



HUMAN RESPONSE TO VIBRATION

ABSTRACTS

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A. M. Doezie, A. K. Freehill, C. B. Novak, A. M. Dale and S. E. Mackinnon 1997 *Journal of Hand Surgery* **22A**, 867–872. Evaluation of cutaneous vibration thresholds in medical transcriptionists. (6 pages, 0 figures, 3 tables, 32 references) (in English).

Authors' Abstract. This study was designed to determine whether thresholds of transcriptionists varied significantly from the thresholds of individuals not exposed to keyboard activities. Using a multifrequency vibrometer, we obtained vibration threshold values from 31 medical transcriptionists who perform work on computer keyboards and compared them to values obtained from 40 control subjects. Thresholds tended to become more abnormal at higher frequencies although this difference was statistically significant only at frequencies of 125 Hz, 250 Hz, and 500 Hz in the index and small fingers. Vibration thresholds were not found to increase significantly with age or years of occupation. Vibration thresholds were significantly increased in medical transcriptionists at the higher frequencies, suggesting subtle neural dysfunction.

Topics: Vibration sense (thresholds).

E. K. Kristinsdottir, G.-B. Jarnlo and M. Magnusson 1997 *Scandinavian Journal of Rehabilitation Medicine* **29**, 257–265. Aberrations in postural control, vibration sensation and some vestibular findings in healthy 64–92 year old subjects. (9 pages, 1 figure, 6 tables, 31 references) (in English).

Authors' Abstract. To assess changes in postural control among healthy elderly and to correlate with suspected age-related events, 33 women and 16 men were studied. Postural control was evaluated by vibration-induced body sway, measured on a force platform, and vibration sensation was tested with a tuning fork. Occurrence of spontaneous gaze and head-shake induced nystagmus was observed with infrared charged couple device (CCD) cameras and the subjects' medical history was reviewed. Vibration perception was the major determinant for the magnitude of body sway. Although these senior citizens considered themselves healthy, they had a variety of ailments in their medical history, diminished vibration sensation and a high prevalence of vestibular asymmetry. Age *per se* was not a determinant factor in any of the findings. The study suggests that interest should also be directed to the status of sensation in the legs and vestibular asymmetry when assessing balance function in the elderly. Furthermore, the term "age concomitant" may be more appropriate than "age dependent" when

describing decrements of functions such as postural control in elderly subjects.

Topics: Vibration sense (thresholds); Perceptual mechanisms (vestibular).

M. J. Griffin 1998 *Occupational and Environmental Medicine* **55**, 340–348. Evaluating the effectiveness of gloves in reducing the hazards of hand-transmitted vibration. (9 pages, 5 figures, 4 tables, 14 references) (in English).

Author's Abstract. Objectives—a method of evaluating the effectiveness of gloves in reducing the hazards of hand-transmitted vibration is proposed. *Method*—the glove isolation effectiveness was calculated from (a) the measured transmissibility of a glove, (b) the vibration spectrum on the handle of a specific tool (or class of tools), and (c) the frequency weighting indicating the degree to which different frequencies of vibration cause injury. With previously reported tool vibration spectra and glove transmissibilities (from 10–1000 Hz), the method was used to test 10 gloves with 20 different powered tools. *Results*—the frequency weighting for hand-transmitted vibration advocated in British Standard 6842 (1987) and International Standard 5349 (1986) greatly influences the apparent isolation effectiveness of gloves. With the frequency weighting, the gloves had little effect on the transmission of vibration to the hand from most of the tools. Only for two or three tools (those dominated by high frequency vibration) did any glove provide useful attenuation. Without the frequency weighting, some gloves showed useful attenuation of the vibration on most powered tools. *Conclusions*—in view of the uncertain effect of the vibration frequency in the causation of disorders from hand-transmitted vibration, it is provisionally suggested that the wearing of a glove by the user of a particular vibratory tool could be encouraged if the glove reduces the transmission of vibration when it is evaluated without the frequency weighting and does not increase the vibration when it is evaluated with the frequency weighting. A current international standard for the measurement and evaluation of the vibration transmitted by gloves can classify a glove as an antivibration glove when it provides no useful attenuation of vibration, whereas a glove providing useful attenuation of vibration on a specific tool can fail the test. *Topics:* Anti-vibration devices (gloves).

S. Scutter, K. S. Türker and R. Hall 1997 *Australian Journal of Rural Health* **5**(1), 2–5. Headaches and neck pain in farmers. (4 pages, 0 figures, 5 tables, 25 references) (in English).

Authors' Abstract. The prevalence of headache and neck pain in farmers was determined by use of a questionnaire. Information about activities which increased the symptoms and about the treatments sought was also recorded. Results showed that 77.7% of farmers experienced neck pain and 79.2% experienced headache. Driving a tractor was the activity which was most frequently described as increasing symptoms in both conditions. While driving a tractor, farmers are exposed to whole-body vibration and assume a rotated neck posture. The contribution of these factors to the development of headache and neck pain is discussed.

Topics: Physiological effects (muscle and nerve, skeletal).

G. A. Gescheider, J. M. Thorpe, J. Goodarz and S. J. Bolanowski 1997 *Somatosensory and Motor Research* **14**, 181–188. The effects of skin temperature on the detection and discrimination of tactile stimulation. (8 pages, 6 figures, 0 tables, 31 references) (in English).

Authors' Abstract. Detection thresholds and intensity–difference thresholds were measured on four subjects ranging in age from 19 to 22 years. The stimuli were 250 Hz bursts of vibration applied through a 3.0 cm² contactor to the thenar eminence of the right hand. Detection thresholds were substantially higher at 20°C than 30° or 40°C and were only slightly higher at 40°C than 30°C. When the intensity–difference threshold was expressed in relative terms, as the proportion by which two stimuli must differ in amplitude to be discriminated ($\Delta\phi/\phi$), discrimination capacities were unaffected by surface-skin temperature. The results are consistent with the hypothesis that surface-skin temperature alters the sensitivity of tactile receptors, and that, because of the “near miss” to Weber’s law, the relative difference threshold is unaffected substantially by skin temperature. It was concluded that, at least a partial explanation of the “near miss” lies in the fact that, at low to moderate sensation levels, the P channel is exclusively activated whereas, at moderate to high sensation levels, because of recruitment of activity on non-Pacinian channels, neural information for intensity discrimination is additionally provided by channels with superior discriminative capacities.

Topics: Vibration sense (thresholds).

M. Barnekow-Bergkvist, G. E. Hedberg, U. Janlert and E. Jansson 1998 *Spine* **23**, 235–243. Determinants of self-reported neck-shoulder and low back symptoms in a general population. (9 pages, 2 figures, 3 tables, 40 references) (in English).

Authors' Abstract. Study Design. A combined cross-sectional and longitudinal design. *Objectives.* To investigate the relation between, on one hand self-reported neck-shoulder symptoms and, on the other hand, low back symptoms and self-reported work-related physical loads, psychosocial factors, and individual characteristics and to study the influence of physical capacity in adolescence on neck-shoulder and low back symptoms in adulthood. *Summary of Background Data.* Heavy physical work and exposure to vibration constitute risk factors for low back problems, and repetitive and static work are risk factors for neck-shoulder symptoms in many jobs. The interplay between individual factors and work-related psychosocial and physical exposure, however, is not well documented. This study addresses effects of adolescent capacity on this interplay in a general population. *Methods.* A random sample of 425 Swedish students was investigated when the students were 16 years and 34 years of age. Sixty-five percent participated in both examinations; only those who worked ≥ 16 hours/week at the follow-up period, 148 men and 90 women, were included in these analyses. Data about musculoskeletal symptoms, work, and sociodemographic and individual characteristics were collected at the age of 34 years; physical performance data were collected at the age of 16 years and 34 years. *Results.* Among the men, self-employment and worry were associated with neck-shoulder symptoms; among the women, monotonous work and high decision latitude were associated with neck-shoulder symptoms. Low back problems were related to monotonous work

among men and women and to exposure to vibration among men. Performance in certain fitness tests at the ages of 16 years and 34 years was negatively associated with musculoskeletal symptoms. *Conclusions.* The inverse relationship between performance at the age of 16 years and adult musculoskeletal symptoms may imply benefits of early fitness training.

Topics: Physiological effects (muscle and nerve, skeletal).

M. M. Wierzbicka, J. C. Gilhodes and J. P. Roll 1998 *Journal of Neurophysiology* **79**, 143–150. Vibration-induced postural posteffects. (8 pages, 6 figures, 2 tables, 47 references) (in English).

Authors' Abstract. It generally is known that vibration of various muscles in free-standing subjects evokes a spatially oriented postural response. Furthermore, it recently has been shown that when a vibratory stimulus is terminated, a powerful involuntary contraction of the previously vibrated muscle often occurs that, under the isotonic condition, is accompanied by movement of a limb. The aim of this study was to explore effects of a low-amplitude mechanical vibration, applied in a seated position, on the standing posture. The 30 s vibration was applied bilaterally at the ankle level to an anterior or posterior tendons and at the cervical level in front or back of the neck, at one site only at a time. Center of pressure trajectories were monitored during quiet stance for ≤ 19 min after the offset of vibration, and these measurements were compared with a previbration control trial. The results clearly indicate that vibration produced in all subjects strong, long lasting dynamical modification of posture mainly in the anterior-posterior direction. Spatial orientation of the induced postvibratory shift posture was dependent on the vibration side. We conclude that sustained la sensory inflow, evoked by vibration, has powerful after-effect on the motor system at the postural level.

Topics: Physiological effects (muscle and nerve, postural function).

S. Perremans, J. M. Randall, L. Allegaert, M. A. Stiles, G. Rombouts and R. Geers 1998 *Journal of Animal Science* **76**, 416–420. Influence of vertical vibration on heart rate of pigs. (5 pages, 6 figures, 3 tables, 17 references) (in English).

Authors' Abstract. Pigs with a body weight between 15 and 20 kg were vibrated in the vertical direction for 1 h at 2, 8, and 18 Hz, in combination with root mean square (RMS) acceleration magnitudes of 1 or 3 m/s². Welfare and stress were quantified by comparing heart rate characteristics during a control period (22:00–06:00) before vibration exposure and during vibration (10:00–11:00). The level of maximum heart rate and number of ventricular ectopic beats during vibration at 2 and 8 Hz in combination with a RMS acceleration of 3 m/s² indicated a larger fear response than at 1 m/s². ISO comfort contours based on mean heart rate during vibration showed the greatest specific sensitivity of the pigs to vibration at a frequency of 8 and 18 Hz, especially in combination with a RMS acceleration of 3 m/s². During transport, RMS acceleration should be less than 3 m/s² to protect pigs' welfare. Pigs were more sensitive to acceleration than to frequencies within the range of treatments in this investigation. Although the response of the pigs in this experiment fit within the model concept for adult

humans and for domestic fowl, changes in heart rate are dependent on body weight.

Topics: Non-human subjects (pigs); Physiological responses (cardiovascular).

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Contributions to the Literature Collection are invited. They should be sent to Professor M. J. Griffin, Human Factors Research Unit, Institute of Sound and Vibration Research, University of Southampton, Southampton, SO17 1BJ, England.