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HUMAN RESPONSE TO VIBRATION

ABSTRACTS

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S. D. Smith 2002 *Aviation, Space, and Environmental Medicine* **73**, 36–45. Characterizing the effects of airborne vibration on human body vibration response. (10 pages, 6 figures, 3 tables, 15 references) (in English).
Authors' Abstract. Background—Exposure to high-intensity, low-frequency noise can cause whole-body vibration. Such exposures to airborne vibration can reach the limits of human tolerance and have been associated with physiological and pathological disorders. The objective of this study was to characterize human body vibration response during exposures to operational airborne vibration. Methods—Triaxial body accelerations were collected at multiple anatomical sites with the subject located at selected crew positions during ground-based engine runup tests on several military tactical aircraft. The acceleration time histories were processed in one-third octave frequency bands and compared with the one-third octave band noise data. Results—The most significant finding was the occurrence of a resonance peak in the fore-and-aft (X) chest acceleration in the frequency bands between 63 and 100 Hz. Both the chest acceleration and associated noise level increased as the subject moved aft of the exhaust outlet, coinciding with the report of increasing chest vibration. A relatively linear relationship was found between the overall chest accelerations and noise levels between 5 and 250 Hz. An approach to developing combined noise and vibration exposure criteria was proposed. Conclusions—The resonance observed in the upper torso strongly suggested that airborne vibration in the 60–100 Hz frequency band may be an important contributing factor in the generation of subjective symptoms and possibly physiological and pathological disorders. Additional field and laboratory studies are required to validate the relationship between the biodynamic responses, noise levels, and physiological and pathological consequences.
Topics: Combined stress (noise and vibration); Biodynamics (transmissibility).

R. Cham and M. S. Redfern 2001 *Human Factors* **43**, 381–391. Effect of flooring on standing comfort and fatigue. (11 pages, 5 figures, 3 tables, 13 references) (in English).
Authors' Abstract. This study investigated the influence of flooring on subjective discomfort and fatigue during standing and on potentially related objective measures. Participants stood for 4 h on each of seven flooring conditions while performing computer tasks. During the third and fourth hour, floor type had a significant effect on a number of subjective ratings, including lower-leg and lower-back discomfort/fatigue and 2 of 4 objective variables (center of pressure weight shift and lower-extremity skin temperature). In addition, lower-leg volumetric measurements showed tendencies toward greater lower-extremity swelling on uncomfortable floors. The hard floor and one floor mat condition consistently had the worst discomfort/fatigue and objective ratings. Significant relationships were noted between the affected subjective ratings and objective variables. In general, floor mats characterized by increased elasticity, decreased energy absorption, and

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increased stiffness resulted in less discomfort and fatigue. Thus, flooring properties do affect low-back and lower-leg discomfort/fatigue, but the result may be detectable only after 3 h of standing. Potential applications of this research include the reduction of work-related health problems associated with long-term standing.
Topics: Subjective assessment.

H. Yamamoto, K.-C. Zheng and M. Ariizumi 2002 *Industrial Health* **40**, 59–62. A study of the hand–arm vibration syndrome in Okinawa, a subtropical area of Japan. (4 pages, 2 figures, 1 table, 12 references) (in English).
Authors' Abstract. The purpose of this study was to understand the peculiarity of the development of hand–arm vibration syndrome (HAVS) in a subtropical area of Japan. We analyzed the medical records of 21 subjects reported by the Okinawa Labor Bureau, and tried to determine whether the warm environment has any effect on the severity of HAVS. The mean operating time of vibration tools for all the subjects was over 10000 h. Almost all the subjects from Okinawa have been working only in Okinawa. The presence of vibration-induced white fingers (VWF) was markedly smaller in the subjects from Okinawa as compared to those from other prefectures. The results of cold water immersion tests were similar for all subjects. Ten minutes after the cold water immersion test, the mean finger skin temperature was about 19°C in all subjects. The findings suggest that not only the operating time of vibration tools but also the warm environment might have an effect on the severity of HAVS. However, the number of subjects in our study was very small. There is the need therefore for further investigations with a larger number of subjects.
Topics: Vibration syndrome; Combined stress (vibration and temperature).

N. A. Webb and M. J. Griffin 2002 *Aviation, Space, and Environmental Medicine* **73**, 351–358. Optokinetic stimuli: motion sickness, visual acuity, and eye movements. (8 pages, 4 figures, 3 tables, 12 references) (in English).
Authors' Abstract. Background—It is commonly assumed that motion sickness caused by moving visual scenes arises from the illusion of self-motion (i.e. vection). Hypotheses—Both studies reported here investigated whether sickness and vection were correlated. The first study compared sickness and vection created by real and virtual visual displays. The second study investigated whether visual fixation to suppress eye movements affected motion sickness or vection. Method—in the first experiment, subjects viewed an optokinetic drum and a virtual simulation of the optokinetic drum. The second experiment investigated two conditions on a virtual display: (1) moving black and white stripes and (2) moving black and white stripes with a stationary cross an which subjects fixated to reduce eye movements. Results—In the first study, ratings of motion sickness were correlated between the conditions (real and the virtual drum), as were ratings of vection. With both conditions, subjects with poor visual acuity experienced greater sickness. There was no correlation between ratings of vection and ratings of sickness in either condition. In the second study, fixation reduced motion sickness but had no affect on vection. Motion sickness was correlated with visual acuity without fixation, but not with fixation. Again, there was no correlation between vection and motion sickness. Conclusions—Vection is not the primary cause of sickness with optokinetic stimuli. Vection appears to be influenced by peripheral vision whereas motion sickness is influenced by central vision. When the eyes are free to track moving stimuli, there is an association between visual acuity and motion sickness. Virtual displays can create vection and may be used to investigate visually induced motion sickness.
Topics: Motion sickness (causes of).

W. C. Hutton, T. M. Ganey, W. A. Elmer, E. Kozlowska, J. L. Ugbo, E.-S. Doh and T. E. Whitesides 2000 *Spine* **25**, 2993–3004. Does long-term compressive loading on the intervertebral disc cause degeneration? (12 pages, 8 figures, 1 table, 29 references) (in English).

Authors' Abstract. Study design—Coil springs were stretched and attached to produce a compressive force across the lumbar intervertebral discs of dogs for up to 53 weeks. Objective—To test the hypothesis that compressive forces applied to the intervertebral disc for a long period of time cause disc degeneration *in vivo* in a dog model. Summary of Background Data—It is a commonly held belief that high forces applied to the intervertebral disc, and to joints in general, play a role in causing degeneration. Methods—Coil springs were stretched and attached to produce a compressive force across the lumbar intervertebral discs (L3/L4) of 12 dogs. After up to a year, the dogs were killed, and their lumbar spines were removed and radiographed. The L3/L4 disc and the controls (T13/L1 and L4/L5) were excised and examined for visible signs of degeneration. The discs then were assessed using immunohistochemical analysis and enzyme-linked immunosorbent assay. Disc chrondocytes also were assayed for apoptosis. Results—No obvious signs of degeneration in the discs (L3/L4) that have been under compression for up to a year could be observed. There was no disc bulging, anular fissures, or disc space narrowing. Some changes were observed at the microscopic level, although no thickening of the endplate was apparent. The enzyme-linked immunosorbent assay analysis provided significant data for all three regions of the disc (nucleus, inner anulus, and outer anulus). When comparing the compressed discs (L3/L4) with either of the control discs (T13/L1 and L4/L5), in the compressed disc: (1) the nucleus contained less proteoglycan and more collagens I and II; (2) the inner anulus contained less proteoglycan and collagen I; and (3) the outer anulus contained more proteoglycan and less collagen I. The collagen II differences for the inner and outer anulus were not significant. Conclusion—Compression applied to the lumbar intervertebral discs of dogs for up to a year does not produce degeneration in any visible form. It does produce microscopic changes and numerical changes, however, in the amounts of proteoglycan and collagen in the nucleus, inner anulus, and outer anulus. The present results add no credence to the commonly held belief that high compressive forces play a causative role in disc degeneration.

Topics: Physiological effects (skeletal)

K. Jin, G. S. Sorock, T. Courtney, Y. Liang, Z. Yao, S. Matz and L. Ge 2000 *International Journal of Occupational and Environmental Health* **6**, 26–33. Risk factors for work-related low back pain in the People's Republic of China. (8 pages, 0 figures, 3 tables, 39 references) (in English).

Authors' Abstract. A critical review was conducted of studies of work-related low back pain in the People's Republic of China. The published literature in both English and Chinese languages from 1983 to 1997 was reviewed for studies that permitted the calculation of prevalence ratios. Thirty-five papers were identified initially, and after quality inclusion/exclusion criteria were applied, 16 (14 in Chinese and two in English) were selected for more detailed review. Prevalence ratios were statistically elevated in all but two of the selected studies. Prevalence ratios for individual groups ranged from 2·0 to 8·5 for bending and twisting, 1·5 to 14·3 for static posture, 1·9 to 5·5 for whole-body vibration, and 2·6 to 9·4 for low-temperature exposure. The literature was limited by the absence of standardized and robust measures of low-back-pain outcomes and exposures and by the omission of fundamental details from research reports. Even with these limitations, the review findings suggest that three physical risk factors, all well known in

the international literature, are associated with the prevalence of low back pain in the People's Republic of China.
Topics: Epidemiological (whole-body vibration); Physiological effects (skeletal, muscle and nerve).

A. Todaro, M. Tomasini, D. di Carlo, D. Consonni and E. Mariani 2000 *La Medicina del Lavoro* **91**, 217–225. Neuropatia da stumenti vibranti: studio clinico-diagnostico in un gruppo di soggetti sintomatici. Disorders of the peripheral nervous system due to vibrating instruments. Clinical and diagnostic study of a group of symptomatic subjects. (9 pages, 0 figures, 5 tables, 25 references) (in Italian).
English Abstract. In order to evaluate the risk connected with hand–arm vibration exposure and associated disorders of the peripheral nervous system, a study was made to assess the relationship between nervous symptoms and laboratory data to determine the kind of disorder. Forty male subjects with hand–arm vibration exposure for more than 5 years and nervous symptoms of the hands for more than 1 year and two control groups of non-symptomatic non-exposed subjects were considered. An electroneurophysiological study of the exposed subjects revealed 18 nerve conduction speed changes (12 median nerve, four ulnar nerve, two median and ulnar nerve), most of which were sensitivity-motor changes; only nine Carpal Tunnel Syndromes were diagnosed. Some statistically significant differences between exposed subjects with negative results of the electroneurophysiological study and non-exposed subjects were observed. Prolonged vibration exposure seems to induce a hand–arm nerve suffering, initially with a progressive nerve conduction speed change and non-specific symptoms, but subsequently a peripheral nervous system disorder associated or not to a Carpal Tunnel Syndrome may occur.
Topics: Vibration Syndrome (neurological effects).

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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, SO*17 1*BJ, England.*