EFFECTS OF SHORT-TERM EXPOSURE TO WHOLE-BODY VIBRATION ON WAKEFULNESS

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Introduction

Whole-body vibration occurs when the body is supported on a surface which is vibrating. Occupational exposures to whole-body vibration mainly occurs in the transportation industry, but also in association with other industrial process. Epidemiological studies have frequently indicated an elevated health risk for the spine in workers exposed to whole-body vibration. With regarding to train or bus operators, a fall of drivers' wakefulness level because of fatigue is often pointed out. This decrease in wakefulness results in an increase of the occurrence of accidents. However, a study of how whole-body vibration affects people's level of wakefulness has not been done. To test the hypothesis that exposure to whole-body vibration has a certain effects on level of wakefulness, the change of a subjective wakefulness level and changes of electroencephalogram (EEG) were observed under experimental exposure to short-term whole-body vibration.

Methods

Subjects are ten healthy male university students, with an average age of 20.7 ± 1.8 years old, and they are all nonsmokers. Using the equipment (CV-300, AKASHI) of whole-body vibration generator, we consider an exposure environment of actual driver work, so that set the frequency and the acceleration level as 10 Hz and $0.6 ms^{-2}$ r.m.s.. The subjects were exposed to whole-body vibration in the seated position and exposure time was fixed for 12 minutes. Subjective wakefulness level was evaluated using the questionnaire of VASS (Visual Analog Sleepiness Scale) and KSS (The Kwansei Gakuin Sleepiness Scale). For the electroencephalogram (EEG) measurement, it was equipped with the electrodes based on the International ten-twenty electrode system (C3-A2, O1-A2, O2-A1). EEG activity in the alpha frequency band (8 – 12 Hz) is one of the most typical physiological indicator which represent the transition from wakefulness to sleepiness. AAT (Alpha Attenuation Test) which repeats three times each opened and closed eye for 1 minute was performed in a seating position with directions of the researcher in the beginning, in the middle and in the end of exposure to whole-body vibration. For analysis, power spectral analysis was conducted over the last 6 min of EEG, and wakefulness levels were defined as the ratio of mean alpha power during eyes closed versus eyes opened. The laboratory was kept at room temperature (21 ± 1.0 degrees C), humidity was 50 ± 5%, noise level was 63.6 dB (A) eq, and illumination 510 lx. Each experiment was started around 10:00 am to minimize the effect of biorhythm.

Results

VASS and KSS increased and subjective level of wakefulness decreased from pre- to post exposure in all subjects, regardless of exposure. Using the AAT as an objective wakefulness measure also showed that wakefulness levels were reduced at the post-exposure test in all subjects. However, wakefulness level was almost constant in the case without exposure to whole-body vibration and in the case with exposure to whole-body vibration fell down largely, and it was rising after that. Moreover, the case with exposure to whole-body vibration was a significant difference from the case without exposure to whole-body vibration.

Discussion

It is difficult to simulate the exact environment that drivers are exposed to in transportation vehicles in the laboratory. However, in this study, exposure to whole-body vibration was simulated so that the effects on wakefulness could be measured. We demonstrate that wakefulness levels changes with exposure to whole-body vibration. Based on these results we suggest that attention should be focused on reducing whole-body vibration exposure. This may decrease the risk of accidents caused by a driver's vibration-induced reduction in wakefulness levels.

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