



## HUMAN RESPONSE TO VIBRATION

### ABSTRACTS

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B. Griefahn, and P. Bröde 1999 *Applied Ergonomics* **30**, 505–513. The significance of lateral whole-body vibrations related to separately and simultaneously applied vertical motions. A validation study of ISO 2631. (9 pages, 4 figures, 5 tables, 22 references) (in English)  
*Authors' Abstract.* Sensitivity of lateral motions relative to vertical motions were determined and compared to predictions provided by ISO 2631. Two experiments were executed where lateral and vertical motions were applied consecutively or simultaneously and where the magnitude of a single- or dual-axis test signal was adjusted until it was judged as equivalent to a preceding single-axis reference motion of the same frequency. Experiment 1: References consisted of vertical sinusoidal motions presented with 1.6–12.5 Hz and weighted accelerations of  $a_{zw} = 0.3, 0.6$  and  $1.2 \text{ m/s}^2$  r.m.s. single-axis test signals were lateral motions of the same frequency. 26 subjects (15 men, 11 women, 20–56 yr) participated in the experiments. Accelerations adjusted for lateral vibrations above 1.6 Hz were considerably lower than predicted suggesting that the weighting factors provided in ISO 2631 are incorrect. Experiment 2: References consisted of single-axis vertical or lateral sinusoidal motions presented with 1.6–12.5 Hz and a weighted acceleration  $a_{zw} = 1.25 \text{ m/s}^2$  r.m.s. The dual-axis test signals consisted of a constant fraction of the reference acceleration (10, 25, 50, 75, 90%) and a perpendicularly oriented adjustable component. 31 subjects (15 men, 16 women, 19–51 yr) participated in the experiments. Both experiments revealed that ISO 2631 is qualitatively valid; the weighting of lateral motions above 1.6 Hz, however, should be increased in order to meet the actual sensitivity particularly in case of multi-axis vibration.

*Topics:* Subjective assessment; complex vibration (multiple axis).

M. Turner and M. J. Griffin 1999 *British Journal of Psychology* **90**, 519–530. Motion sickness in public road transport: the relative importance of motion, vision and individual differences. (12 pages, 2 figures, 2 tables, 27 references) (in English)

*Author's Abstract.* The relative importance of vehicle motion, a view of the road ahead and passenger characteristics in the causation of motion sickness in road transport has been investigated using survey data from 3256 coach passengers and measurements of coach motion. Overall, 28% of passengers said they felt unwell during coach travel. Prior experience of sickness, travel regularity and age were the factors most highly correlated with illness. Increased vehicle motion and poorer forward vision also correlated with illness. Little difference in illness was apparent with a good view of the road ahead, regardless of motion exposure, although vision alone was not sufficient to eliminate passenger sickness entirely. The results suggest that travel sickness could be significantly reduced by improved forward external vision and that improved forward vision may be particularly beneficial for individuals new to coach travel and for those who travel less often.

*Topics:* Motion sickness (causes of prevention); vibration measurements (road coaches).

A. H-Y. Park and S. Hu 1999 *Aviation, Space, and Environmental Medicine* **70**, 1077–1080. Gender differences in motion sickness history and susceptibility to optokinetic rotation-induced motion sickness. (4 pages, 5 figures, 0 tables, 10 references) (in English)

*Authors' Abstract.* Purpose: the present study investigated gender differences in motion sickness history and susceptibility to optokinetic rotation-induced motion sickness. Methods and Results: the study included two phases. In phase 1, 485 subjects filled out a survey of previous incidence of motion sickness. Results indicated that women reported significantly greater incidence of feeling motion sickness than did men on buses, on trains, on planes, in cars, and on amusement rides before the age of 12 yr; and on buses, on trains, on planes, in boats, on ships, in cars, on amusement rides, and on swings between the ages of 12 and 25 yr. Women also reported significantly higher incidence of being actually sick than did men on buses before the age of 12 yr and on buses, on ships, and in cars between the ages of 12 and 25 yr. In phase 2, each of the 47 subjects viewed an optokinetic rotating drum for 16 min. Subjects' subjective symptoms of motion sickness (SSMS) were obtained during drum rotation. The results showed that there were no significant differences on SSMS scores between men and women. Conclusion: although women reported greater incidence in motion sickness history, women did not differ from men in severity of symptoms of motion sickness while viewing a rotating optokinetic drum.

*Topic:* Motion sickness (causes of)

J. J. Devereux, P. W. Buckle and I. G. Vlachonikolis 1999 *Occupational and Environmental Medicine* **56**, 343–353. Interactions between physical and psychosocial risk factors at work increase the risk of back disorders: an epidemiological approach. (11 pages, 3 figures, 9 tables, 75 references) (in English)

*Author's Abstract.* Objectives: to investigate the possible interactions between physical and psychosocial risk factors at work that may be associated with self-reported back disorders. Methods: 891 of 1514 manual workers, delivery drivers, technicians, customer services computer operators, and general office staff reported risk factors at work and back disorders with a self-administered questionnaire (59% return rate). Of the 869 respondents with a valid questionnaire, 638 workers were classified into one of four exposure groups: high physical and high psychosocial; high physical and low psychosocial; low physical and high psychosocial; and low physical and low psychosocial. Low physical and low psychosocial was used as an internal reference group. The exposure criteria were derived from existing epidemiological publications and models for physical and psychosocial work factors. The frequency and amplitude of lifting and the duration spent sitting while experiencing vibration were used as physical exposure criteria. Ordinal values of mental demands, job control, and social support from managers and coworkers were used as psychosocial exposure criteria. Results: the highest increase in risk was found in the high physical and high psychosocial exposure group for symptoms of back disorders. In the crude and multivariate analyses, departure from an additive risk model was found for the 7 day prevalence of symptoms of a low back disorder and also for a recurrent back disorder and also for a recurrent back disorder not present before the current job but also experienced in the past 7 days. Conclusions: this study suggests that an interaction between physical and psychosocial risk factors at work may exist to increase the risk of self-reported back disorder. Ergonomic prevention strategies that aim to minimize the risks of symptoms of work-related back disorders should not only focus on physical but also on psychosocial risk factors at work. The greatest benefits are likely to be realized when both physical and psychosocial factors are put right.

*Topics:* Injury and disease: physiological effects (skeletal)

K. McGeoch and W. H. Gilmour 2000 *Occupational and Environmental Medicine* **57**, 35–42. Cross sectional study of a workforce exposed to hand-arm vibration: with objective tests and the Stockholm workshop scales. (8 pages, 2 figures, 8 tables, 27 references) (in English) *Authors' Abstract*. Objectives: medical surveillance of work forces exposed to vibration has been recommended with the Stockholm workshop scales. The aims of this study were to evaluate (a) how the results of the objective tests individually and jointly associated with the final Stockholm workshop staging, (b) how this staging related to the history of exposure to vibration, and (c) how different trades were affected by the hazards from vibrating tools. Methods: all workers exposed to vibration in a heavy engineering company were examined with a questionnaire and a battery of tests. An assessment of staging by the Stockholm workshop scales was made. Estimates of the daily exposure and lifetime dosage of vibration of the various trades were reached. Results: the average years of tool use was 23.3 yr (range 3–47 yr) and the mean lifetime exposure was 11 022 (range 1012–46 125) h. The individual neurological tests were all strongly associated with the Stockholm neurological staging but the cold provocation test was not associated with the Stockholm vascular staging. Neurological staging was significantly associated with age, years of tool use, and total hours of exposure to vibration, but not with trade or smoking. Vascular staging was significantly associated with age, years of tool use, total hours of exposure to vibration, and trade, but not with smoking. The mean neurological latent period was 19.7 (range 2–40) yr and for the vascular component 19.1 (range 2–40) yr. These means varied significantly by trade. The overall prevalence of neurological findings of 62% was greater than the overall prevalence of vascular findings, which was 33%. Conclusions: (1) the neurological objective tests were found to be of use of neurological staging. The cold provocation test was not associated with the vascular staging and therefore was of little value. (2) Years of tool use was the exposure variable most significantly associated with evidence of damage of neurological component while years of tool use and trade were the variables most associated with vascular damage. (3) The prevalence of neurological symptoms (62%) was greater than the prevalence of vascular symptoms (33%). (4) Dressers and welders have shorter latent periods than platers and fitters. *Topics*: Vibration syndrome (general).

C. J. Lindsell and M. J. Griffin 1999 *International Archives of Occupational and Environmental Health* **72**, 377–386. Thermal thresholds, vibrotactile thresholds and finger systolic blood pressures in dockyard workers exposed to hand-transmitted vibration. (10 pages, 8 figures, 5 tables, 33 references) (in English) *Authors' Abstract*. Objectives: to quantify neurological dysfunction in workers exposed to hand-transmitted vibration using alternative neurological tests. To relate the neurological findings to the results of vascular tests and the symptoms reported by subjects with vibration-induced white finger. Methods: thermal thresholds (for perception of heat and cold), vibrotactile thresholds (for perception of vibration at 31.5 and 125 Hz) and finger systolic blood pressures were measured in 107 dockyard workers, including 31 controls and 76 workers exposed to hand-transmitted vibration (50 reporting finger blanching consistent with vibration-induced white finger). A history of vibration exposure and symptoms associated with hand-transmitted vibration were obtained for each subject. Results: increased duration of exposure to vibration resulted in a deterioration of both thermal thresholds and vibrotactile thresholds. Finger systolic blood pressure were lower in subjects reporting finger blanching and were related to the extent of blanching on the measured finger. Reported sensations of tingling were not correlated with any of the threshold measures; thermal thresholds and vibrotactile thresholds showed evidence of deterioration with reports of increasing numbness. Both numbness and tingling were correlated with

reports of finger blanching. Finger systolic blood pressures were not correlated with either thermal or vibrotactile thresholds. Conclusions: vascular and neurological signs produced by hand-transmitted vibration can occur independently, but the principal vascular symptoms (i.e., attacks of blanching) and some commonly reported neurological symptoms (i.e., sensations of numbness and tingling) may be related.

*Topics:* Vibration syndrome (diagnosis).

T. Strömberg, L. B. Dahlin, I. Rosén and G. Lundborg 1999 *Journal of Hand Surgery, (British and European Volume)* **24B**, 203–209. Neurophysiological finding in vibration-exposed male workers. (7 pages, 0 figures, 6 tables, 32 references) (in English)

*Authors' Abstract.* Fractionated nerve conduction, vibrotactile sense, and temperature thresholds were studied in 73 symptomatic vibration-exposed male workers. Three symptomatic groups were distinguished: patients with isolated sensorineural symptoms; with isolated vasospastic problems; and with both. Clinical carpal tunnel syndrome occurred in 14 patients and abnormal cold intolerance (without blanching of the fingers) in 23. In the group as a whole, nerve conduction studies were abnormal in the median nerve but not in the ulnar nerve and vibration perception and temperature thresholds were impaired. Of the three symptomatic groups, patients with isolated sensorineural symptoms differed from controls. No differences were seen between patients with and without clinical carpal tunnel syndrome. With severe sensorineural symptoms the vibration perception thresholds, but not the values of the nerve conduction studies, were further impaired. The results indicated two injuries that are easily confused: one at receptor level in the fingertips and one in the carpal tunnel. Careful clinical assessment, neurophysiological testing and examination of vibrotactile sense are required before carpal tunnel release should be considered in these patients.

*Topics:* Vibration syndrome (neural).

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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, SO171BJ, England.*