The Impact of Gender on Personal, Health and Workplace Psychosocial Risk Factors for Carpal Tunnel Syndrome: A Pooled Study Cohort.

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The impact of gender on personal, health and workplace psychosocial risk factors for carpal tunnel syndrome: A Pooled Study Cohort.

Carisa Harris-Adamson, PhD, PT[a,b], Ellen A Eisen, ScD[b], Ann Marie Dale, PhD[c], Bradley Evanoff, MD[c], Kurt T. Hegmann, MD[d]; Matthew S. Thiese, PhD[d], Jay Kapellusch, PhD[e], Arun Garg, PhD[e], Susan Burt, ScD[f], Stephen Bao, PhD[g], Barbara Silverstein, PhD[g], Fred Gerr, MD[h], Linda Merlino, MS[h], David Rempel, MD[i,j]

[a]Samuel Merritt University, Department of Physical Therapy; [b] University of California Berkeley, School of Public Health, Occupational, Social, and Environmental Medicine; [c] Washington University School of Medicine, Division of General Medical Science; [d]University of Utah, Rocky Mountain Center for Occupational and Environmental Health (RMCOEH); [e]University of Wisconsin-Milwaukee, Center for Ergonomics; [f]National Institute for Occupational Safety and Health (NIOSH); [g]Washington State Department of Labor and Industries, Safety and Health Assessment and Research for Prevention (SHARP) Program; [h]University of Iowa, Department of Occupational and Environmental Health; [I]University of California at San Francisco, Division of Occupational and Environmental Medicine; [j] University of California Berkeley, Department of Bioengineering

Between 2001 and 2010 six research groups conducted coordinated multi-year, prospective studies of upper extremity musculoskeletal disorders in US workers from various industries and collected detailed subject-level exposure information with follow-up symptom, physical examination, electrophysiological measures, and job changes. **Objective.** This analysis of the pooled cohort examined the incidence of dominant-hand carpal tunnel syndrome (CTS) in relation to demographic characteristics and estimated associations with occupational psychosocial factors, adjusting for confounding by personal risk factors. **Methods.** 3,515 participants, without baseline CTS, were followed up to 7 years. Case criteria included symptoms and an electrodiagnostic study consistent with CTS. Adjusted hazard ratios were estimated in Cox proportional hazard models. Workplace biomechanical factors were collected but not evaluated in this analysis. **Results.** Females were at elevated, though statistically non-significant, risk for CTS (HR=1.30; 95%CI: 0.98-1.72). The incidence of CTS increased linearly with both age and BMI over most of the observed range. High job strain increased risk (HR=1.86; 95%CI: 1.11-3.14) and social support was protective (HR=0.43; 95%CI: 0.23-0.78). There was no effect modification of gender on age, BMI or high job strain. **Conclusions.** Personal factors associated with an increased risk of developing CTS were BMI, age and being female, though no effect modification by gender was evident. Workplace risk factors were high job strain while social support was protective.

INTRODUCTION

Carpal tunnel syndrome (CTS), a common peripheral entrapment neuropathy at the wrist, is an important driver of workers compensation costs, lost time, lost productivity and disability [Stapleton, 2006; BLS, 2010]. Prior studies have related CTS to both personal and occupational risk factors [Nordstrom et al, 1998; Mondelli et al., 2002; Bernard, 1997; Violante et al., 2007; Bonfiglioli et al., 2012], however, the strength of these associations and the exposure-response relationships are not well described [Stapleton, 2006]. To date, few large prospective studies using rigorous case criteria, individual-level exposure data, and appropriate control for confounding by personal factors have examined associations between occupational psychosocial and biomechanical risk factors and CTS incidence [Bonfiglioli et al., 2012]. To address this and other gaps in the literature, six research groups designed coordinated, multi-year, prospective epidemiological studies of US production and service workers from a variety of industries. Subsequent to completion of the studies, data on detailed subject-level exposure information was pooled with longitudinal assessment of symptoms, physical examination results, electrophysiological measures and biomechanical factors due to job changes [Dale et al., in press]. Here we describe the relationships between personal factors, occupational psychosocial factors and duration of employment, with CTS incidence, while adjusting for effects of confounding variables. Workplace biomechanical factors were collected but not evaluated in this paper.

METHODS

Participants. The 4,321 individuals in the study were recruited into six prospective epidemiological studies of risk factors for work-related upper-extremity musculoskeletal disorders (UEMSDs) conducted between 2001 and 2010. Details on each study design, health outcome pooling methods, and baseline CTS prevalence are provided elsewhere [Dale et al., in press]. Common inclusion criteria were: 1) full-time work in industries

primarily engaged in manufacturing, production, service, and construction, and 2) availability of individual level exposure information. This analysis was restricted to the 3,515 participants for whom follow-up data were available and who did not have baseline carpal tunnel syndrome or previous carpal tunnel surgery release (n=338), or baseline polyneuropathy (n=58). There was varied representation of workers across standard industrial classification (SIC) divisions with the majority of subjects coming from the manufacturing (n=2256), services (n=673), and construction (n=335) sectors.

Baseline Information. In all six studies, questionnaires were administered at study enrollment (baseline) to collect information on work history, demographics, medical history and musculoskeletal symptoms, and psychosocial work environment. Five of six studies administered an electrodiagnostic study (EDS) of all workers' median and ulnar nerves at baseline, while one study administered EDS only to those reporting symptoms consistent with CTS. All studies administered physical examinations either to all subjects or for those reporting upper limb symptoms [Dale et al., in press]. In all studies, investigators responsible for collecting health outcome information were blinded to exposure status.

Periodic follow-up. Symptoms and job changes were assessed at regular intervals during follow-up. Physical examinations and EDS were administered either in response to positive symptoms or annually.

Outcome Measures

All studies collected demographic data and co-morbid medical conditions such as rheumatoid arthritis and diabetes mellitus. Previous carpal tunnel release and disorders of the distal upper extremity were also assessed. The time spent engaged in non-occupational, non-aerobic hand intensive activities (i.e., knitting, gardening, housework) and non-occupational, aerobic, non-hand intensive activities (i.e., jogging, walking, swimming, basketball, soccer) were assessed. General health was assessed on a 5-point scale.

Information on occupational psychosocial factors was collected with scales from the Job Content Questionnaire (JCQ). The JCQ psychological job demand and decision latitude scales were each dichotomized by splitting the distributions at their respective median values. The four-category job strain variable was created by assigning participants to one of the four quadrants resulting from the two split distributions (i.e., high demand, low control; low demand, low control; high demand, high control; and low demand, high control) [Karasek et al., 1998]. In addition to the demand and control domains, a dichotomous social support variable was created by summing the JCQ co-worker and supervisor support scale scores and then splitting the resulting distribution at the median.

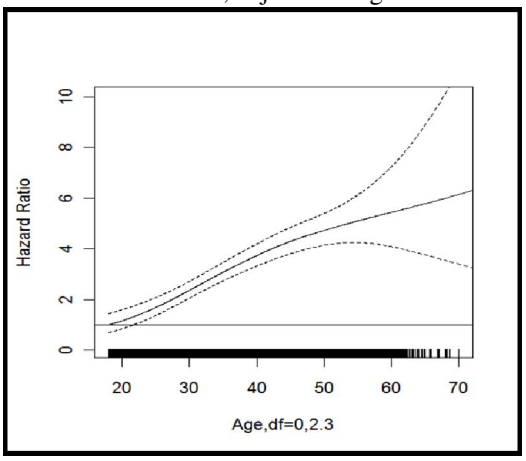
Statistical analysis

Dominant hand CTS incidence rates and crude incidence rate ratios (IRR) were calculated for each demographic and health related factor, as well as for occupational psychosocial characteristics and years worked. Hazard ratios (HR) were estimated using Cox proportional hazards regression and adjusted for potential confounding. Covariates including age, gender, BMI, and medical conditions were considered as predictors and as potential confounders. Confounding was assessed using a 10% change-in-coefficient criterion of the magnitude of the primary exposure effect. The interactions of gender and co-morbidities (BMI>=30kg/m^2 or the existence of a co-morbid medical condition) were assessed by stratification and inclusion of interaction terms in the models. The functional form of the relationship between CTS and age and BMI were assessed using penalized splines [Eisen et al., 2004] in a Cox model (R Core Team, Vienna, Austria). All analyses were implemented with the Stata statistical package (Stata, College Station, TX).

RESULTS

There were 204 (5.8%) incident cases of dominant-side carpal tunnel syndrome observed during the 8,833 person-years of follow-up, for an incidence rate of 2.3 (95%CI=2.0-2.7) per 100 person-years. Women had 1.7 times the CTS incidence rate of men, though the adjusted hazard ratio was 1.3 (95%CI: 0.98-1.72). Age over 50 was associated with a three-fold increase in CTS risk than those under 30 (HR=3.04; 95% CI:1.96-4.71). When assessed as a continuous variable, risk of developing CTS increased approximately linearly with age (Figure 1). Above 50 years, the confidence intervals widen due to sparse data.

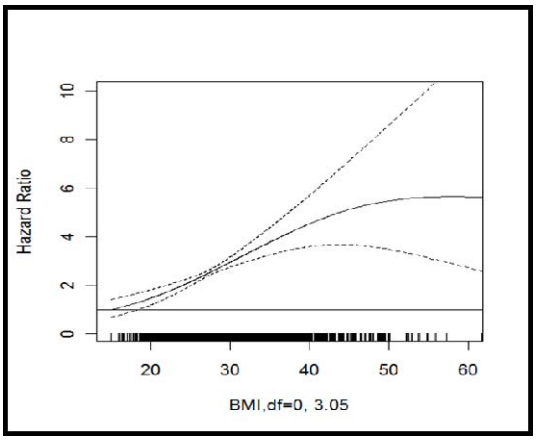
Figure 1. Age as a predictor of carpal tunnel syndrome with 95% confidence intervals, adjusted for gender and BMI.



When the three medical conditions (diabetes mellitus, thyroid disease, rheumatoid arthritis) were combined and adjusted for gender, age and BMI, medical conditions were not associated with increased risk for developing CTS. None of the conditions were statistically significant predictors of risk when analyzed in separate adjusted models. A BMI greater than or equal to 30 kg/m^2 almost doubled risk of CTS (HR=1.7; 95%CI:1.26-2.21). When assessed as a continuous variable, the hazard ratio increased approximately linearly with

increasing BMI (Figure 2). There was no evidence for effect modification by gender of the associations between CTS with age, BMI, or medical condition.

Figure 2. BMI as a predictor of carpal tunnel syndrome with 95% confidence intervals, adjusted for gender and age.



Participants with a high psychological demand score had increased risk of CTS (HR=1.57; 95% CI: 1.06-2.33), and those with high decision latitude had reduced risk (HR=0.73; 95% CI: 0.51-1.04). Those with high job strain (high demand and low control) had a hazard ratio of 1.90 (95%CI: 1.11-3.14) relative to those with low job strain (high control and low demand), and subjects with high social support had half of the risk of incident CTS compared to those with low support (HR= 0.54; 95%CI: 0.31-0.95). There was no interaction between gender, BMI, or medical conditions with either job strain or social support on risk of CTS.

DISCUSSION

This analysis provided a unique opportunity to assess the relationships between selected personal and workplace risk factors and CTS incidence with a large, prospective study. The observed associations provide evidence for both modifiable and non-modifiable risk factors for CTS. The wide range of industries, jobs and locations represented in this cohort increases the generalizability of results. The CTS incidence rate in this worker cohort was 2.3 per 100 person years. This incidence rate was higher than the 0.13 to 0.37 per 100 person years reported from population studies [Bongers et al., 2007; Gelfman et al., 2009] and higher than the 0.17 per 100 person years reported from workers' compensation data sets [Gorshce et al., 1999]. However, the incidence rate was at the low end of the range (1.2 to 11.0 per 100 person years) of incidence rates reported by other prospective studies of working populations [Bonfiglioloi et al., 2012; Gorsche et al., 1999, Gell et al., 2005]. In this analysis, we identified a near linear relationship between CTS incidence and both age and BMI. CTS incidence was also higher in categories with high job strain and decreased with higher social support at work, after adjusting for confounding by age, gender and BMI. There was no evidence of effect modification by gender for the association of age, BMI, medical condition, or high job strain and carpal tunnel syndrome.

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