and deviated posture are commonly believed risk factors for CTS. The aim of this study was to quantify associations between workplace biomechanical factors and incidence of dominant-hand CTS after adjusting for personal risk factors.

2751 incident eligible workers were followed prospectively for up to 6.4 years and contributed 6243 person-years of data to this longitudinal study. Applied force, frequency and duty cycle of exertions, wrist posture, and ACGIH TLV for HAL were quantified for each worker and periodically remeasured throughout the study. Incident cases of CTS were determined from symptoms and electrodiagnostic studies. Hazard Ratios were estimated using proportional hazards regression. All models were adjusted for age, gender, BMI, and orthogonal physical exposures.

In the adjusted models, associations were found between CTS and peak force (HR = 2.17; 95% CI: 1.38 to 3.43), frequency of forceful exertions (HR = 1.84; 95% CI: 1.19 to 2.86),% of time spent in forceful exertions (HR = 2.05; 95% CI: 1.34 to 3.15), and the TLV for HAL as a continuous variable (HR = 1.32 per unit; 95% CI: 1.11–1.57). Conversely, statistical associations with increased risk of CTS were not found between total frequency of, or total% time under exertions, nor for deviated wrist postures.

These results suggest that peak force acts as an independent risk factor for CTS. However, frequency of exertion and% time under exertion are only associated with CTS when a non-trivial amount of force is being applied, thus "repetition" does not appear to be an independent risk factor per se. We found no evidence to suggest that hand/wrist posture is an independent risk factor for CTS.

S02-2 THE STRAIN INDEX AND RISK OF UPPER LIMB MUSCULOSKELETAL DISORDERS: RESULTS FROM THE WISTAH HAND STUDY

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10.1136/oemed-2016-103951.258

The Strain Index (SI) is a widely used distal upper limb (DUL) physical exposure model that combines six putative risk factors (force, repetition, percent duration of exertion, hand/wrist posture, speed of work, shift duration) to provide a summary measure of risk. The aim of this study was to quantify exposure-response relationships between the SI and risk of DUL musculoskeletal disorders (MSDs).

A cohort of 536 manufacturing workers was followed for up to 5 years. At baseline, physical exposures were quantified using the SI. Changes to physical exposure were determine quarterly. Age, gender, BMI, and other relevant demographic, health, and psychosocial confounders were determine at baseline. MSD symptoms were evaluated monthly and electrodiagnostic studies and physical examinations were performed to identify incidence cases of carpal tunnel syndrome (CTS), lateral epicondylitis (LE), and trigger digit (TD). Exposure-response relationships were quantified using proportional hazards regression models with time-varying covariates. SI scores were modelled using linear splines.

The SI showed statistically significant exposure-response relationships with each of the three disorders in both unadjusted and adjusted models. Adjusted, peak

hazard ratios (HR) for CTS, LE, and TD were 5.9, 8.6, and 7.1 respectively. Confounders varied in importance between the disorders.

The SI score was consistently associated with increased risk of CTS, LE. And TD regardless of the presence of confounders. This suggests that physical exposure is an important, independent risk factor for developing these occupational illnesses. The SI is a useful tool for quantifying risk of DUL MSDs from job physical exposures.

S02-3 RELATIONSHIPS BETWEEN WORK ORGANISATION FACTORS AND CARPAL TUNNEL SYNDROME AND EPICONDYLITIS

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10.1136/oemed-2016-103951.259

Based on analyses of prevalence data on a pooled cohort of 1834 subjects from three research groups, this study examined the relationships between four work organisation variables (job rotation, overtime work, having second job and work pacing) and the three musculoskeletal health outcome measures (prevalence of carpal tunnel syndrome (CTS), lateral epicondylitis (LEPI) and medial epicondylitis (MEPI)). There were 249 prevalence CTS cases out of a total 1799 eligible subjects, 65 LEPI out of 1807 eligible subjects, and 14 MEPI out of 1812 eligible subjects in this cohort.

The relationships between the work organisation factors and the health outcome variables were assessed using logistic regression models fitted by the generalised estimating equations (GEE) method to account for non-independence of data collected by the same research group. Odds ratios and 95% confidence intervals were estimated for each work organisation variable separately, while always adjusting for age, gender, and body mass index (BMI).

Varied degrees of associations between these work organisation variables and the health outcome variables were found. Job rotation had significant association with CTS cases (OR = 1.23, 95%CL: 1.00–1.50). No statistically significant associations were found between the other work organisation variables and CTS cases. Contradictory to common believe, overtime work was significantly associated with lower LEPI prevalence (OR = 0.48, 95% CI: 0.28–0.84). For the LEPI, job rotation was marginally associated with LEPI cases (OR = 1.69, 95% CI: 0.96–2.97). No associations were found between having second job or different types of work pacing and LEPI. No statistically significant associations were found between the four work organisation variables and MEPI.

The results demonstrated that while clear associations between many biomechanical/psychosocial factors and the musculoskeletal health outcome variables, the work organisation variables have much more complicated impact on these health outcome variables.

S02-4 PERSONAL, PSYCHOSOCIAL, AND BIOMECHANICAL RISK FACTORS FOR WORK DISABILITY FROM CARPAL TUNNEL SYNDROME: A POOLED PROSPECTIVE STUDY

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10.1136/oemed-2016-103951.260

Introduction Carpal tunnel syndrome (CTS), the most common peripheral entrapment neuropathy, results from compression of the median nerve at the wrist that leads to more disability than most other upper extremity disorders (Foley 2007).
Method 4321 workers were followed up to 7 years with repeated symptom surveys and nerve conduction studies to identify prevalent and incident cases of CTS (N = 318). Work disability was derived from SF12 and quickDASH questionnaires, and defined as symptom driven: (1) change in work pace, (2) lost time, or (3) job change. Workplace psychosocial exposure was assessed using the Karasek Job Content Questionnaire. Job level biomechanical exposures were time weighted averages of peak hand force, HAL scale, total repetition rate, forceful repetition rate,% time all hand exertions, and% time in forceful hand exertions (≥1 kg-pinch or ≥4 kg-grip). Adjusted hazard ratios were estimated using Cox proportional hazards models.
Results Being female was associated with increased work disability (HR = 1.75; 95% CI: 1.23–2.5) as was having rheumatoid arthritis (HR = 1.85; 95% CI: 1.04–3.26). High job strain compared to low job strain more than doubled the rate of disability (HR = 2.38; 95% CI:1.03–5.51). The HAL Scale (HRmiddle = 3.91;95% CI: 1.82–8.38;HRupper = 3.20; 95% CI: 1.43–7.19), total repetition rate(HRmiddle = 2.30; 95% CI: 1.15–4.58; HRupper = 2.58; 95% CI: 1.23–5.38),% time in forceful exertions (HRupper = 2.03; 95% CI: 1.02–4.05) and% time in all exertions (HRupper = 2.53; 95% CI: 1.17–5.43) were associated with job change. Forceful repetition rate was associated with lost time (HRmiddle = 2.46;95% CI: 1.11–5.48; HRupper = 1.86; 95% CI: 0.91–3.83) and the HAL Scale (HRmiddle = 1.97; 95% CI: 1.24–3.12) and % time in all exertions (HRupper = 1.94; 95% CI: 1.17–3.24) was associated with pace change.
Discussion These results indicate that personal, workplace psychosocial and biomechanical factors are associated with an increased rate of work disability from CTS and should be taken into account for secondary prevention programs.

S02-5 THE RELATIONSHIP BETWEEN MEDIAN NERVE LATENCY, PAIN AND WORK DISABILITY FROM CARPAL TUNNEL SYNDROME

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10.1136/oemed-2016-103951.261

Background Carpal tunnel syndrome (CTS) is an important occupational health problem because its frequency and severity lead to more disability than most other upper extremity disorders and is an important driver of overall workers compensation costs (US Bureau of Labour & Statistics 2010; Foley 2007). Identifying individuals at risk for increased severity is an important aspect of secondary prevention programs. This analysis examined the relationship between median nerve latency, pain and work disability from CTS in a pooled prospective cohort.
Methods 4321 workers were evaluated and followed up to 7 years with repeated symptom surveys and nerve conduction studies to identify prevalent and incident cases of CTS (N = 318). CTS case criteria included symptoms in a median nerve distribution of the digits (1–3) and an abnormal electrodiagnostic study. Among those with CTS, work disability was defined as symptom driven: (1) change in work pace/quality, (2) lost time, or (3) job change, derived from SF12 and quickDASH questionnaires. Adjusted hazard ratios were estimated using Cox proportional hazards models.
Results Of the 318 workers with prevalent or incident CTS, 57.5%(N = 183) reported a work disability. The most common disability was a change in work pace/quality (n = 124), followed by job change (n = 71), and lost-time(n = 56). Median sensory latency (HRupper = 1.83; 95% CI: 1.06–3.16) and pain(HRupper = 1.64; 95% CI: 1.03–2.62) were associated with increased changes in work pace/quality but were not associated with lost time or job change due to hand symptoms. Median motor latency at the time of diagnosis was not associated with any measures of CTS related work disability.
Discussion These results indicate that median sensory latency and hand/wrist pain were associated with increased change in work pace/quality from CTS, but were not associated with other more severe measures of work disability such as lost time or job change.

Symposium 3 – Heat as an Occupational Hazard – The Evidence-base for Interventions Now and in the Future

S03-1 CLIMATE CHANGE INCREASES WORKPLACE HEAT STRESS, AFFECTING WORK CAPACITY AND OCCUPATIONAL HEALTH, INCLUDING KIDNEY DISEASE AND OTHER HEALTH OUTCOMES RELATED TO HEAT AND DEHYDRATION

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10.1136/oemed-2016-103951.262

Climate change leads to increasing temperatures, shifting rainfall patterns and more extreme weather events, which affect occupational health in many ways. Heat stress at work poses health risks and reduced work capacity, presenting a new and widespread occupational health challenge due to climate change.

Human physiology limits to coping with heat stress are well known, but the links to climate change need further analysis. Occupational health effects include heat exhaustion (reducing work capacity), serious heat stroke (including deaths), dehydration effects on the kidneys, and exacerbation of chronic diseases. Cognitive performance is also affected by heat stress. Physical work significantly adds to heat stress because of internal heat production from muscles. Working people slow down or take frequent breaks (self-pacing) to compensate. As a result, reduced productivity creates economic losses.

We compared population based estimates of health impacts of heat stress for selected climate models applied to the four different "Representative Concentration Pathways" of greenhouse gases established by the UN Intergovernmental Panel on Climate Change (IPCC).

S02-4 Personal, psychosocial, and biomechanical risk factors for work disability from carpal tunnel syndrome: a pooled prospective study

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Occup Environ Med 2016 73: A96-A97
doi: 10.1136/oemed-2016-103951.260