Safety and Health at Work 6 (2015) 240–248

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.org

Original Article

Self-Reported Recovery from 2-Week 12-Hour Shift Work Schedules: A 14-Day Follow-Up

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ARTICLE INFO

Article history:
Received 13 April 2015
Received in revised form
25 June 2015
Accepted 2 July 2015
Available online 29 July 2015

Keywords:
fatigue
long working hours
night work
offshore workers
recovery after work

ABSTRACT

Background: Recovery from fatigue is important in maintaining night workers' health. This study compared the course of self-reported recovery after 2-week 12-hour schedules consisting of either night shifts or swing shifts (i.e., 7 night shifts followed by 7 day shifts) to such schedules consisting of only day work.

Methods: Sixty-one male offshore employees—20 night workers, 16 swing shift workers, and 25 day workers—rated six questions on fatigue (sleep quality, feeling rested, physical and mental fatigue, and energy levels; scale 1–11) for 14 days after an offshore tour. After the two night-work schedules, differences on the 1st day (main effects) and differences during the follow-up (interaction effects) were compared to day work with generalized estimating equations analysis.

Results: After adjustment for confounders, significant main effects were found for sleep quality for night workers (1.41, 95% confidence interval 1.05–1.89) and swing shift workers (1.42, 95% confidence interval 1.03–1.94) when compared to day workers; their interaction terms were not statistically significant. For the remaining fatigue outcomes, no statistically significant main or interaction effects were found.

Conclusion: After 2-week 12-hour night and swing shifts, only the course for sleep quality differed from that of day work. Sleep quality was poorer for night and swing shift workers on the 1st day off and remained poorer for the 14-day follow-up. This showed that while working at night had no effect on feeling rested, tiredness, and energy levels, it had a relatively long-lasting effect on sleep quality.

1. Introduction

Recovery from work-related fatigue is important in maintaining employee health [1–4]. Studies show that the inability to recover after work, as assessed by self-reports, predicts longer sickness absence [5,6], as well as cardiovascular disease and cardiovascular mortality [7,8]. The effort–recovery model defines recovery as a process of unwinding to and stabilizing at a baseline level of activation in the absence of specific work demands [3,9]. Recovery can be impeded when the body's psychophysiological systems remain activated, even when work demands have been removed. According to the allostatic load model an accumulative process of increased and prolonged activation over time may cause gradual wear and tear on the body's organs causing a predisposition to disease [9,10].

Working long hours can impede the recovery process in two ways. Firstly, prolonged exposure to work demands may leave the employee experiencing a higher level of fatigue than after an 8-hour working day. Secondly, the reduction in time to unwind may not be sufficient to recover completely in between working days [11]. When recovery is impeded in schedules with long working hours and extended working weeks, it leads to an

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2093-7911/$ – see front matter
http://dx.doi.org/10.1016/j.shaw.2015.07.003

accumulation of fatigue over the working period [12,13], and a spill-over of the level of fatigue into the start of the free period [14]. Recovering from long night shifts in extended schedules is seen to be extra challenging, as the opportunity to recover between shifts is further impeded by sleep problems and disruption of the physiological circadian rhythm associated with the changed sleep/wake cycle [15–17].

Long working hours in extended schedules are standard in the Norwegian offshore petroleum industry [18–20]. The remote offshore locations of the oil platforms necessitate compressing the working hours into 12-hour shifts and extending the working periods to 14–21 days. Shift schedules consist of: permanent day work; permanent night work; fixed shifts: alternating day and night shifts every other tour; or swing shifts: either 7 night shifts followed by 7 day shifts every tour, or vice versa. The offshore working periods are followed by 3–4 weeks of respite.

Studies from the offshore petroleum industry have assessed sleep after 2 weeks of night shifts, swing shifts (7 night shifts followed by 7 day shifts), and day shifts, but omitted other dimensions of fatigue [20–22]. For sleep quality, night and swing shift workers scored similarly to day workers during the free period, but for sleepiness, night workers scored poorer [20,21]. However, fatigue does not only consist of a sleep-related dimension, it also has a mental and a physical dimension, as well as dimensions for lack of energy and reduced activities [22–24]. Studying multiple dimensions of fatigue is important in understanding the full scale of implications of working at night in schedules with long shifts and extended weeks [19,22].

Previous research on compressed and extended night working periods have not assessed recovery indicators beyond 7 days of the free period [18,19,25], while in this period sleep indicators still fluctuated [18]. Recovery is a dynamic process that unfolds over time [26] and knowing more about it would be beneficial for recovery theory [9]. Therefore, a longer follow-up than 7 days is needed to study the course of recovery to a period of stability inherent to the definition of recovery.

This study aimed to compare the course of self-reported recovery from work-related fatigue after 2-week 12-hour schedules that consisted of either night shifts or swing shifts (7 night shifts followed by 7 day shifts) to such schedules consisting of only day work, by assessing several dimensions of fatigue during a 14-day follow-up period.

2. Materials and methods

2.1. Participants and procedure

In total, 2,492 invitations were distributed in eight oil companies active on the Norwegian Continental Shelf. Inclusion was restricted to: (1) male employees; (2) at least 2 years offshore experience; and (3) parental responsibility for at least one child living at home younger than 18 years. The latter criterion mirrored the research goal of the larger project under which this study falls, i.e., studying work–family balance amongst offshore personnel. Response was received from 184 employees, of whom 20 did not meet the inclusion criteria and were excluded, 60 declined to participate or withdrew from the study, and 33 were lost to follow-up. Eight swing shift workers rotating from day to night shifts were excluded from analysis, as were two swing shift workers of whom the rotation directions were unknown. The final study sample consisted of 61 participants, all of whom had given written informed consent prior to the start of the study. It was not known how many of the 2,492 employees approached for this study were eligible for participation, because privacy regulations prevented the research team from gaining information on how many employees met the third inclusion criterion.

The study had an observational, repeated measures design. Participants received a booklet by postal mail that consisted of a diary that assessed self-perceived recovery and a general questionnaire that assessed demographic, work-related, and health-related background information. The diary was filled in daily during the first 14 days of a self-chosen free period; the general questionnaire was filled in on the 1st day of that same free period.

2.2. Dependent variables

2.2.1. Daily self-reported recovery

Self-reported recovery was the main outcome of this study and was assessed daily by six single-item questions. The items consisted of questions on sleep quality, feeling rested, physical tiredness, mental tiredness, energy for activities related to the family and home, and energy for activities of personal interest. All questions were assessed with similar questions, for example: “On a scale from very little to a great extent, how *mentally tired* did you feel today?” The items were assessed on an 11-point Likert scale anchored on both extremes with *very badly* and *very well* for sleep quality, and with *very little* and *a great extent* for the remaining items. The outcomes for sleep quality, feeling rested, and both items on energy levels were reverse-coded for data analysis to consistently assign low scores to positive levels of self-reported recovery. Single-item questions on recovery, with comparable 1–10 Likert scale answer categories, have been used in previous diary studies to reduce the burden of participation for the respondent [11,27]. Single-item questions have been found to be valid, reliable, and practical in studies where full questionnaires are not feasible [28,29].

2.3. Independent variables

2.3.1. Shift schedule

For the offshore tour preceding the diary study, the shift schedule was assessed together with the starting and finishing times of the shifts. From this information the shift schedules were categorized into night shifts, swing shifts (7 night shifts followed by 7 day shifts), and day shifts.

2.4. Background information and control variables

2.4.1. Demographic and health-related information

Demographic information was assessed regarding age, level of education, marital status (partner/no partner), and age of the children living at home. Based on the idea that younger children require more care and, therefore, could be considered more fatiguing, the age of the children was dichotomized into: (1) at least one child younger than 7 years; and (2) all children aged 7 years or older. Self-perceived general health status was assessed using a single-item question with answer categories on a 5-point Likert scale ranging from *very good* to *very poor* [30].

2.4.2. Fatigue, need for recovery, and sleep problems during offshore period

For the offshore tour preceding the diary study, information was assessed regarding fatigue, need for recovery, and sleep problems. Self-perceived ratings of fatigue and need for recovery were assessed using the Checklist Individual Strength (CIS) [31,32] and Need for Recovery Scale [33,34], respectively. Sleep problems experienced during the offshore working period were assessed with four questions answered on a 4-point Likert scale (never/sometimes/often/every day). Three questions came from the Karolinska Sleep Questionnaire (problems with falling asleep, problems