Tenth International Conference on Managing Fatigue: Abstract for Review

Daily Measurements of Fatigue and Sleep During a Full Offshore Rotation. Implications for Fatigue Risk Management Programs.

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Problem

Fatigue is an important health and safety risk factor in the offshore oil and gas industry.[1,2] Some of the major offshore and industry disasters have been linked to human error, and more specifically fatigue.[3,4] To better understand fatigue offshore, we investigated the course of fatigue and sleep parameters during a full offshore rotation. Specifically, we were interested in the identification of possible fatigue prone periods to help improve current fatigue risk management programs.

Method

A prospective cohort study with repeated measures was conducted among N=49 offshore workers in the Dutch Continental Shelf. Offshore workers were monitored for a full offshore rotation of four weeks. Three across offshore rotation periods were defined: (1) pre-departure (week 1); (2) offshore (week 2 & 3); and (3) post-offshore (week 4). In addition, days on shift during the offshore period, were defined: Offshore days 1&2; Days 3-9; Days 10&11; Days 12-14.

Subjective and objective monitoring tools were used to measure the course of fatigue and sleep parameters over time. During the four-week study period, subjective fatigue was measured bi-daily with the self-reported Karolinska Sleepiness Scale (KSS). Sleep parameters were measured objectively with continuous actigraphy recordings (MotionWatch 8®, Camntech). Actigraph parameters included: time in bed (TIB), sleep latency (SL) and sleep efficiency percentage (SE%). Furthermore, during the offshore period, fatigue was objectively measured bi-daily with the 3-min Ipad app version of the psychomotor vigilance tasks (PVT-B) (Pulsar Informatics; Joggle Research®). Mean daytime scores were calculated for the KSS and PVT-B recordings. Linear mixed models were used to investigate the course of fatigue and sleep parameters over time. Ethical approval for the study was granted by the Medical Ethics Committee of the University Medical Center Groningen, The Netherlands (reference number: M14.165646).

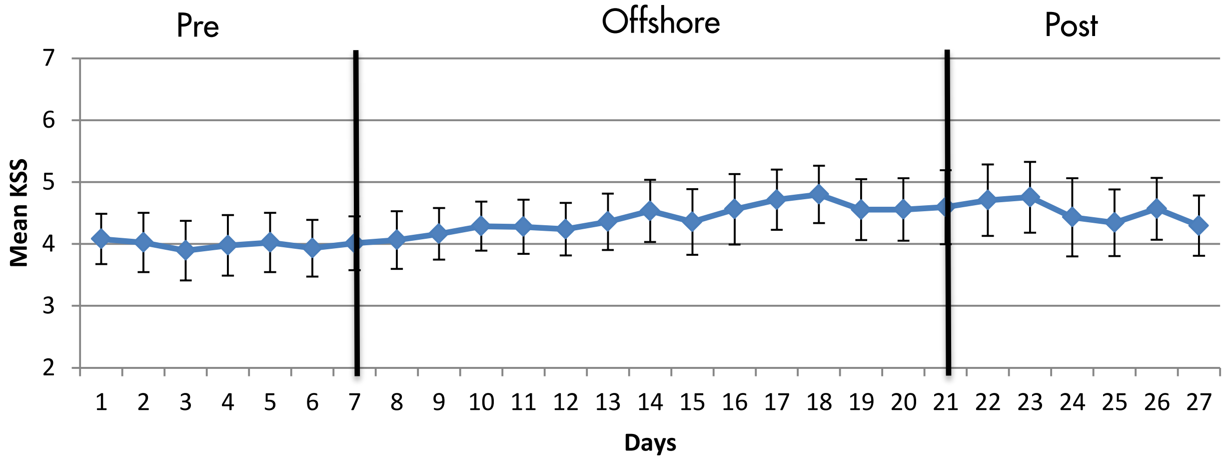
Results

The final sample consisted of N=49 (82%) offshore workers. All participants were males and their mean age was 42 years (SD=11.9).

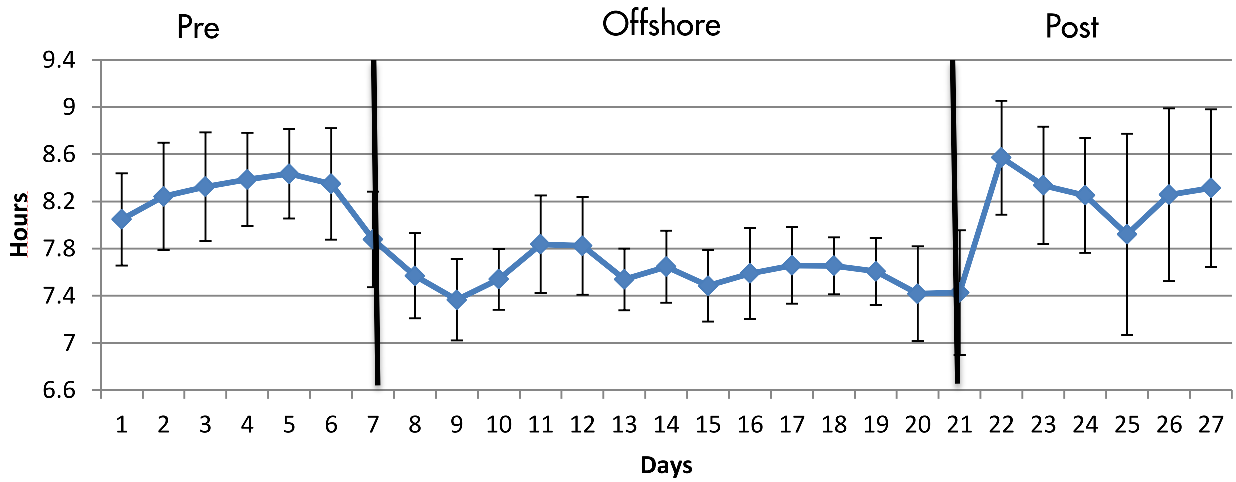
Across the offshore rotation, mean daytime fatigue scores (KSS) changed significantly over the three pre-defined periods (p=.004). Mean daytime fatigue was significantly higher during post-offshore period compared to pre-departure and offshore period (see graph 1). Both time in bed (TIB) (p<.001) and sleep latency (SL) (p=.05) changed significantly over the three pre-defined periods. TIB was significantly shorter during offshore periods compared to pre-departure [$M_{difference}$=-28.67 SE=9.90, CI(-48.13,-9.22), p=.004] and post offshore periods [$M_{difference}$=-52.91, SE=10.11, CI(-72.77,-33.05), p<.001] (see graph 2). SL was significantly shorter in the post offshore period versus the offshore period [$M_{difference}$=.41, SE=.18, CI(.06,.75), p=.02]. SE% did not differ significantly between the pre-defined periods.

During the offshore shifts, a significant difference of day average offshore fatigue scores (KSS) was found between the four different days on shift (p=.003). Days 10 &11 had the highest fatigue day average scores compared to all other days on shift (see graph 1). Mean day reaction time scores (PVT-B) did not differ significantly over the four different days on shift. Days 1 & 2 had the slowest reaction time scores compared to all other days on shift (see graph 3).

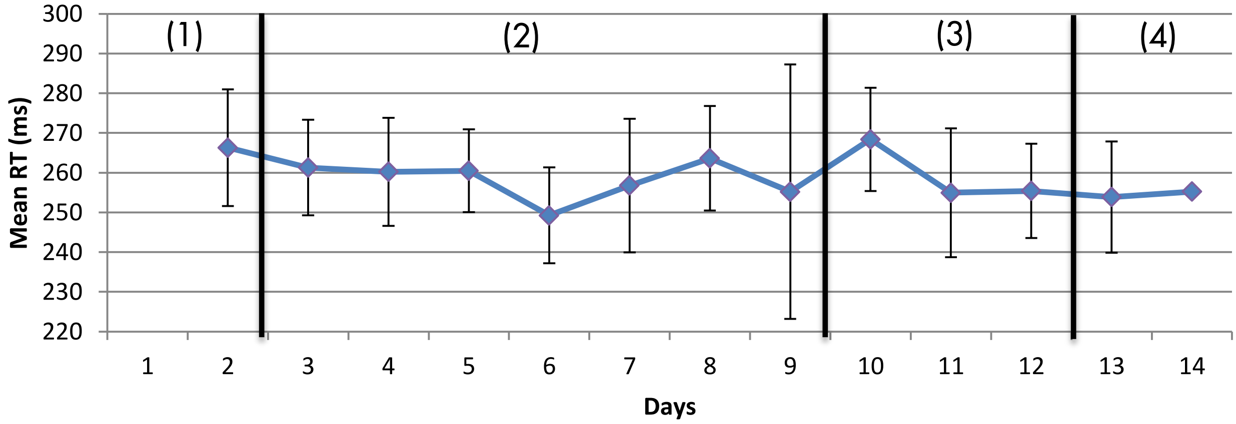
Graph 1. Mean day average KSS scores across the offshore rotation



Graph 2. Time in bed (TIB) scores across the offshore rotation



Graph 3. Mean day average reaction time test scores (PVT-B) during the days on shift



Discussion

Across the offshore rotation, mean subjective fatigue scores did not exceed the cut-off KSS≥ 7 for severe fatigue. However, subjective fatigue increased and remained elevated even in the first few days of the post offshore period, indicating a need for recovery upon return to the home environment. This finding is supported by decreased sleep latencies (SL) in the post-offshore period, i.e.an increased sleep pressure after offshore shifts. This sleep pressure could be due to the shorter sleep lengths (time in bed; TIB) during offshore shifts compared to the pre-departure and post-offshore periods. Although the minimum requirement of 7-8 hours of sleep was attained in all three periods, the shortened sleep lengths could have had an impact on the fatigue scores. Thus, the post offshore period represents a possible fatigue prone period which could be considered in FRM policies.

During the offshore shift, we found that subjective fatigue scores (day average KSS scores) reached a peak on day 10&11 offshore. Although the mean scores did not reach the cut-off of KSS≥ 7 for severe fatigue, we believe that this finding may indicate another possible fatigue prone period. The peak in offshore days 1&2 may be explained by the hectic offshore arrival and hand over period and the novelty of completing the PVT.

Summary

The course of fatigue and of some sleep parameters (TIB, SL) significantly changed during offshore rotations. Overall, offshore days 1&2, 10&11 as well as the first few days in the post offshore period were identified as likely fatigue prone periods, though the mean scores did not reach the cut-off of KSS≥7 for severe fatigue. Our research indicates the importance of looking at the whole offshore rotation (pre-, during and post offshore) to assess all fatigue related risks of the employees. Future research should validate our findings and link fatigue prone periods to health and safety outcomes. We suggest that incident reporting systems should incorporate a question on the day of shift of the employee when an incident occurs. These proposed measures could have the potential to improve current and future fatigue risk management programs in the offshore and in other industrial environments.

References

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