. In this context, the present study focuses on overtime work and on the physical/psychosocial work

environment; as outlined below, both these factors are known to be significant predictors of sleep outcomes.

The role of overtime work in relation to sleep has been widely studied; prospective and cross-sectional studies have identified consistent links between overtime (i.e. hours worked in excess of normal contractual hours) and sleep disturbances, including short sleep duration (e.g. Artazcoz et al., 2009; Tsuboya et al., 2015; Virtanen et al., 2009). Moreover, there is evidence that these associations take a dose–response form; for instance, Nakashima et al. (2011) found dose–response relationships between overtime and sleep impairments, including short sleep hours and poor sleep quality. Consistent with these findings, in a review of work hours and health, Bannai and Tamakoshi (2014) identified five studies that linked long work hours to a range of adverse sleep outcomes, including short sleep hours. Other evidence suggests that short sleep duration associated with overtime during work weeks may become habitual, and consequently persist into weekends and holidays (Ohtsu et al., 2013).

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Work characteristics are also significantly associated with sleep. A systematic review of findings relating sleep quality to psychosocial work characteristics concluded that there was strong evidence for the causal role of job demands, and moderately strong evidence for job control, but insufficient studies to allow firm conclusions about other psychosocial work factors, such as social support, influence over decisions, and role conflict (Van Laethem et al., 2013). Other researchers have examined a wider range of sleep outcomes (including insomnia, and sleep loss due to worry) in relation to work environment measures; findings confirm the significance of job demand and control, and provide evidence relating to other work dimensions, including social support (e.g. Elovainio et al., 2013; Salo et al., 2014). Physical work conditions (e.g. strenuous work, tiring postures, and exposure to noise/vibration) have also been found to act as risk factors for sleep disturbances (Lallukka et al., 2010; Nakata et al., 2004).

To date, studies of overtime and of work environment characteristics as predictors of sleep have proceeded largely independently; only rarely have publications (e.g. Sekine et al., 2006) considered how these factors are jointly associated with sleep outcomes. Moreover, the possibility of synergistic or interactive effects has been largely disregarded, even though such effects are consistent with theoretical models of work stress and health (e.g. Israel et al., 1996). However, one existing study is relevant; Van der Hulst et al. (2006) found that 'need for recovery' was predicted by overtime work only under conditions of high job demand; this results suggest that similar synergistic effects may occur in relation to sleep.

A further limitation of existing research is that, although the studies cited above include a range of industries, socio-economic groups, and work settings, they largely relate to personnel whose contractual hours are 30–40 h/week. Thus, even when overtime is added, working time rarely exceeds 60 h/week. In contrast, at remote work sites (typically in the resources industries), the majority of personnel are employed on 'fly-in, fly-out' (FIFO) rosters in which an extended work period (usually two weeks) alternates with leave breaks. These schedules impose a basic work week of 84 h, and overtime may increase work hours to >100 h/week; moreover, many FIFO personnel work in potentially hazardous environments, and are exposed to additional stressors (e.g. safety-critical tasks, heavy manual work, and noise).

In such environments, it is especially important to understand how long work hours and psychosocial/physical conditions may combine to give rise to sleep impairments, and consequently elevated health and safety risks. In seeking to address these issues, the present study examines the extent to which measures of sleep duration and quality among personnel working 12-h day shifts (typically, 07.00–19.00 h) on offshore installations are predicted by the additive and, in particular, the interactive effects of overtime and work environment characteristics.

2. Method

2.1. Participants and data collection procedures

As part of a wider program of offshore research, survey data were collected from day-work personnel on North Sea oil/gas installations (response rate >80%). Researchers visited each installation for 2–3 days to outline the nature and aims of the study (emphasising data confidentiality), respond to questions, distribute the survey questionnaires, and collect them when completed. These visits took place primarily during the Summer months; for further information about the data collection, see Parkes (2015). The present analysis was restricted to male personnel ($N=551$), as females accounted for less than 3% of the sample.

2.2. Measures

2.2.1. Sleep

Day-shift sleep duration and sleep quality were assessed, respectively, by the questions 'When you are working day-shifts, how many hours do you usually sleep during the off-duty period?' and 'How well do you usually sleep during this period?' The sleep quality scale ranged from 'very badly' (coded 0) to 'very well' (coded 6). Similar questions, referenced to leave weeks, assessed sleep duration and quality during shore leave.

2.2.2. Overtime

Participants reported how many hours per week they usually worked in excess of 12 h shifts; although overtime hours are recorded offshore, the need for anonymity did not allow use of these data. Responses were coded to represent overtime status (no overtime = 0; some overtime = 1); overtime duration (h/week) was coded as a second variable. Overtime work attracted additional payment for most personnel (although not for managers), and requests to work overtime were rarely refused.

2.2.3. Work environment

Adopting the framework of the demand/control model (Karasek and Theorell, 1990), job demand was assessed with five items covering quantitative work demands, time pressures, and multiple tasks ($\alpha = .87$); job control was assessed with six items concerned with influence over decisions, being able to work independently, and flexibility in managing work demands ($\alpha = .71$). These items had 5-point, 0 (*do not agree*) to 4 (*agree strongly*) response scales. The social support measure (five items) assessed the extent to which supervisors were perceived to be supportive and helpful (House, 1981); responses ran from 0 (*not at all*) to 3 (*very much*) ($\alpha = .85$). A six-item measure of the physical environment (e.g. heavy work, noise, vibration) (Hellesøy, 1985) was also included ($\alpha = .82$). Mean item scores were used in the analysis of these measures.

2.2.4. Control variables

Job type (seven occupational categories), site (12 installations), age and anxiety (Goldberg and Hillier, 1979) were treated as control variables. Also, to control for possible individual biases in sleep reporting, sleep duration during leave weeks was used as a control variable in the multivariate analysis of day-shift sleep duration; similarly, sleep quality during leave weeks was used as a control variable in the analysis of day-shift sleep quality.

2.3. Statistical treatment

Multivariate regression methods were used to evaluate the extent to which the measures of day-shift sleep duration and sleep quality were predicted by overtime status, overtime hours, and the work environment measures (entered simultaneously with the control variables). Interactions of overtime with the work environment measures were tested as a block, and were only retained in the model if significant. In these analyses, the 'missing data dichotomy' (MDD) method (Cohen and Cohen, 1983) was used to examine overtime status (i.e. overtime versus no overtime), together with overtime hours, as predictors of sleep. Continuous variables were standardized prior to entry, and interactions were evaluated at the mean levels of other variables in the model.

3. Results

3.1. Descriptive statistics

Overall, 54% of the participants reported overtime work. As shown in Table 1, the mean duration of overtime in this group was

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