IMPACTS OF PHYSIOLOGICAL ASPECTS ON DRIVER

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Driving a car is a major contributor to the general stress of life in the modern industrialized countries, yet relatively little is known about the physiological stress involved.

Noise, vibration, temperature and air pollutants are environmental factors to which many people, for example, those in the transport sector, using various kinds of vehicles, are exposed. Besides being exposed to varying temperatures, noise, vibration, and impurities of breathing air, the principal drivers of vehicles are especially subject to psychic stress. The continual need to observe the traffic, read the control cab instruments and keep moving according to a schedule, which is today the rule rather than the exception in in-city and inter-city traffic, undoubtedly increases psychic stress, and changes drivers' bodily functions from what they were before exposure to mere noise, vibration, air pollutants and thermal factors.

Compared with other drivers, professional drivers may be at extra risk of death or injury on the highway, partly because they drive more kilometers (Baker et al. 1976). One study, for example found that drivers of large trucks, taxis, and buses averaged about 83 000 kilometers annually, compared with an average of 13 000 kilometers for drivers not driving on the job (Carroll 1973).

This paper is to be a review of the previous, recent and further work on cardiovascular and functional changes during automobile driving. The paper emphasizes environmental approaches to the scope of safety driving. Approaches making drivers of buses, heavy trucks, private cars and hazardous cargo more capable of performing their tasks are needed. Modification of the environment
(cabins of drivers and passanger compartments) is a fruitful approach through which to promote safety driving.

In drawing up recommendations, selecting the point of measurement (head or seat) and improving the performance of drivers it should be borne in mind that the intensity of vibration in drivers' heads depends on the cab temperature (Manninen 1987). The relation between vibration doses on the head and on the seat is presented in the figure below (Figure 1). The increase in vibration doses on the head in winter is mainly explained by the fact that in winter the temperature of the cab is lower the drivers sit stiff and tense while in summer they are more relaxed. Tense back and trunk muscles and stiff sitting posture increase the transmission of vibration from the seat to the head.

![Figure 1](image)

Fig. 1. Relation between vibration doses on the seat and on the head of busdrivers during driving in summer and in winter.

Comparing the results from measurements of vibration with the limit values laid down in the ISO standard of whole body vibration (ISO 2631) we note that the root-mean-square values of the acceleration of vibration fell around the limit values corresponding a 4 hour and 8 hour exposure times at the mean frequencies of 2.5 Hz and 10.0 Hz.
In Finland and other Scandinavian countries temperature and seasonal variations in temperature have particularly pronounced effects on the conditions in the driver's cab. According to the results from the study of bus drivers (Manninen 1987) the temperature inside cabins varied considerably between seasons and different hours of measurements. Particularly low cab temperatures were measured in winter early in the morning. Both in summer and in winter the cab temperature gradually climbed up towards noon. In summer the cab temperatures at noon were too high to be convenient and affected the drivers' performance, while the morning temperatures in winter were too low.

The figure below (Figure 2) presents the relation between outside temperature and cab temperature. The regression lines show that with outside temperature sinking to about minus seven degrees in winter the average cab temperature is 18 degrees. When outside temperature sinks to minus thirty degrees, cab temperature drops to ten degrees.

![Graph](image)

Fig. 2. Relation between outside temperature and inside temperature during driving in summer and winter.

Furthermore, Figure 3 shows that the skin temperature at the back of left palm is on average three to four degrees lower in winter than in summer. The skin temperature of bus drivers is lowest at the start of the driving.
All in all, the type of physiological stress involved in driving is complex, and comprehensive further studies involving recording of functional changes in human body together with performance of both vehicle and driver ought to be promoted and to be launched soonest possible. First of all, it appears that there is a significant cardiovascular involvement in the general stress of driving a car. When typifying this kind of stresses among drivers it would be useful to consider at least three types of vehicles: 1) the public service vehicle in which tens of passengers may be carried, 2) the heavy commercial vehicle, and 3) the private car. It sounds logical to suppose that the risk of unacceptable behaviour due to changes in physiological conditions in a driver varies with the total environmental impact and the time spent driving. This means above all that the study of interactions more attention should be paid on the effects of complex combinations and varying exposure times.

References


146