Vibration Injury Network

Research Network on Detection and Prevention of Injuries due to Occupational Vibration Exposures

Acute vascular responses to the frequency of vibration transmitted to the hand

Appendix H3G to Final Report

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Bovenzi M, Lindsell CJ, Griffin MJ (2000) Acute vascular response to the frequency of vibration transmitted to the hand. *Occupational & Environmental Medicine*, **57**, 422-430.

OBJECTIVES

To investigate the acute effects of the frequency of hand transmitted vibration on finger circulation. A further aim was to investigate whether the frequency weighting assumed in current standards for hand transmitted vibration reflects the haemodynamic changes which occur in the fingers exposed to vibration with different frequencies but with the same frequency weighted acceleration magnitude.

METHODS

Finger skin temperature (FST) and finger blood flow (FBF) were measured in the middle fingers of both hands of 10 healthy men. With a static load of 10 N, the right hand was exposed for 15 minutes to the following root mean square (rms) acceleration magnitudes and frequencies of vertical vibration: 5.5 m/s^2 at 16 Hz; 11 m/s^2 at 31.5 Hz; 22 m/s^2 at 63 Hz; 44 m/s^2 at 125 Hz; and 88 m/s^2 at 250 Hz. These exposures to vibration produce the same frequency weighted acceleration magnitude (5.5 m/s^2 rms) according to the frequency weighting included in the international standard ISO 5349. A control condition consisted of exposure to the static load only. Finger circulation was measured before application of the vibration and static load and at fixed intervals during exposure to vibration and a 45 minute recovery period.

RESULTS

No significant changes in finger circulation were found with only the static load. The FST did not change significantly during or after acute exposure to vibration. In the vibrated right finger, exposures to vibration with frequencies of 31.5-250 Hz provoked a greater reduction in FBF than did vibration of 16 Hz or the static load only. In the non-vibrated left finger, the FBF measured with vibration at each frequency of 63-250 Hz was significantly lower than that measured with static load only. The reduction in FBF during exposure to vibration with any frequency was stronger in the vibrated finger than in the non-vibrated finger. In both fingers, there was a progressive decrease in FBF after the end of exposure to vibration with frequencies of 31.5-250 Hz. The higher the frequency of vibration, the stronger the decrease in FBF in both fingers during recovery.

CONCLUSIONS

Acute exposures to vibration with equal frequency weighted magnitude reduce the FBF in both vibrated and non-vibrated fingers for frequencies between 31.5 and 250 Hz. The extent of digital vasoconstriction after exposure to vibration increases with increasing frequency. The frequency weighting given in current standards tends to overestimate the vasoconstriction associated with acute exposures to vibration frequencies around 16 Hz.