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DIFFERENCES IN PERCEIVED VIGILANCE TASK PERFORMANCE BASED ON THE MAGNITUDE OF THE WHOLE BODY VIBRATION EXPOSURE

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Introduction

This study was designed to explore whether there may be an association between a truck driver's exposure to whole body vibration (WBV) and psychomotor fatigue. Statistics in the United States have shown that there are 100,000 vehicle crashes each year which are likely related to some aspect of driver fatigue.

The Psychomotor Vigilance Task (PVT) is a reaction time task that has been used to assess psychomotor fatigue[1]. Exposure to WBV has been shown to affect cognitive performance and a better understanding of how exposure to WBV affects stress, mental and cognitive performance has been advocated[2]. The hypothesis of this experiment was that WBV exposures may impair a truck driver's cognitive function and differences in WBV exposures may differentially affect cognitive function as measured by the PVT.

Methods

In a pilot study, 8 experienced male truck drivers, with a mean age of 43.2 years (range of 25-55 years) were recruited to participate in this laboratory-based experiment. Using field-collected WBV exposures collected from the floor of a semi-truck cab, a three-dimensional vibrating platform (hexapod system) was used to expose subjects to a z-axis, floor-measured, daily average weighted vibration exposure of 0.41 m/s^2 for two hours. The subjects were systematically exposed to two different levels of WBV by having them participate in two different seating conditions. In one seating condition, the subjects simulated driving a semi-truck while sitting in a passive-suspension semi-truck seat; and in the other condition conducted on a separate day, subjects simulated driving a semi-truck while sitting in an active-suspension semi-truck seat. The seats the subjects sat in were identical in design and appearance (BoseRide System; Bose Corporation; Framingham, MA, USA), the passive-suspension seat was simply an active-suspension seat with the active-suspension turned off; so for the most part, the seat behaved like an industry-standard, passive, air-suspension seat. Seat order was randomized and counterbalanced. Based on field measurements, WBV exposures were expected to be approximately 50% higher when truck drivers sat in the passive-suspension seat.

Immediately before and after the two hour exposure to WBV, subjects were asked to complete a 5-minute, laptop-based, Psychomotor Vigilance Task (PVT). To characterize PVT performance, measurements included the mean reaction time (RT) and the average number of response lapses (RTs longer than 500 ms) for each trial. Lapses were included in the final analysis, but rather than using the RTs from the actual lapses, which can lead to data outliers, the RTs from the lapses were calculated using the subject's mean RT for that given trial and taking the RT value three standard deviations above the mean. PVT performance was assessed pre- and post-WBV exposure and between the two different WBV exposure conditions (the two seat conditions).

Results

There were significant differences ($p < 0.0001$) in the WBV exposures between the two seating conditions with the mean (standard error) z-axis WBV exposures measured at the seat top 0.25 (± 0.01) and 0.51 (± 0.01) m/s^2 for the active- and passive-suspension seats, respectively. As can be seen in Figure 1, there was a significant difference ($p = 0.043$) in RTs between the two seat conditions, with the pre-WBV exposures RTs were slightly lower with the active suspension seat. Post-WBV exposure, Figure 1(b) shows that the average number of lapses per trial were significantly greater ($p = 0.025$) after sitting in the passive-suspension seat.

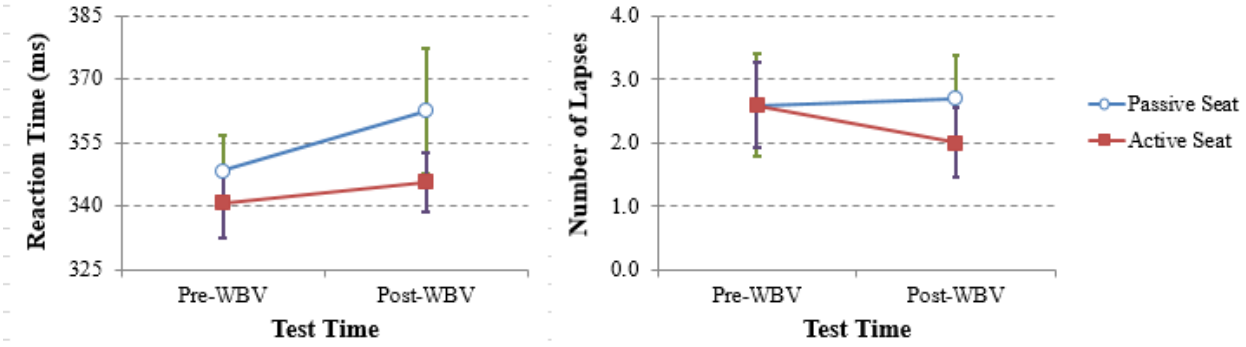

Figure 1 - Pre- and Post-WBV exposure PVT responses grouped by seat type: (a) - mean reaction times and (b) - mean number of lapses per trial [n = 8]

Discussion

The results demonstrated that the passive, air-suspension seat had substantially higher WBV exposures relative to the active-suspension seat and the responses to the PVT appeared to be affected by the magnitude of the WBV exposure levels. When the subjects sat in the passive-suspension seat, post-WBV exposure, they had longer reaction times, greater variation in reaction times and more lapses per trial. Therefore, it appears WBV exposures and the magnitude of the WBV exposures may adversely affect the vigilance of truck drivers and potentially contribute to cognitive fatigue. A follow-up study with a larger sample size and more realistic, day-long WBV exposures may real greater differences in PVT performance between the two WBV exposure/seating conditions. Ultimately, this work may eventually demonstrate that reducing a truck driver's exposure to WBV may reduce cognitive fatigue and their subsequent chances for getting in fatigue-related vehicle accidents.

References

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