Comparison of three different assessments of workplace physical exposures applied to analysis of incident carpal tunnel syndrome

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1. Introduction
Several different methods are used for measuring and analyzing workplace physical exposures in studies of work-related MSD (Spielholz, Silverstein, Morgan, Checkoway, & Kaufman, 2001; Van der Beek & Frings-Dresen, 1998). Variation in exposure assessment methods used in different studies may not be taken into account when comparing results across studies (Homan & Armstrong, 2003). Commonly used methods include self-reported surveys, job exposure matrices, observation, and instrumentation with sensors and data loggers. The frequency and duration of separate data collection efforts and the complexity of the data collection methods will produce data of different precision, representing different time periods, for different costs (Bao, Howard, Spielholz, & Silverstein, 2006). Previous literature has reported the strengths and limitations of different methods, including costs and their application to situations with different types of exposure variability. The choice of exposure method is a key design consideration in studies of MSD (Gardner, Landsittel, Nelson, & Pan, 2000).

Exposure-response studies for chronic health conditions present a particular challenge. It is important to consider whether the association is cumulative, has a long or short latency, or may be a combination of time and intensity of the exposure. Musculoskeletal disorders have a progressive etiology, changing from minor symptoms to an irreversible physiological state (Descatha et al., 2008; Ha et al., 2009; Silverstein et al., 2010). Repeated collection of exposure data over time expands the options for examining relationships between exposures and health outcomes (Violante et al., 2007).

1.1 Objective
The purpose of this study was to compare the associations of workplace physical exposures and carpal tunnel syndrome (CTS), using data collected by three different exposure methods, and three different temporal approaches.

2. Methods
We used data from the PrediCTS study, a 3 year longitudinal study of 1107 newly employed workers in various industries. Self-reported and job-title based exposure data were available for all workers; observational data were collected on a subset of the full cohort. We restricted the analysis to workers with complete data for all three exposure methods. We examined the temporal relationship of each exposure to the outcome by three approaches: most recent exposure prior to case determination, time weighted average of exposures during employed time of the study period, and peak or highest exposure value during the study. We collected data for each job held by each worker during the 3-year study period.

2.1 Exposure Measures
The three physical exposure methods included self-reported exposures using a modified Nordstrom questionnaire, exposures derived from a job exposure matrix (JEM) based on exposure data from the Occupational Network (O*NET), and exposures observed at the job site and rated by trained staff. We compared exposures of hand repetition and hand force, known risk factors for CTS, by measures commonly used for each exposure method. Self-reported exposures of repetition included usual daily time spent performing forearm rotation and time spent in wrist bending; measures of force included daily time spent lifting and time spent in forceful gripping. O*NET provided the mean values for repetitive motion and use of hands to hold objects, and the dynamic strength and static strength of each standard occupational job classification code. Observed exposures provided ergonomist rated repetition (using the Latko scale) and average and peak force levels on a modified Borg scale (rating 0 to 10).
2.2 Data Analysis
To account for the differences in exposure-response scales, we computed tertiles for each exposure and categorized workers into high, medium, and low-exposed groups. Bivariate logistic regression showed the relationship between tertiles of exposure and CTS. Forest plots illustrated the differences and similarities between each model’s odds ratios (ORs) and confidence intervals (CIs). The CTS outcome was based on an epidemiologic case definition of median nerve hand symptoms and abnormal nerve conduction findings.

3. Results
Full data were available for 357 workers; they were relatively young (32 years), male (60%), and employed in several industries: construction (43%), technical (18%), service (26%) and clerical work (13%) with 17% unemployed more than 30 days during the 3-year follow-up period. There were 22 incident cases of CTS representing 6% of the sample. Bivariate logistic regression showed the highest odds ratios and widest confidence levels for the self-reported responses in ratings of both repetition and hand force (see Figures 1 and 2) using any of the three exposure approaches (most recent, employed time weighted, and peak). The job-title O*NET exposures showed the lowest strength of association with CTS.

Figure 1. High versus Low Categories of Repetition Measures.
4. Discussion

These results are novel because they show exposure-response relationship using three different exposure methods within a single sample of workers. Our results showed differences in the exposure-response relationships in models that used different exposure methods and different approaches to the temporality of exposures. The variation in these findings may explain some of the variation in results found across the wide range of exposure-response studies with CTS and other upper extremity MSD. Caution should be used when combining results of different studies for meta-analyses if different exposure assessment methodologies were used.

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6. References


