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Sleep patterns of offshore day-workers in relation to overtime work and age

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ABSTRACT

In addition to long contractual hours during offshore weeks (14 × 12 h shifts), many personnel on North Sea oil/gas installations also work overtime, but little is known about the implications of overtime for sleep patterns offshore. In this study, the additive and interactive effects of overtime and age were analysed as predictors of sleep duration and sleep quality among offshore day-workers ($N = 551$), 54% of whom reported overtime. Sleep duration and quality were impaired among personnel who worked overtime, relative to those who worked only standard shifts; there was also an inverse dose–response relationship between overtime hours and sleep duration. Although the sleep measures were more favourable during shore leave than during offshore weeks, there was little evidence of compensatory sleep patterns. These findings are discussed with reference to known performance and health effects of short sleep hours; formal guidance on overtime work offshore is noted; and methodological issues are considered.

1. Introduction

Long work hours have been implicated in a range of physical and mental health impairments, including hypertension, cardiovascular disease, obesity, and depression (e.g. Bannai and Tamakoshi, 2014; Kim et al., 2013; Landsbergis et al., 2013; Solovieva et al., 2013). Decrements in cognitive performance have also been linked to long work hours (Proctor et al., 1996; Virtanen et al., 2009a,b). At an organizational level, long hours are associated with low productivity and poor work performance (Holden et al., 2010; Rosekind et al., 2010), high turnover rates (Steinmetz et al., 2014), sickness absence (Lallukka et al., 2014), and increased risks of accidents and injuries (Dong, 2005; Uehli et al., 2014). In seeking to understand the pathways by which long work hours are associated with these adverse individual and organizational outcomes, sleep has been a central focus of attention.

Thus, a review of earlier work, van der Hulst (2003) identified consistent links between long work hours and sleep disturbances, including short sleep duration. More recently, prospective and cross-sectional studies have provided further evidence that long hours are a risk factor for short sleep duration (Artazcoz et al., 2009; Magee et al., 2009; Ohtsu et al., 2013; Swanson et al., 2011) and other sleep impairments (Nakashima et al., 2011; Virtanen et al., 2009a,b). For instance, in a prospective study of UK civil servants, working >55 h per week (relative to 35–40 h week) predicted sleep disturbances among those free from sleep problems at baseline (Virtanen et al., 2009a,b); the associations took a linear dose–response form. Nakashima et al. (2011) reported similar findings, again including a dose–response relationship between work hours and short sleep duration.

Long work hours (60 h/week) have also been found to predict sleep impairment not only during work days but also during non-work days (Ohtsu et al., 2013; Swanson et al., 2011), although some evidence suggests that extended recovery sleep follows long hours of work (e.g. Hirsch Allen et al., 2014). Other evidence, in turn, links sleep impairments, particularly short sleep hours, to severe sleepiness at work (Son et al., 2008), occupational injuries (Salminen et al., 2010), sickness absence (Lallukka et al., 2014), performance impairment and increased risk of errors (Rogers et al., 2004; Williamson and Feyer, 2000), and depression (for a review, see, Weich, 2010).

Thus, sleep disturbances associated with long work hours and overtime are a potential risk factor not only for health problems, but also for performance decrements, accidents and injuries, and

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other organizationally-relevant outcomes. Much of the existing research in this area derives from large-scale studies covering a variety of socio-economic groups, occupations, and work rosters. These studies typically consider long work hours and sleep disturbance in the context of a regular work week of 30–40 h, and examine the effects of varying amounts of overtime, which may increase the total hours worked to 55 h per week or more (e.g. Artazcoz et al., 2009; Swanson et al., 2011; Virtanen et al., 2009a,b). In contrast, little is known about the impact on sleep of overtime carried out during extended work rosters in which 12-h shifts are worked for two or more weeks, alternating with periods of extended leave; when these long contractual hours are combined with overtime, work hours may be in excess of 100 h/week.

Research into extended work patterns has been carried out in several different industries, including remote mining (Di Milia and Bowden 2007; Muller et al., 2008), offshore oil/gas (Nielsen et al., 2013; Parkes, 2012; Waage et al., 2012), seafaring (e.g. Bridger et al., 2010; Hansen and Holmen, 2011), and remote construction (Forberg et al., 2010). Personnel employed in these industries are typically exposed not only to long work hours but also to a range of occupational stressors, including demanding physical work, potentially hazardous processes, safety-critical tasks, and crowded living space; in these circumstances, it is particularly important to understand the impact of overtime work as evidence suggests that physical and psychosocial stressors at work may combine with long work hours to predict need for recovery (Jansen et al., 2003).

Existing research into extended work schedules and sleep in industries that operate in remote locations tends to focus on standard contractual hours and, in particular, on day/night shift rotation (e.g. Menezes et al., 2004; Persson et al., 2006; Saksvik et al., 2011a). Thus, the issue of overtime among day-work personnel has been largely overlooked by researchers in these industries, although in the North Sea oil/gas industry the need for research into overtime work and its impact on sleep has long been recognized. In particular, Härmä et al. (2008) noted that overtime worked offshore merits research not only because it extends the 84-h contractual week, but it also because it increases exposure to harmful chemicals, and other potential health hazards. The present study represents an initial attempt to evaluate the impact of overtime work on the sleep patterns of offshore day-shift personnel.

1.1. Present study

The present study was carried out on North Sea oil/gas installations; in this environment, the standard work pattern is 14 consecutive days of 12-h shifts, alternating with a similar period of shore leave. In addition to these contractual work hours, overtime is not unusual (Lodden, 2000). Moreover, the offshore environment exposes personnel to challenging physical and psychosocial conditions, including potentially hazardous processes, constrained working and living space, and shared cabin accommodation. The main aim of the present study was to examine the role of overtime in relation to the duration and quality of sleep among North Sea personnel during offshore weeks and, for comparison, during leave weeks. The data analysis was restricted to permanent day-shift workers (who are responsible for the majority of offshore overtime work) in order to avoid the possible confounding effects of circadian disruption associated with day/night shift rotation.

In the analysis of sleep patterns, the study also took into account individual differences in age. Higher age is known to be associated with greater risk of sleep impairment (e.g. Marquié et al., 2012; Ohayon et al., 2004); in the present study, sleep disturbances associated with age were of particular interest in view of their implications for health and safety offshore. On the basis of the onshore research findings outlined above, it was predicted that overtime hours would be inversely associated with sleep quality and duration and, more specifically, that there would be a negative dose–response relationship between overtime hours and sleep duration during offshore weeks. It was also expected that age would be inversely related, either additively or interactively with overtime hours, to sleep duration and/or sleep quality during work weeks.

2. Methods and materials

2.1. Participants and procedure

Data were collected from personnel working on 12 North Sea oil/gas production installations. Researchers visited each installation for 2–3 days to distribute the survey materials; all personnel on board were invited to participate. Two visits were made to each installation to allow crew members on leave during the initial visit to take part. During these visits, researchers outlined the nature of the research to potential participants (emphasising that participation was voluntary and that all data would be treated as confidential) and responded to questions. Questionnaires were identified only by ID numbers. Completed questionnaires were returned in individual sealed envelopes before the researchers left the installation. Further details of the data collection are given by Parkes (in press). In total, 1130 personnel (85% response rate) returned completed questionnaires. Exclusion of personnel who did not work permanent day shifts, personnel who had been working on the installation for less than 2 months, and females (who made up <3% of personnel on board), left 572 personnel in the sample. After listwise deletion of missing data, the analysis sample consisted of 551 male day-shift personnel.

2.2. Measures

The following measures (obtained as part of a wider survey of offshore work conditions, health and safety) were included in the present analysis.

2.2.1. Age

The mean age of participants was 40.2 (SD 8.9) y, range 20–62 y.

2.2.2. Overtime

Participants recorded how many hours in excess of 12 h shifts they normally worked during a week offshore. 46% ($n = 254$) reported that they worked no overtime; among the remaining 54% ($n = 297$), the mean overtime was 16.0 (SD 7.6) h per week (range 2–42 h).

2.2.3. Control variables

Installation and job category were included in the analysis model to control for environmental and task-related differences. Anxiety was also included as a control variable to take into account individual differences in shift work tolerance (Tamagawa et al., 2007), and to avoid possible confounding with overtime in predicting sleep. *Installations.* Across the 12 installations in the study, the number of participants included in the present analysis ranged from 19 to 84; the mean was 46, SD 25. *Job category.* Seven job categories were identified: maintenance/technical ($n = 231$); management ($n = 98$); production ($n = 16$); catering (48); administration/clerical ($n = 55$); construction/deck/marine ($n = 81$); drill crew ($n = 22$). *Anxiety* was assessed by the General Health Questionnaire (Goldberg and Hillier, 1979) seven-item anxiety scale. Items were scored on a 0–3 rating scale. The mean score was 4.10 (SD 3.63), range 0–21. Coefficient alpha was .83.