Fatigue and Sleepiness in Rotating Night Shift Drivers

WSH Institute funded ST Medical Services Pte Ltd (now ST Healthcare Pte Ltd) for the project: "To study the impact of fatigue on the Situational Awareness (SA) of workers doing shift work at night and to develop a Fatigue Risk Management System (FRMS)", under WSH Institute's 2012 Call for Research Proposals (MOMOSDETT11000012). The study was completed in 2014.

Study Objectives:

- To study fatigue, sleepiness, situation awareness, reaction time and task performance in a group of rotating night shift workers; and
- To develop and apply interventions to manage fatigue risk and evaluate the impact of those interventions

The study[1] was conducted on prime mover drivers in a logistics company, working on a 12h rotating[2] night shift. A range of assessment tools were used, including self-rating fatigue and sleepiness checklists, a reaction time test and the Fatigue Calculator (which calculates fatigue risk based on hours awake and asleep).

Assessment Tools*	
Samn Perelli Fatigue Checklist (SP)	Subjects scored their own **tiredness, sleepiness** and **situation awareness** on point scales. The scores were classified into broad categories to facilitate analysis.
Epworth Sleepiness Scale (ESS)	
Karolinska Sleepiness Scale (KSS)	
Situation Awareness Rating Technique (SART)	
Sleep Log and Duty Diaries	Captures **sleep patterns**
Wrist activity monitors (Actiwatch)	
Fatigue Calculator (FC)	Calculates **fatigue risk** based on hours awake and asleep
Deary-Liewald Simple Reaction Time Task (RT)	Tests subjects on **task performance** and vigilance based on reaction to stimuli

Table 1: Assessment tools used in study. SP, KSS, SART and RT were administered on one night shift at the start, middle and end of shift. Sleep log and duty diaries and actiwatches were used continuously during the shift cycle studied. ESS was applied at the start of the shift cycle.

[1] The study initially involved night shift workers in two marine companies as well, but was discontinued in those companies due to circumstances making it not possible to continue with the intervention and post-intervention phases. The findings here cover the logistics company for which the project was completed.

[2] Shift cycle included both day and night shifts, rotating in a set pattern

Pre-intervention findings

Generally, fatigue risks, sleepiness and tiredness increased as the night shift progressed, which is expected for workers on night shifts who are likely to suffer sleep loss.

Most of the subjects were observed to have mean reaction times that were significantly slower than the average of 300 milliseconds reported in literature for visual stimuli, even at the start of the night shift. The subjects also had a mean sleep duration of 6h which suggests that the drivers may not have sufficient sleep.

Interventions

Interventions included sleep hygiene education; provision of ear plugs and eye shades to improve sleep quality; a change in break schedule to facilitate rest during the circadian trough; and provision of a conducive rest area.

Post-intervention findings

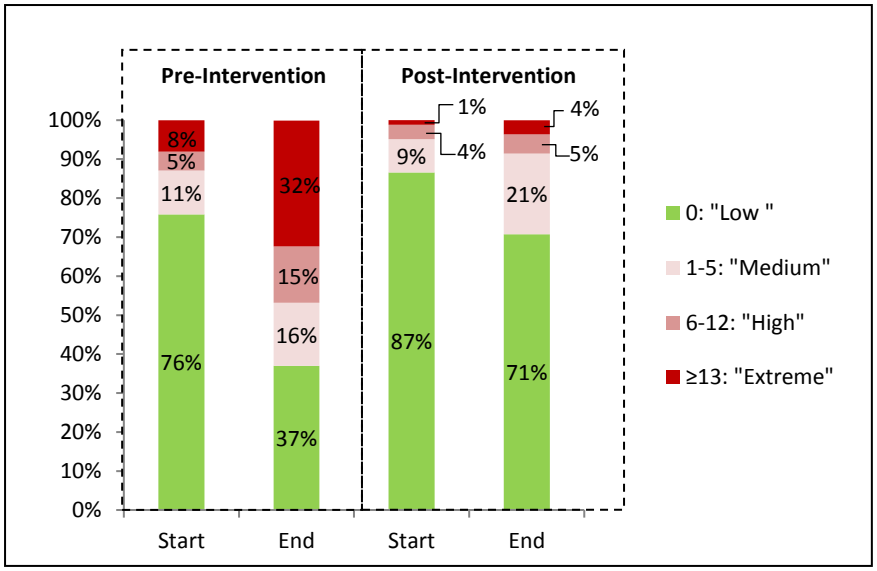

Figure 1: Percentage of subjects with extreme, high, medium and low fatigue risk at the start and end of shift: Pre & Post-Intervention

While fatigue scores were similar for Pre- and Post-Intervention at the start of shift, the improved fatigue scores at the end of shift for the Post-Intervention group suggests that the change in break schedule mitigated the Fatigue Score and hence reduced the risk of fatigue at the end of the shift.

The restorative effect of the compulsory break is supported by the survey responses from the Post-Intervention group, which showed that the majority of subjects felt the same or more alert after the compulsory break, in particular for those who took naps during the break.

KSS and SP scores were higher for the Post-Intervention Group, which suggests that the Post-Intervention subjects subjectively felt more sleepy and tired at the end of their night shift compared to the Pre-Intervention Group. The Post-Intervention Group also had higher daytime sleepiness (or higher ESS scores), compared to the Pre-Intervention group. Given that there was an opportunity for subjects to rest or nap before the end of the shift in the Post-Intervention group and the Fatigue Scores reflected this, these findings were unexpected. Possible reasons for these findings are variability in the subject groups, or the limitations of the KSS, SP and ESS scales being self-rating tests and hence subject to bias and self-perception.

In the Post-Intervention Group, the Situation Awareness (SA) decreased as the shift progressed. These findings are consistent with the sleepiness and tiredness data collected for the Post-Intervention Group. However, the SA scores for the Pre-Intervention Group remained largely similar at all time points, despite the subjects indicating higher levels of tiredness and sleepiness towards the end of shift. It should be noted that the SART has its limitations as a self-rated test. This is likely due to subjects not being able to rate their own situational awareness adequately, as the subjects would be unaware of what errors they could be making if they are not aware of the hazard. Also, there is potential bias from subjects making ratings based on how well they think they are doing or how well they want others to think they are doing.

Conclusions and Recommendations

There was evidence of fatigue in the drivers studied, with fatigue increasing as the shift progressed. While the feedback provided by the subjects was positive and there was an improvement in fatigue scores, the subjective rating scales (SP, KSS and ESS) showed that the Post-Intervention group felt more tired and sleepy at the end of the shift compared to the Pre-Intervention group. We believe that this could be a result of the self-rating tests being subject to bias and self-perception.

To mitigate fatigue risk in night shift drivers, general principles of minimising the number of continuous night shifts, planning for adequate rest breaks and encouraging good sleep hygiene practices could be applied. The Fatigue Calculator could also be used as a tool for workers to self-assess their levels of fatigue risk and companies could advise their workers on appropriate steps to take to reduce the fatigue risk. These measures could similarly be applied to all companies with workers who are at risk of fatigue. A Fatigue Management Programme could be implemented by companies, with interventions identified jointly by workers and management.