



Age and work environment characteristics in relation to sleep: Additive, interactive and curvilinear effects



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ABSTRACT

Although additive combinations of age and work environment characteristics have been found to predict sleep impairment, possible *age x work environment* interactions have been largely disregarded. The present study examined linear and curvilinear interactions of age with work environment measures in relation to sleep quality and duration. Survey data were collected from offshore day-shift personnel (N = 901). Main effects and interactions of the age terms with work environment measures (job demand, control, and social support, physical environment and strenuous work) were evaluated. Sleep duration was predicted by a curvilinear interaction, *age² x job demand* ($p < .005$), and by the *age x social support* interaction ($p < .002$); sleep quality was predicted by *age x job demand* ($p < .002$). Job control and physical environment showed significant additive effects. At a time when older employees are encouraged to remain in the workforce, the findings serve to increase understanding of how ageing and work demands jointly contribute to sleep impairment.

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1. Introduction

Global, economic and technological changes in recent years have led to 'work intensification', characterized by increased workloads, time pressures, long work hours, lean production methods, and deteriorating employment conditions (Chandola, 2010). At the same time, the age profile of the workforce is increasing (Office of Science and Technology, 2011), and current employment policies encourage older workers to continue working longer than was expected in previous generations. Together, these factors highlight the importance of understanding how work environment characteristics and age combine to predict organizational and individual outcomes. Sleep impairment, the outcome examined in the present study, is particularly relevant as there is evidence that insufficient or poor quality sleep is a causal factor in short-term performance decrements (Williamson and Feyer, 2000), and longer-term outcomes, including work absences (Lallukka et al., 2014), reduced productivity (Rosekind et al., 2010), occupational injuries (Hägg et al., 2015; Salminen et al., 2010), and chronic ill-health (Grandner et al., 2012). The present study builds on

published research, as summarized below, into the roles of age and the work environment in relation to sleep impairment.

1.1. Age and sleep

Higher age is typically associated with greater risk of sleep impairments in the general population (e.g. Ansiau et al., 2005; Moraes et al., 2014). However, relations between age and sleep are complex; they are not necessarily linear (Grandner et al., 2012), and they may be at least partially attributable to lifestyle factors rather than physiological changes (Ohayon et al., 2001). Also, patterns of change over time vary with the nature of the sleep impairment examined. Thus, Salo et al. (2012) found that the prevalence of insomnia symptoms was higher at older ages, relative to the age range 34–45 y, while 'sleep lost over worry' showed a high prevalence at age 34–60 y followed by a decline at older ages.

More directly relevant to the present work, age-related changes in sleep have also been found in occupational samples (Marquié et al., 2012; Ribet and Derriennic, 1999). Among shift workers, there is evidence of non-linear relationships between age and sleep; thus, some studies report an upturn in sleep quality at higher ages, most likely due to the tendency of older workers to give up shift work if they experience sleep difficulties (Marquié et al., 2012; Tucker et al., 2011). A similar upturn in sleep quality at older ages

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was found by Parkes (2015a), but it applied only to night-shift work. Curvilinear age effects have also been found in relation to measures of occupational well-being (Hochwarter et al., 2001; Zacher et al., 2014).

1.2. Work environment and sleep

1.2.1. Psychosocial work characteristics

Findings relating psychosocial work characteristics to sleep quality were reviewed by Van Laethem et al. (2013). A total of 16 longitudinal studies, including three judged to be of high standard, met the inclusion criteria. Evaluating these studies, the authors concluded that “higher job demands are associated with lower future sleep quality” (p.544); they also found moderate evidence of a positive link between job control and sleep quality. However, they noted that the proportion of variance attributable to these job characteristics was relatively small and, for other measures, including social support, the evidence was insufficient to draw firm conclusions. More specific findings are summarised below.

1.2.1.1. Job demand. Measures of job demands or job strain (Karasek and Theorell, 1990) are typically found to be strong predictors of adverse sleep outcomes; prospective studies have demonstrated that, among participants free of insomnia at baseline, high demands and/or high strain increases the risk of insomnia at follow-up (Jansson and Linton, 2006; Jansson-Fröjmark et al., 2007; Linton, 2004; Ota et al., 2009). Changes from low to high job demand (Åkerstedt et al., 2012), or job strain (de Lange et al., 2009) are also associated with onset of, or increases in, sleep impairments. Structural modeling analyses have provided further evidence of the causal role of job demand in sleep disturbance (Magnusson Hanson et al., 2014).

1.2.1.2. Job control. Studies of job control in relation to sleep have tended to produce inconsistent findings. Prospectively, de Lange et al. (2009) found that higher control predicted a reduction in sleep complaints; other studies reported that low influence over decisions predicted maintenance of insomnia over a one-year period (Jansson and Linton, 2006; Jansson-Fröjmark et al., 2007). However, some authors have reported non-significant findings (Åkerstedt et al., 2012; Nakata et al., 2004). Evidence also indicates that ‘low control over work time’ predicts impaired sleep (e.g. Kubo et al., 2013; Takahashi et al., 2011). Other studies have produced more complex results, suggesting that additional factors may also be implicated. Thus, among physicians, work-time control was associated with fewer short sleeps (<6 h), but only among those who never worked long shifts (>12 h) (Tucker et al., 2015). Also, increased risk of sleep problems was linked to low work-time control among employees who worked low or average hours, but also to high work-time control among those working very long hours (Salo et al., 2014).

1.2.1.3. Social support. The nature, magnitude and direction of the relationships between social support and sleep remain unclear. In cross-sectional analyses, Hämmig and Bauer (2014) found that low social support was related to sleep disturbances among industrial employees; other researchers reported similar findings (Åkerstedt et al., 2002; Sinokki et al., 2010). Prospectively, two studies have shown that low social support predicts the maintenance of insomnia over a one-year period (Jansson and Linton, 2006; Ota et al., 2009), but Magnusson Hanson et al. (2011) identified a significant reverse causal path, sleep disturbance leading to low social support. Saijo et al. (2014) reported ‘more-than-additive’ effects of job control and social support; low control combined with low support predicted high risk of insomnia.

1.2.2. Physical work conditions

Physical environment stressors and strenuous physical work are also associated with sleep impairments. Among industrial employees, an adverse physical environment, including exposure to noise/vibration and awkward postures (Hämmig and Bauer, 2014; Ribet and Derriennic, 1999) and poor lighting, temperature and ventilation (Nakata et al., 2004), and have been found to increase the risk of insomnia. Strenuous work is also a significant risk factor for sleep disturbance (Åkerstedt et al., 2002; Åkerstedt et al., 2002). More generally, Zhang et al. (2015) found that a composite measure of favorable physical/psychosocial work characteristics (including low levels of physical work demands and violence at work, and high physical safety) was inversely and linearly related to the proportion of the sample reporting short sleep duration (defined as ≤ 6 h per day).

1.3. Research questions

The findings reviewed above demonstrate that both age and the work environment are significantly associated with sleep impairments. However, a limitation of much research in these areas is that only additive combinations of age and work environment measures are considered (e.g. Åkerstedt et al., 2002; Ribet and Derriennic, 1999); often, age is treated solely as a control variable (e.g. Ota et al., 2009; Lallukka et al., 2010; Swanson et al., 2011). These approaches may over-simplify the nature of the joint contribution of age and work environment characteristics to sleep impairment. Theoretical models (Israel et al., 1996; Siegrist, 2008) suggest that more complex mechanisms, particularly mediator and moderator effects, may be implicated in pathways that link age and the work environment to health-related outcomes. These mechanisms have rarely been considered in relation to sleep, although Virtanen et al. (2009) noted that high job demands could partially explain links between long work hours and sleep disturbances.

The role of age as a potential moderator of relations between work environment characteristics and sleep remains largely unexplored. Marquie et al. (1999) noted that few studies addressed the extent to which job characteristics interact with age to predict sleep quality. This observation still applies, although in one recent exception, age was found to moderate the association between control over work hours and sleep disturbance (Loudoun et al., 2014). Failure to consider possible moderator effects limits understanding of relations between work characteristics, age and sleep, and may lead to important issues being overlooked. For instance, if older age combines synergistically with adverse work characteristics to predict sleep disturbance, this mechanism could contribute to negative outcomes associated with work intensification (e.g. Worrall and Cooper, 2014).

1.4. Present study

The present study sought to examine how age and measures of the psychosocial/physical work environment combine to predict the duration and quality of sleep. The participants were day-work personnel employed in the North Sea oil/gas industry. Demanding work conditions and long hours are inherent in offshore employment; day-shift personnel work 14 x 12-h shifts (and possible overtime) during offshore work weeks, alternating with 2–3 weeks of shore leave. In the present study, psychosocial work characteristics were assessed with measures of job demand, control, and social support; the physical environment measures assessed adverse ambient conditions (e.g. noise, poor air quality) and strenuous work, respectively. In view of evidence of curvilinear effects of age on sleep, both linear and curvilinear age terms and their interactions with work environment variables were

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