

Published in *Accident Analysis and Prevention*, 54 (2016), 41-50

## Work environment, overtime and sleep among offshore personnel

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### KEYWORDS

Work environment; overtime; long work hours; sleep; offshore day-shifts; FIFO

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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 x 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.

## 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 & 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).

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 & 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 & 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 & 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  $16.0 \text{ h} \pm 7.6 \text{ h/week}$ . Relative to the group who did no overtime, the overtime group was significantly older, and reported shorter day-shift sleep duration and poorer day-shift sleep quality, although the two groups did not differ significantly in sleep during leave weeks. Compared to those who worked only standard 12-h shifts, the work environment of overtime personnel was significantly higher in both job demand and control, but significantly lower in physical environment stressors.

Age was non-significant in relation to the day-shift sleep measures, but anxiety was negatively related to sleep quality during day-shifts and leave weeks. The proportion of personnel reporting overtime differed significantly across job categories ( $\chi^2 = 73.0$ ,  $df = 6$ ,  $p < .001$ ). In particular, 90% of management personnel reported overtime, whereas only 46% of other personnel did so; managers also reported longer overtime hours, on average  $19.7 \text{ h/week}$  (compared with  $14.5 \text{ h/week}$  for other personnel), and their mean age ( $44.1 \pm 6.5 \text{ y}$ ) was higher than that of other personnel ( $39.4 \text{ y}$ ), ( $t = 4.77$ ,  $df = 495$ ,  $p < .001$ ).

A scatter plot was used to examine the bivariate relationship between reported overtime hours and day-shift sleep duration in the overtime group ( $n=297$ ). As shown in Figure 1, the regression line relating overtime hours and sleep duration was significant and negative ( $B = -.028$ ,  $t = -4.65$ ,  $df = 295$ ,  $p < .001$ ; constant = 6.95), and indicated that high levels of overtime ( $\geq 33 \text{ h/week}$ ) were associated with approximately 1 h per day sleep loss relative to the lowest level of overtime ( $1 \text{ h/week}$ ). However, there was considerable variation of individual data points around the regression line. A similar analysis showed no relationship between overtime hours and sleep quality.

**Table 1**

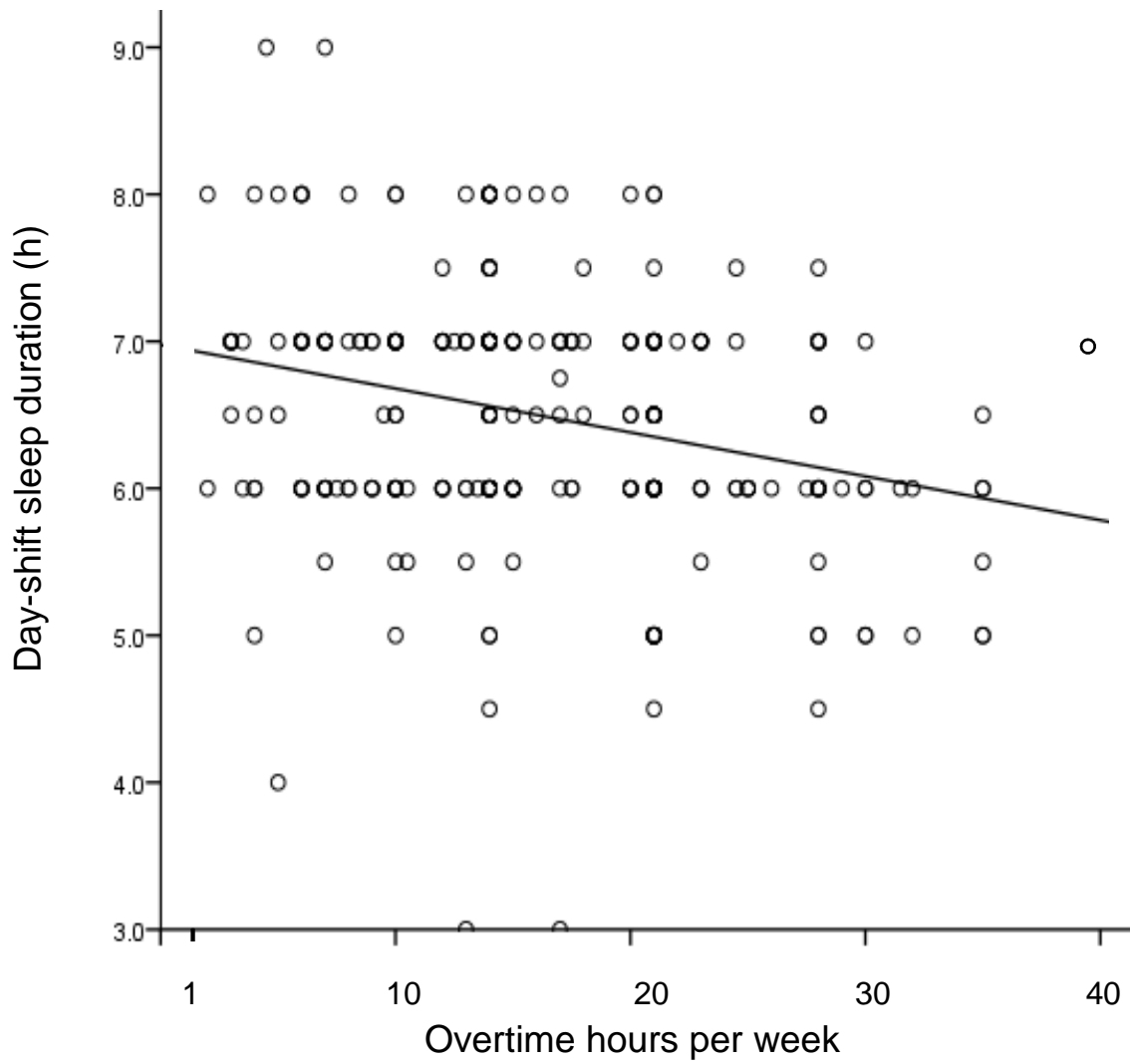
Study variables in relation to overtime status

	Overtime group N=297		No overtime group N=254		t <sup>1</sup>	Significance
	Mean	SD	Mean	SD		
Age (y)	41.9	8.0	38.2	9.6	4.83	<.01
Standard work week (h)	84.0	-----	84.0	-----	-----	-----
Overtime h/week	16.0	7.6	-----	-----	-----	-----
Sleep duration (h)						
Day shifts	6.50	0.85	7.00	0.81	7.01	<.01
Leave weeks	7.75	0.99	7.75	1.03	<1	ns
Sleep quality						
Day shifts	3.75	1.33	4.11	1.22	3.27	<.001
Leave weeks	4.79	1.12	4.87	1.09	<1	ns
Job demand	2.63	.89	1.99	.98	7.98	<.001
Job control	2.72	.71	2.51	.71	3.47	<.001
Supervisor support	1.66	.72	1.66	.70	<1	ns
Adverse physical environment	1.70	.87	2.01	.86	4.17	<.001

<sup>1</sup> df = 549 for all t-tests



**Relationship between overtime hours per week and day-shift sleep duration**



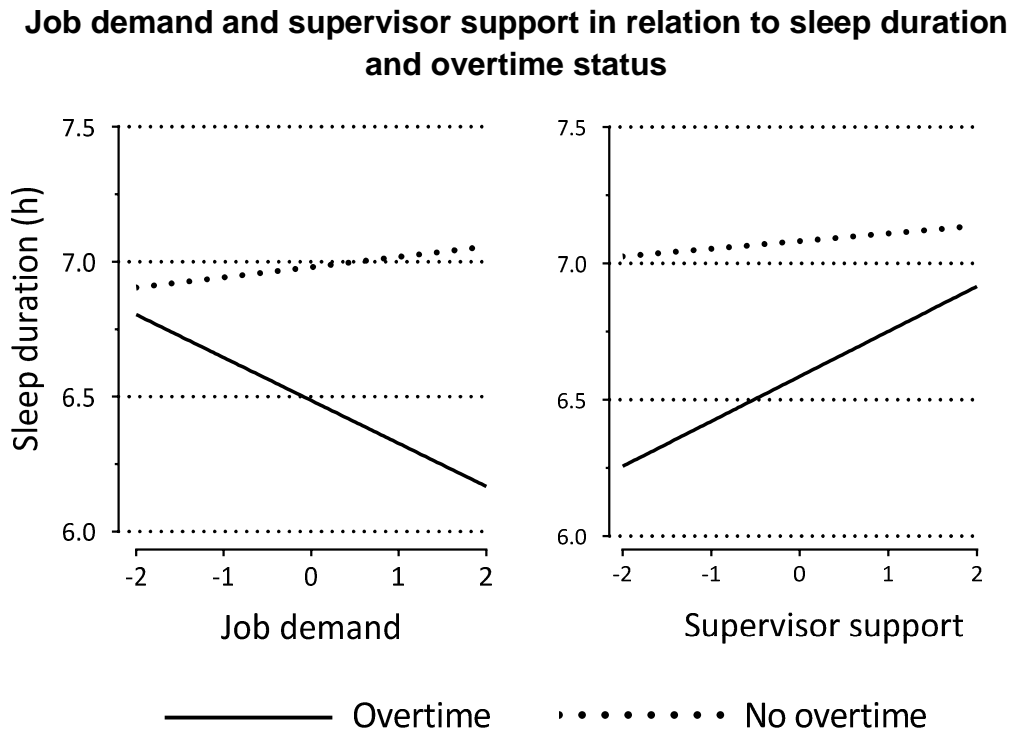
**Fig. 1.** Relationship between overtime hours worked per week and duration of sleep among offshore day-shift workers

### 3.2 *Multivariate analyses predicting day-shift sleep outcomes*

#### 3.2.1 *Sleep duration*

In a simultaneous additive multiple regression analysis, day-shift sleep duration was significantly predicted by overtime status ( $F=40.04$ ,  $df = 1,524$ ,  $p<.001$ ) and by overtime hours ( $F=16.75$ ,  $df = 1,524$ ,  $p<.001$ ). The group that reported overtime had significantly shorter mean day-shift sleep duration than those who reported no overtime; also, consistent with the bivariate regression analysis shown in Figure 1, in the overtime group, sleep duration was linearly and negatively related to number of overtime hours worked ( $B = -0.027$ ,  $t = -4.09$ ,  $p<.001$ ). Among those who worked the lowest number of overtime hours, mean adjusted sleep duration (6.8 h/day) was only marginally different from that for personnel who did no overtime (6.9 h/day) but sleep duration decreased significantly with increased overtime hours. For those reporting the highest rates of overtime ( $>33$  h/week), sleep duration fell below 6 h/day. In the additive model, supervisor support was also positively related to day-shift sleep duration ( $B = .10$ ,  $t = 2.71$ ,  $p<.01$ ).

Tests of interactions between overtime measures and the work environment variables revealed significant interactions of overtime status with job demand ( $F=6.77$ ,  $df = 1,522$ ,  $p<.01$ ) and with supervisor support ( $F=4.37$ ,  $df=1,522$ ,  $p<.05$ ). Among personnel who worked overtime, sleep duration was negatively related to job demand ( $B = -0.16$ ,  $t = -2.79$ ,  $p<.01$ ), and positively related to supervisor support ( $B = 0.17$ ,  $t = 3.51$ ,  $p<.001$ ), but for those who worked only standard 12 h shifts, these associations were non-significant. Figure 2 shows the form of the interactions. Overtime duration did not interact significantly with the work environment measures, but it remained a significant negative contributor to the model.



**Fig. 2.** Interactions of overtime status with job demand and supervisor support in relation to day-shift sleep duration. Standardized scores are used on the x-axes.

### 3.2.2 Sleep quality

In the multivariate analysis of sleep quality, overtime status was a significant factor; adjusted sleep quality ratings were 3.76 and 4.10, respectively, in the overtime and no-overtime groups ( $B = -.34$ ,  $t = -2.85$ ,  $p < .005$ ). However, duration of overtime was unrelated to sleep quality. Two work environment characteristics were also significant in the additive analysis; adverse physical environment was associated with poorer sleep quality ( $B = -.13$ ,  $t = -2.23$ ,  $p < .05$ ), while supervisor support was associated with higher sleep quality ( $B = .16$ ,  $t = 2.99$ ,  $p < .005$ ). When the additive model was extended to include interactions between overtime and the work environment variables, no significant interactions were found.

## 4. Discussion

Offshore installations impose long hours of work in a challenging, constrained and potentially hazardous environment. It is therefore particularly important that the duration and quality of sleep experienced by offshore personnel is sufficient to minimise operational and individual safety risks associated with fatigue and impaired performance, and to promote the health and well-being of those on board. Against this background, the aim of the present study was to examine the extent to which the additive and interactive effects of overtime work and physical/ psychosocial work characteristics predicted measures of sleep quality and duration among offshore day-shift workers.

### 4.1 *Overtime in relation to sleep*

More than half the study participants (54%) reported carrying out overtime work offshore; the mean duration of overtime was 16 h/week, equivalent to a total week of 100 h. The duration and quality of sleep were significantly impaired among those who reported overtime relative to those who worked only 12 h shifts. In addition, consistent with onshore research findings (Nakashima et al., 2011; Virtanen et al., 2009), day-shift sleep duration decreased in a linear dose-response manner with increases in overtime from 1 h/week to 40h/week.

Among personnel reporting 1 h/week overtime, adjusted mean sleep duration was only marginally different from that for the no-overtime group. However, for personnel working the longest overtime hours (>33 h/week), day-shift sleep fell below 6 h/day, the minimum duration required to prevent significant performance impairment (Van Dongen et al., 2003). Whilst only a small proportion of personnel reported these high levels of overtime, among those reporting average overtime hours (16 h/week), mean sleep duration was less than 6.5 h, markedly shorter than the 7 - 8 h sleep per day identified as optimal (e.g. Lallukka et al., 2014). Although the present study did not extend to examining relations between short sleep hours and individual/ organizational outcomes (e.g. reduced work ability, poor productivity, and accidents), evidence

suggests that short sleep durations, comparable to those found in the present study, act as a risk factor for adverse health and safety outcomes (e.g. Lian et al., 2015; Lombardi et al., 2012).

Overtime was also found to predict sleep quality; personnel who worked no overtime reported significantly higher sleep quality than those who did work overtime. However, in contrast to the findings of Nakashima et al. (2011), there was no evidence of a dose-response relationship between overtime duration and sleep quality, as might be observed if the link was a direct causal one. Other factors may be implicated; for instance, cognitive processes, such as work-related rumination, may play a mediating role (Åkerstedt et al., 2002; Kompier et al., 2012). Also, the association between overtime status and impaired sleep quality may be inflated by personality-related factors (e.g. obsessionality, workaholism) linked to both sleep and the tendency to work excessively (Kubota et al., 2010).

#### *4.2 The role of work environment characteristics*

Consistent with existing literature (e.g. Åkerstedt et al., 2002), in the additive analysis, sleep quality was positively related to supervisor support; it was also significantly negatively related to physical stressors. Evidence linking sleep impairments to adverse physical environments in onshore work settings tends to be relatively weak (Lallukka et al., 2010; Nakata et al., 2004) but on offshore installations the physical environment is particularly salient as personnel remain on board during off-shift hours. Thus, physical stressors such as cramped space, sea conditions, noise, and disturbances due to round-the-clock production, are risk factors for poor sleep quality among offshore personnel.

However, the main focus of the present study was to examine possible interactions between overtime and work environment variables as predictors of sleep outcomes. Significant interactions of overtime status with job demand and with supervisor support predicted day-shift sleep duration. The form of these interactions suggests that, relative to those who worked only standard 12-h shifts, overtime acts to increase the negative impact of job demand on sleep

duration and, conversely, high social support acts as a protective factor reducing sleep deficits associated with overtime. Thus, whilst definite causal interpretation is not possible, the present results suggest that the adverse impact of overtime on sleep duration may be mitigated by a favourable work environment (low job demand and high support). Also, the number of overtime hours reported made an independent, additive contribution to the interactive model; thus, working long overtime hours in an environment high in job demand and low in support represents a particularly adverse combination of conditions, exposing personnel to elevated risks of short sleep.

In this context, the work hours of offshore managers (90% of whom worked overtime) merit particular comment; relative to the other occupational groups, managers reported the longest overtime hours (an average of 19.7 h/week) and the highest levels of job demand. Offshore managers typically choose to work very long hours during offshore weeks, although (unlike the other occupational groups in the present study) they do not receive additional payment for extended work hours. Rather, high levels of overtime tend to reflect managers' commitment to, and responsibility for, the safety and productivity of the installation, and the well-being of personnel on board. In particular, in view of the potentially hazardous nature of offshore operations, the ability of managers to monitor production activities, to make decisions, and to respond promptly to operational incidents, is of vital importance.

The literature reviewed in the Introduction suggests that these capabilities would be impaired by long overtime hours, high job demands, and consequent short sleep duration, thus potentially increasing operational risks. Moreover, in the present study, the average age (44 y) of management personnel was higher than that of the other occupational groups. Recent evidence indicates that the association between poor sleep quality and work injury is significantly stronger for workers older than 30 years than among their younger counterparts (Uehli et al., 2014). This finding, which could also apply to other health and safety outcomes, suggests that older personnel offshore, especially senior managers, need to be particularly vigilant to ensure they obtain adequate sleep during offshore work weeks.

### 4.3 *Methodological issues*

The cross-sectional, self-report design of the present study inevitably limits interpretation of the findings. However, the sleep durations reported were broadly in line with those from actigraphic sleep assessments offshore (Saksvik et al., 2011). Moreover, in the multivariate models used to predict sleep duration and quality during offshore weeks, the corresponding sleep measures relating to leave weeks were included as control variables. Thus, in effect, the analyses examined the extent to which, relative to sleep at home, sleep during offshore weeks was associated with the work conditions experienced. This approach served to control for individual differences in sleep reporting, and to reduce possible ‘third factor’ confounding of relations between predictor variables and sleep outcomes. However, the use of single items, rather than established scales, to assess sleep represents a further methodological constraint.

In spite of these limitations, the present study adds new findings to the sparse literature on the combined effects of overtime and psychosocial/physical work characteristics. In particular, it demonstrates that interactions between overtime and work environment characteristics predict sleep duration, while sleep quality is predicted by additive models. However, future studies in this area would be enhanced by use of longitudinal methodology, actigraphic methods for assessing sleep, independent overtime data (e.g. from company records), and objective physical environment measures. These methods could strengthen causal interpretation, and allow evaluation of the extent to which demographic, environmental, and individual factors act independently or as moderators of the effects of overtime on sleep and other health and safety outcomes.

The present findings also have several implications for the offshore industry. First, the high rates of overtime reported, and the negative associations of overtime with sleep outcomes, suggest that increased monitoring of overtime is needed to ensure that long work hours do not prevent offshore personnel from obtaining adequate sleep, and hence leave them vulnerable to fatigue and performance impairment. Second, there is a need to identify personnel groups,

operating companies, and geographical sectors which have the highest rates of overtime work, so that interventions to reduce the risks of excessive overtime can be appropriately targeted. Third, although the present findings should be interpreted with caution, they suggest that impaired sleep associated with overtime offshore could potentially be mitigated by reducing job demands, enhancing supervisor support, and improving the physical environment.

## Acknowledgements

This study was carried out as part of a research program funded by the UK Health and Safety Executive (HSE) (Grant number MATSU/8550/3037); however, the contents of the article, including any opinions and/or conclusions expressed, are those of the author alone. The contributions of following individuals and organizations are gratefully acknowledged: Rob Miles, Offshore Safety Division, HSE for his support of the work; Melanie Clark and Esther Payne-Cook for their assistance in collecting and processing the data; and the companies and individuals that took part in the survey for their co-operation and interest in the work.

## References

- Åkerstedt, T., Axelsson, J., Lekander, M., Orsini, N., & Kecklund, G. (2014). Do sleep, stress, and illness explain daily variations in fatigue? A prospective study. *Journal of Psychosomatic Research*, 76, 280-285. doi: 10.1016/j.jpsychores.2014.01.005
- Åkerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., & Kecklund, G. (2002). Sleep disturbances, work stress and work hours: A cross-sectional study. *Journal of Psychosomatic Research*, 53, 741-748.
- Artazcoz, L., Cortès, I., Escribà-Agüir, V., Cascant, L., & Villegas, R. (2009). Understanding the relationship of long working hours with health status and health-related behaviours. *Journal of Epidemiology and Community Health*, 63, 521-527.



- Bannai, A., & Tamakoshi, A. (2014). The association between long working hours and health: A systematic review of epidemiological evidence. *Scandinavian Journal of Work, Environment and Health*, 40, 5-18.
- Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Elovainio, M., Salo, P., Jokela, M., Heponiemi, T., Linna, A., Virtanen, M., . . . Vahtera, J. (2013). Psychosocial factors and well-being among Finnish GPs and specialists: A 10-year follow-up. *Occupational and Environmental Medicine*, 70, 246-251. doi: 10.1136/oemed-2012-100996
- Goldberg, D. P., & Hillier, V. F. (1979). A scaled version of the General Health Questionnaire. *Psychological Medicine*, 9, 139-145.
- Hellesøy, O. H. (1985). *Work environment: Statfjord Field*. Bergen, Norway: Universitetsforlaget.
- House, J. S. (1981). *Work Stress and Social Support*. Reading, Mass.: Addison-Wesley Publishing Company.
- Israel, B. A., Baker, E. A., Goldenhar, L. M., Heaney, C. A., & Schurman, S. J. (1996). Occupational stress, safety, and health: conceptual framework and principles for effective prevention interventions. *Journal of Occupational Health Psychology*, 1, 261-286.
- Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity and the reconstruction of working life*. New York: Basic Books, Inc.
- Kompier, M. A. J., Taris, T. W., & van Veldhoven, M. (2012). Tossing and turning - insomnia in relation to occupational stress, rumination, fatigue, and well-being. *Scandinavian Journal of Work, Environment and Health*, 38, 238-246.
- Kubota, K., Shimazu, A., Kawakami, N., Takahashi, M., Nakata, A., & Schaufeli, W. B. (2010). Association between workaholism and sleep problems among hospital nurses. *Industrial Health*, 48, 864-871.
- Lallukka, T., Haaramo, P., Rahkonen, O., & Sivertsen, B. (2013). Joint associations of sleep duration and insomnia symptoms with subsequent sickness absence: The Helsinki Health Study. *Scandinavian Journal of Public Health*, 41, 516-523.

- Lallukka, T., Kaikkonen, R., Härkänen, T., Kronholm, E., Partonen, T., Rahkonen, O., & Koskinen, S. (2014). Sleep and sickness absence: A nationally representative register-based follow-up study. *Sleep*, 37, 1413-1425.
- Lallukka, T., Rahkonen, O., Lahelma, E., & Arber, S. (2010). Sleep complaints in middle-aged women and men: The contribution of working conditions and work-family conflicts: Sleep in the middle-aged. *Journal of Sleep Research*, 19, 466-477.
- Lian, Y., Xiao, J., Liu, Y., Ning, L., Guan, S., Ge, H., . . . Liu, J. (2015). Associations between insomnia, sleep duration and poor work ability. *Journal of Psychosomatic Research*, 78, 45-51. doi: 10.1016/j.jpsychores.2014.09.009
- Lombardi, D. A., Wirtz, A., Willetts, J. L., & Folkard, S. (2012). Independent effects of sleep duration and Body Mass Index on the risk of a work-related injury: Evidence from the US national health interview survey (2004-2010). *Chronobiology International*, 29, 556-564. doi: 10.3109/07420528.2012.675253
- Nakashima, M., Morikawa, Y., Sakurai, M., Nakamura, K., Miura, K., Ishizaki, M., . . . Nakagawa, H. (2011). Association between long working hours and sleep problems in white-collar workers. *Journal of Sleep Research*, 20, 110-116.
- Nakata, A., Haratani, T., Takahashi, M., Kawakami, N., Arito, H., Kobayashi, F., & Araki, S. (2004). Job stress, social support, and prevalence of insomnia in a population of Japanese daytime workers. *Social Science and Medicine*, 59, 1719-1730.
- Nishikitani, M., Nakao, M., Karita, K., Nomura, K., & Yano, E. (2005). Influence of overtime work, sleep duration, and perceived job characteristics on the physical and mental status of software engineers. *Industrial Health*, 43, 623-629.
- Ohtsu, T., Kaneita, Y., Aritake, S., Mishima, K., Uchiyama, M., Akashiba, T., . . . Ohida, T. (2013). A cross-sectional study of the association between working hours and sleep duration among the Japanese working population. *J. Occup. Health*, 55, 307-311.
- Parkes, K. R. (2015). Shift rotation, overtime, age and anxiety as predictors of offshore sleep patterns. *Journal of Occupational Health Psychology*, 20, 27-39. doi: <http://dx.doi.org/10.1037/a0038164>

- Saksvik, I. B., Bjorvatn, B., Harvey, A. G., Waage, S., Harris, A., & Pallesen, S. (2011). Adaptation and readaptation to different shift work schedules measured with sleep diary and actigraphy. *Journal of Occupational Health Psychology*, 16, 331-344.
- Salminen, S., Oksanen, T., Vahtera, J., Sallinen, M., Härmä, M., Salo, P., . . . Kivimäki, M. (2010). Sleep disturbances as a predictor of occupational injuries among public sector workers. *Journal of Sleep Research*, 19, 207-213.
- Salo, P., Ala-Mursula, L., Rod, N. H., Tucker, P., Pentti, J., Kivimäki, M., & Vahtera, J. (2014). Work time control and sleep disturbances: Prospective cohort study of Finnish public sector employees. *Sleep*, 37, 1217-1225.
- Sekine, M., Chandola T, Martikainen P, Marmot M, & S., K. (2006). Work and family characteristics as determinants of socioeconomic and sex inequalities in sleep: The Japanese Civil Servants Study. *Sleep*, 29, 206-216.
- Tsuboya, T., Aida, J., Osaka, K., & Kawachi, I. (2015). Working overtime and risk factors for coronary heart disease: A propensity score analysis based in the J-SHINE (Japanese Study of Stratification, Health, Income, and Neighborhood) study. *American Journal of Industrial Medicine*, 58, 229-237. doi: 10.1002/ajim.22409
- Uehli, K., Miedinger, D., Bingisser, R., Dürr, S., Holsboer-Trachsler, E., Maier, S., . . . Leuppi, J. D. (2014). Sleep quality and the risk of work injury: A Swiss case-control study. *Journal of Sleep Research*.
- Van der Hulst, M., Van Veldhoven, M., & Beckers, D. (2006). Overtime and need for recovery in relation to job demands and job control. *Journal of Occupational Health*, 48, 11-19.
- Van Dongen, H. P. A., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26, 117-126.
- Van Laethem, M., Beckers, D. G. J., Kompier, M. A. J., Dijksterhuis, A., & Geurts, S. A. E. (2013). Psychosocial work characteristics and sleep quality: A systematic review of longitudinal and intervention research. *Scandinavian Journal of Work, Environment and Health*, 39, 535-549.

Virtanen, M., Ferrie, J. E., Gimeno, D., Vahtera, J., Elovainio, M., Singh-Manoux, A., . . .

Kivimäki, M. (2009). Long working hours and sleep disturbances: The Whitehall II prospective cohort study. *Sleep*, 32, 737-745.

Williamson, A. M., & Feyer, A. M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational and Environmental Medicine*, 57, 649-655.