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Scholarly interests and selected publications

Musculoskeletal Disorders in Automobile Manufacturing

We have carried out several studies of ergonomic exposures and musculoskeletal disorders in this industry, most recently an investigation of upper extremity disorders in a stamping plant and an engine manufacturing plant in a fixed cohort. Disorders defined both on the basis of symptoms and physical examinations were strongly associated cross-sectionally and longitudinally with an index of ergonomic exposure that included work pace, manual force, non-neutral postures and segmental vibration. Among workers with low exposures, the prevalence was higher among women, but the exposure-related increase was greater among men. In an earlier study we showed strong associations between MSDs and non-neutral postures of the back and shoulder. Several methodological issues are still being explored, including the magnitude of under-reporting in the OSHA log and compensation data systems; the extent of any "healthy worker" selection effect operating in this population; and the validity of the psychophysical exposure ratings.

1. Punnett L, Gold J, Katz JN, Gore R, Wegman DH. Ergonomic stressors and upper extremity musculoskeletal disorders in automobile manufacturing: A one-year follow-up study. Occup Envir Med 2004; 61(8):668-674.
2. Punnett L. Ergonomic stressors and upper extremity disorders in vehicle manufacturing: Cross-sectional exposure-response trends. Occup Environ Med 1998;55:414-420.
3. Punnett L. The costs of work-related musculoskeletal disorders in automotive manufacturing. New Solutions: A Journal of Environ Occup Health Policy 1999;9(4):403-426.
4. Punnett L, van der Beek AJ. A comparison of approaches to modeling the relationship between ergonomic exposures and upper extremity disorders. Amer J Industrial Med 2000;37:645-655.
5. Punnett L, Fine LJ, Keyserling WM, Herrin GD, Chaffin DB. Shoulder disorders and postural stress in automobile assembly work. Scand J Work Environ Health 2000; 26(4):283-291.
6. Punnett L, Fine LJ, Keyserling WM, Herrin GD, Chaffin DB. Back disorders and non-neutral trunk postures of automobile assembly workers. Scand J Work Environ Health 1991;17:337-46.

Work-Relatedness of Musculoskeletal Disorders

The questions of whether or not musculoskeletal disorders (MSDs) are causally associated with physical workload, whether or not dose-response curves can be defined, and what proportion of MSDs in the U.S. workforce can be attributed to work demands, have generated substantial discussion in recent years. Some of this discussion occurred specifically in the context of OSHA's attempt to establish an Ergonomics Standard to protect employees from risk of work-related MSDs. Challenges in interpreting the literature include diverse exposure assessment methods, definitions of endpoints, and other methodologic issues discussed below. In this context, we have undertaken several reviews of the epidemiology, some of which have been published in the open literature. We have also

used international data to estimate that about 37% of low back pain world-wide could be attributable to working conditions.

1. Punnett L, Pruss-Ustun A, Nelson DI, Fingerhut MA, Leigh J, Tak SW, Phillips S. Estimating the global burden of low back pain attributable to combined occupational exposures. Amer J Industrial Med 2005; 48:459-469.
2. Punnett L, Wegman DH. Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. Journal of Electromyography and Kinesiology 2004; 14 (1): 13-23.
3. Punnett L. Commentary on the scientific basis of the proposed Occupational Safety and Health Administration Ergonomics Program Standard (invited editorial). J Occup Environ Med 2000; 42(10):970-981.
4. Punnett L. Ergonomics and public health. Oxford Textbook of Public Health, 4th ed. Oxford University Press, 2002, volume 2: 1067-1081.

Socioeconomic and Gender Disparities in Working Conditions and Health

Overall differences between men and women in the rates and patterns of workplace injury and illness must be interpreted in the light of de facto occupational sex segregation and the consequent differences in exposure to health and safety hazards. With regard to musculoskeletal disorders, in particular, women are over-represented in “light,” monotonous jobs that require rapid, precise, repetitive hand motions but high static loading of the neck and shoulder, with less control over the work process, less latitude for making autonomous decisions, and fewer opportunities for job modification. Perceptions of gender and racial discrimination in the work climate may contribute to psychosocial strain and impact on employees' health and work outcomes (see also the UML Center for Women and Work, "Current Projects: Discrimination and Health"). In addition, the co-variation between physical and psychosocial stressors may be stronger for women than men, suggesting a greater impact of interaction between them. Successful strategies for resolving health and safety problems among women workers need to take into account the features of women’s employment and its broader socioeconomic context.

1. Punnett L, Herbert R. Work-related Musculoskeletal Disorders: Is There a Gender Differential, and If So, What Does it Mean? In: Women and Health, eds. MB Goldman, M Hatch. San Diego CA: Academic Press, 1999: 474-492.
2. Bond MA, Punnett L, Pyle JL, Cazeca D, Cooperman M. Gendered work conditions, health and work outcomes. J Occupational Health Psychology 2004;9(1):28-45.
3. Messing K, Punnett L, Bond M, Alexanderson K, Pyle J, Stock S, Wegman DH, Zahm S, de Grosbois S. Be the fairest of them all: Challenges and recommendations for the treatment of gender in occupational health research. Amer J Industrial Med 2003;43(6):618-29.
4. MacDonald LA, Karasek RA, Punnett L, Scharf T. Covariation between workplace physical and psychosocial stressors: Evidence and implications for occupational health research and prevention. Ergonomics 2001; 44(7): 696-718.
5. Bond MA, Kalaja A, Punnett L, et al. Expanding our Understanding of the Psychosocial Work Environment: A Compendium of Measures of Discrimination, Harassment, and Biases. Center for Women and Work, U. Mass. Lowell, Final Report to the National Institute of Occupational Safety and Health, April 2005.
6. Klitzman S, Silverstein BA, Punnett L, Mock A. A women's occupational health agenda for the 1990's. New Solutions 1990;1(1):7-17.

A more recent study examines the socioeconomic gradient in selected health conditions among workers in the healthcare sector in northeastern Massachusetts. The primary epidemiologic goals are to assess the extent to which working conditions (especially physical, psychosocial, and organizational) explain this gradient for general self-rated physical and mental health, as well as musculoskeletal disorders and acute injuries at work. This project is described in more detail under "Promoting Healthy and Safe Employment in Healthcare."

Work with Video Display Units

An intervention study was carried out among video display unit (VDU) users at a large university (n=627) to evaluate the effect of an ergonomic training program on workstation changes and on the prevalence of musculoskeletal disorders. Administrative units were randomly allocated to receive the intervention in year one or year two. Six months after the training, improvements in postural stressors were more frequent in the experimental group, especially among workers less than 40 years old. The prevalence of musculoskeletal disorders decreased among workers younger than 40 in the experimental group, while there was no significant change in other sub-groups.

A critical review of the epidemiologic literature on soft-tissue disorders of the upper extremity and their relation to physical ergonomic features of work at computer terminals and video display units (VDUs) was undertaken in collaboration with Dr. Ulf Bergqvist at the Swedish National Institute for Working Life (NIWL). The review also included a discussion of psychosocial aspects of VDU work and addressed the differences between men and women in terms of both their job demands and their frequency of disorders. The report was approved and published as an official document of the Institute's Standards Committee.

1. Brisson C, Montreuil S, Punnett L. A six-month follow-up of the effect of an ergonomic training program on musculoskeletal disorders among video display unit workers. Scand J Work Environ Health 1999;25(3):255-263.
2. Punnett L, Bergqvist U. Visual Display Unit Work and Upper Extremity Musculoskeletal Disorders: A Review of Epidemiologic Findings. Solna SWEDEN: National Institute of Working Life, Arbete och Hälsa 1997;16:1-161. (http://www.niwl.se/ah/1997-16.pdf)
3. Punnett L, Bergqvist U. Upper extremity disorders in video display unit operators. In: Occupational Medicine: State of the Art Reviews, Office Ergonomics, ed. Martin Cherniack, Philadelphia PA: Hanley & Belfus, Inc., 1999; 14(1):113-124.

Ergonomic Exposures in Construction and Other "Non-Routinized" Work

We have been fortunate to have a large construction "laboratory" in Boston in the 1990's: the "Big Dig," more formally known as the Central Artery/Third Highway Tunnel Project. This has provided us with the opportunity to work extensively on methods related to the assessment of ergonomic exposures for construction work, as well as exploring the sources of variability in exposure in heavy and highway construction. Posture, Activities, Tools and Handling (PATH), a work-sampling based method, was developed in the Department of Work Environment. More information is also found at the Construction Occupational Health Project. Development of the PATH method for analysis of ergonomic exposures in construction work was followed by its refinement and adaptation to other work settings, including health care, agriculture, and manual material handling in the retail sector. These experiences have also informed an evolving overview of job analysis methodologies.

1. Gold JE, Park JS, Punnett L. Work routinization and implications for ergonomic exposure assessment. Ergonomics 2006; 49(1):12-27.
2. Paquet V, Punnett L, Woskie S, Buchholz B. Reliable exposure assessment strategies for physical ergonomic stressors in construction and other non-routinized work. Ergonomics 2005;48(9):1200-1219.
3. Moir S, Paquet V, Punnett L, Buchholz B. Making sense of highway construction: A taxonomic framework for ergonomic exposure assessment and intervention research. Applied Occup Environ Hygiene 2003; 18(4):256-267.
4. Paquet V, Punnett L, Buchholz B. An evaluation of manual materials handling in highway construction work. Internat J Industr Ergonomics 1999; 24(4):431-444.
5. Buchholz B, Paquet V, Punnett L, Lee D, Moir S. PATH: A work sampling-based approach to ergonomic job analysis for construction work. Applied Ergonomics 1996;27:177-87.
6. Pan CS, Gardner LI, Landsittel DP, Hendricks SA, Chiou SS, Punnett L. Ergonomic exposure assessment: An application of the PATH systematic observation method to retail workers. Internat J Occup Environ Health 1999; 5:79-87.
7. Fulmer S, Punnett L, Slingerland DT, Earle-Richardson G. Ergonomic exposures in apple harvesting: Preliminary observations. Amer J Industr Med 2002; 42 (Supplement 2): 3-9.

Definitions of MSD Endpoints, Surveillance, and Under-Reporting

Characterization of musculoskeletal endpoints for epidemiologic studies is a challenging issue. Administrative records such as workers' compensation claims and OSHA 200 logs of injury and illness are often readily available, but typically they underestimate the true frequency of work-related MSDs. Several socioeconomic factors have been shown to influence reporting by workers to employers; employer behavior is less well explained to date.

Self-reported symptoms are highly sensitive and inexpensive to obtain, but it is difficult to measure symptom validity directly, since there is no gold standard for pain. The standard physical examination maneuvers, although widely used in clinical practice, have uncertain sensitivity, specificity and reliability and may not reflect adequately the processes that cause pain. We need to develop better measures, both objective - especially useful in establishing a more secure diagnosis - and subjective - for better description of patient impact.

1. Forde MS, Punnett L, Wegman DH. Pathomechanisms of work-related musculoskeletal disorders: Conceptual issues. Ergonomics 2002;45:619-630.
2. Gold JE, Punnett L, Katz JN. Pressure pain thresholds and musculoskeletal morbidity in automobile manufacturing workers. Internat Archives Environ Occup Health 2005;78.
3. Gold JE, Punnett L, Cherniack M, Wegman DH. Digital vibration threshold testing and ergonomic stressors in automobile manufacturing workers: A cross-sectional assessment. Ergonomics 2005; 48(1):66-77.
4. Punnett L, Gold J. Work-related upper extremity disorders: Epidemiologic findings and unresolved questions. In: Johansson H, et al., editors. Chronic Work-Related

Myalgia: Neuromuscular Mechanisms behind Work-Related Chronic Muscle Syndromes. Springer Publishers, 2004.

5. Wellman H, Davis L, Punnett L, Dewey R. Work related-carpal tunnel syndrome (WR-CTS) in Massachusetts, 1992-1997: Source of WR-CTS, outcomes and employer intervention practices. Amer J Industrial Med 2004; 45(2):139-52.
6. Davis L, Wellman H, Punnett L. Surveillance of work-related carpal tunnel syndrome in Massachusetts, 1992-1997: A report from the Massachusetts Sentinel Event Notification System for Occupational Risks (SENSOR). Amer J Industr Med 2001; 39:58-71.
7. Morse T, Punnett L, Warren N, Dillon C, Warren A. The relationship of unions to prevalence and claim filing for work-related upper-extremity musculoskeletal disorders. Amer J Industr Med 2003; 44(1): 83-93.
8. Punnett L. The costs of work-related musculoskeletal disorders in automotive manufacturing. New Solutions: A Journal of Environ Occup Health Policy 1999;9(4):403-426.
9. Hudak PL, Amadio PC, Bombardier C and the Upper Extremity Collaborative Group. Development of an Upper Extremity Outcome Measure: The DASH (Disabilities of the Arm, Shoulder and Hand). Am J Industr Med 1996;29:602-8.
10. Davis AM, Beaton DE, Hudak P and the Upper Extremity Collaborative Group. Measuring disability of the upper extremity: A rationale supporting the use of a regional outcome measure. Journal Hand Therapy 1999; 12(4): 269-274.
11. Beaton DE, Wright JG, Katz JN and the Upper Extremity Collaborative Group. Development of the QuickDASH: Comparison of three item-reduction approaches. J Bone Joint Surg [Am] 2005;87:1038-46.

Self-Selection out of the Workforce and the Healthy Worker Effect

A recent prospective cohort study concerned the prognosis of carpal tunnel syndrome cases as a function of their prior occupational status as well as baseline morbidity measures. Long-term disability (absence from work) was shown to be associated in a complex way with occupational ergonomic exposures, symptom severity, and socioeconomic variables. In addition, gender differences were observed but could not be fully explained by the available data; this remains a topic for further investigation.

1. Katz JN, Keller RB, Fossel AH, Punnett L, Bessette L, Simmons BP, Mooney N. Predictors of return to work following carpal tunnel release. Amer J Industr Med 1997;31:85-91.
2. Katz JN, Lew RA, Bessette L, Punnett L, Fossel AH, Mooney N, Keller RB. Prevalence and predictors of long term work disability due to carpal tunnel syndrome. Amer J Industr Med 1998;33(6):543-550.

Working people frequently remove themselves from exposure because of perceived hazards and/or health effects, and this movement away from exposure makes it particularly difficult to make unbiased estimates of exposure-risk relationships in the occupational setting. Understanding the special characteristics of this type of bias is essential for correct interpretation of epidemiologic data as well as for appreciation of the externalized cost to workers of occupational health problems.

3. Park RM, Maizlish NA, Punnett L, Moure-Eraso R, Silverstein MA. A comparison of PMRs and SMRs as estimators of occupational mortality. Epidemiology 1991;2:49-59.
4. Punnett L. Adjusting for the healthy worker selection effect in cross-sectional studies. Internat J Epidemiol 1996; 25:1068-75 and 26:914.
5. Bildt C, Alfredsson L, Punnett L, Theobald H, Torgén M, Wikman A. Effects of drop out in a longitudinal study of musculoskeletal disorders. Occup Environ Med 2001;58:194-99.

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