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Introduction

Direct measurement of hand-arm vibration (HAV) exposure in the workplace is a difficult task due to high cost of equipment, interruption of work productivity, and long distance travel to worksites. However, the task is necessary for early detection of HAV and applying suitable HAV exposure prevention methods. The Ministry of Labour Relation and Workplace Safety (LRWS) Saskatchewan collected vibration measurements in a variety of work settings as part of their enforcement duties, generating a substantial dataset. Exposure-prediction modeling, the development of statistical models for the relationship of HAV and occupational characteristics, using the administrative dataset from LRWS can identify the predictors of HAV which can be used to control occupational HAV while saving time and money from direct measurement.

Methods

The dataset used was composed of 177 complete data, with the average vibration exposure over eight hour workday, A(8), serving as the dependent variable, and worker characteristics (e.g. age, weight, job title, etc.), tool characteristics (e.g. brand, type, power source), and worksite characteristics (eg. Industry, department, etc.) serving as independent variables. Standard model building technique was used to build two models: a comprehensive model and a parsimonious model. To account for repeated measurements in certain independent variables, the two models were also built using generalized estimate equations (GEE) technique. The model building and other analyses involved were performed using STATA 13.1.

Results

The models developed using standard model building technique and GEE were identical. The comprehensive and parsimonious models explained 27% and 16% of HAV variance respectively. The comprehensive model include accelerometer attachment method, tool brand, tool power source, job title, and vibration control as significant predictors; the parsimonious model had the same significant predictors, excluding accelerometer attachment method and tool brand. HAV from pneumatic tools had \textasciitilde70 – 82\% higher A(8) than electric and other power sources. Vibration controls (handle wraps) installed on the tools decreased vibration by \textasciitilde84\%. Mechanics were exposed to \textasciitilde65 – 78\% higher A(8) than workers such as technicians, welders, etc. The comprehensive model showed that the hose clamp was
the accelerometer attachment method which gave more accurate measurement of vibration than using T-bars and tool brands served as a confounder in the model.

**Discussion**

The results from this study implies that tool power source, worker job title, and vibration control significantly influence the amount of vibration exposed to by the workers of this dataset. Hence, in the future, it would be practical to install stronger protective measures on pneumatic tools, encourage workers to use handle wrap with hand-held vibration tools, and rearrange mechanics’ work to lower HAV exposure. The variance levels explained by the models were low, probably due to the nature of the administrative data where missing values and unstandardized vocabulary used for data collection occur frequently. But the significant predictors found in this study shows that administrative data can be used to find HAV predictors inexpensively; in addition, the predictors can be taken into consideration for future epidemiological research for hand-arm vibration exposure and for safety precaution installment purposes. A research survey developed with questions which strongly focused on tool power source, vibration control, and worker job title can provide a better assessment of vibration than a survey created with questions without any basis in HAV assessment. Installing safety precautions based on research evidence can mean more suitable allocation of resources.

**Keywords**

Determinants of exposure, Exposure prediction modeling, Occupational hazard, Hand-arm vibration