On the influence of freight trains on humans: A laboratory investigation of the impact of nocturnal low frequency vibration and noise on sleep and heart rate

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Abstract

Background
A substantial increase in transportation of goods on railway may be hindered by public fear of increased vibration and noise leading to annoyance and sleep disturbance. As the majority of freight trains run during night time, the impact upon sleep is expected to be the most serious adverse effect. The impact of nocturnal vibration on sleep is an area currently lacking in knowledge. We experimentally investigated sleep disturbance with the aim to ascertain the impact of increasing vibration amplitude.

Methodology/Principal Findings
The impacts of various amplitudes of horizontal vibrations on sleep disturbance and heart rate were investigated in a laboratory study. Cardiac accelerations were assessed using a combination of polysomnography and ECG recordings. Sleep was assessed subjectively using questionnaires. Twelve young, healthy subjects slept for six nights in the sleep laboratory, with one habituation night, one control night and four nights with a variation of vibration exposures whilst maintaining the same noise exposure. With increasing vibration amplitude, we found a decrease in latency and increase in amplitude of heart rate as well as a reduction in sleep quality and increase in sleep disturbance.

Conclusions/Significance
We concluded that nocturnal vibration has a negative impact on sleep, and that the impact increases with greater vibration amplitude. Sleep disturbance has short and long term health consequences. Therefore, it is necessary to define levels that protect residents against sleep disruptive vibrations that may arise from night time railway freight traffic.