

**0322 THE USEFULNESS OF COMPENSATION STATISTICS TO DETECT HEAT-RELATED HEALTH OUTCOMES IN A TEMPERATE CLIMATE: THE EXPERIENCE OF QUEBEC**

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**Objectives** To explore relationships between summer outdoor temperatures in Quebec (Canada) and occupational compensation statistics for heat-related illnesses.

**Method** Daily compensation counts of heat-related illnesses (heat strain, heatstroke, loss of consciousness, etc.), occurring between May and September, were obtained from the workers' compensation board of Quebec for each health region between 1998 and 2010. Regional daily maximum outdoor temperatures were obtained from Environment Canada. Associations between daily compensation counts and temperature were estimated using negative binomial or Poisson regression models for each region and were adjusted for relative humidity and temporal trends. Pooled effect sizes for Quebec (all health regions combined) were obtained using a fixed effect model for meta-analysis.

**Results** In an average population of 3.7 million workers, 259 illnesses classified as heat-related were compensated between 1998 and 2010, giving an average annual rate of 0.11 case per 100 000 workers per summer month. During the study period, 63.0% of heat-related outcomes occurred on days with a maximum daily average temperature below 30°C. Occupations with the largest number of compensations were those of labourers (32%), firefighters (11%) and truck drivers (4%). The pooled incidence rate ratio (IRR) was 1.41 (95% CI 1.35–1.46) per 1°C increase in daily maximum temperature. Effects of barometric pressure and lag will be explored.

**Conclusions** Heat-related illnesses do occur in temperate climates. Our results suggest that compensation statistics, albeit crude indicators of health effects, can be useful to identify industry sectors and occupations that would benefit from preventive interventions aimed at high risk workers.

**0323 WORKPLACE PSYCHOSOCIAL RISK FACTORS FOR CARPAL TUNNEL SYNDROME: A POOLED PROSPECTIVE STUDY**

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**Objectives** Seven research groups conducted coordinated studies of carpal tunnel syndrome (CTS). In this analysis of the pooled cohort, we estimate associations of workplace psychosocial factors and CTS incidence with adjustment for biomechanical factors.

**Method** 3515 workers were followed up to 7 years. Case criteria included symptoms consistent with CTS and an abnormal electrodiagnostic study. Psychosocial exposure was measured using the Job Content Questionnaire to assess risk among those with high job strain measures. Individual level occupational biomechanical exposures included the %time spent >30° wrist extension, % time in >30° wrist flexion, total repetition rate, and the %time spent in forceful exertion (>1kg-pinch; >4kg-grip). A sub-cohort of 1091 participants had both psychosocial and biomechanical exposure data. Adjusted hazard ratios were estimated using Cox proportional hazards models.

**Results** After adjustment for gender, age and BMI in the sub-cohort, high job strain (HR=1.40; 95% CI:0.86–2.28) and high psychological demand (HR=1.25; 95% CI:0.79–1.98) showed statistically non-significant elevation in risk of CTS, and high decision latitude (HR=0.70; 95% CI:0.44–1.13) showed non-significant decrease in risk. When the same models were adjusted for biomechanical exposures, confounding was not evident; the primary exposure effect estimates changed between 1–7% for high job strain (HR=1.30; 95% CI:0.81–2.17), high psychological demand (HR=1.17; 95% CI:0.74–1.83), and high decision latitude (HR=0.71; 95% CI:0.43–1.18).

**Conclusions** For this sub-cohort analysis, adjustment for biomechanical exposures did not alter the associations between workplace psychosocial factors and incident CTS. The findings suggest that workplace psychosocial risk is independent of workplace biomechanical risk.

**0324 OCCUPATIONAL EXPOSURE TO BENZENE AND RISK OF NON-HODGKIN LYMPHOMA IN A POPULATION-BASED COHORT STUDY OF CHINESE WOMEN IN SHANGHAI**

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**Objectives** The association between benzene exposure and non-Hodgkin lymphoma (NHL) has been the subject of debate, and an IARC working group recently concluded for the first time that there is now limited evidence to support this association in humans. We evaluated the relationship between occupational benzene exposure and NHL risk among 73 087 women in a population-based cohort study of women in Shanghai.

**Method** Benzene exposure estimates were derived using a previously developed exposure assessment framework that combined ordinal job-exposure matrix intensity ratings with quantitative benzene exposure measurements from an inspection database of Shanghai factories collected between 1954–2000. Associations between benzene exposure metrics and NHL (n = 102) were assessed using Cox proportional hazard models, with study follow-up occurring from 1997–2009.

**Results** Women ever exposed to benzene had a significantly elevated risk of NHL (Hazard Ratio (HR) = 1.87, 95% CI = 1.19–2.96). Compared to unexposed women, significant trends in NHL risk were observed for increasing years of benzene exposure ( $p_{\text{trend}} = 0.009$ ) and increasing cumulative exposure levels ( $p_{\text{trend}} = 0.01$ ), with women in the highest duration and cumulative exposure tertiles having a significantly elevated association with NHL (HR = 2.07, 95% CI = 1.07–4.01 and HR = 2.16, 95% CI = 1.17–3.98, respectively).

**Conclusions** Our study is the first to our knowledge to evaluate this association in the context of a population-based prospective cohort of all women with diverse occupational histories. Our findings add to the evidence that benzene is associated with risk of NHL.

### 0330 A STUDY OF RADIOGRAPHIC ABNORMALITIES IN MINNESOTA TACONITE WORKERS

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**Objectives** A limited number of studies have been conducted in the taconite industry, typically without detailed exposure information. We assessed occupational exposure to elongate mineral particles (EMP) in association with chest x-ray findings in a cross-sectional screening of 1188 current and former taconite workers.

**Method** Exposure was determined by a combination of some 1300 onsite measures taken by researchers and historical measures taken by mining companies. The NIOSH 7400 measurement method (PCM) was used to count EMP. Twenty-eight similarly exposed groupings (SEG) were developed and contained all jobs. Each SEG had multiple EMP measures as an anchoring point for historical exposure estimates. Work histories were standardised, mapped to SEGs and used to estimate exposures for each worker in each SEG. Chest x-rays were obtained using ILO methods, with two independent radiologists. Prevalence odds ratios were estimated by logistic regression for work duration and cumulative EMP exposure, adjusting for age, gender, BMI and occupations with high potential for asbestos.

**Results** Pleural findings occurred in 16.8% by consensus. Abnormalities were associated with duration of employment in the taconite industry for those working 21 years or more (OR=1.59, 95% CI=1.06–2.40). Pleural abnormalities were also associated with cumulative exposure to EMP for those cumulatively exposed to 1.16 EMP/cc-years or more (OR=1.93, 95% CI=1.32–2.83). Associations between parenchymal abnormalities and exposure were not observed.

**Conclusions** This study suggests that pleural abnormalities are related to duration of employment and to EMP exposure in taconite miners. Due to the measurement method, the specific type of EMP could not be described further.

### 0333 THE CONTRIBUTION OF OCCUPATIONAL STUDIES TO THE IDENTIFICATION OF CARCINOGENS IN THE IARC MONOGRAPHS AND HOW TO FURTHER IMPROVE IT

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**Objectives** To discuss the important role of occupational studies in identifying carcinogens and suggest how it could be still greater.

**Method** The contribution of occupational studies to the IARC monographs is reviewed.

**Results** Occupational epidemiology has made important contributions beyond developing knowledge to protect workers' health, notably in identifying carcinogens of concern for the general population. The IARC Monographs have evaluated many carcinogens for which occupational studies have provided key evidence. The recent classifications of diesel engine exhaust, trichloroethylene and polychlorinated biphenyls (PCBs) as human carcinogens, which depended heavily on data from occupational studies, are illustrative. In the evaluation of PCBs, for example, occupational cohort studies showing an exposure-related increase in the risk of malignant melanoma were pivotal for the conclusion of sufficient evidence of carcinogenicity. Despite such noteworthy contributions, the number of occupational studies that are ultimately informative tends to be relatively small relative to the number reviewed. The most informative studies tend to have common features, including clear reporting of methods and results, well-defined outcomes, quantitative estimates of exposure, adequate control of major confounders, and state of the art analytical methods, often with internal analyses of exposure-response. In contrast, studies that are too broadly focused and those with crude classifications of exposure or outcome, analyses by external comparisons alone or poor reporting of the methods and results are often less informative in the final evaluation.

**Conclusions** While occupational studies are important for carcinogen identification, their relevance could be further enhanced with improvements in study design, methods and reporting.

### 0344 20 YEARS (1989–2008) OF DIRECT COSTS ASSOCIATED WITH FALLS FROM HEIGHT AMONG UNION CARPENTERS, WASHINGTON STATE, USA

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**Objectives** To examine trends in workers' compensation payments for falls from height (FFH) among a large cohort of carpenters over a 20-year period (1989–2008). Cost data provide an important metric reflecting frequency of falls and severity of associated injuries.

**Method** Using combined administrative data we evaluated workers' compensation (WC) payments associated with FFH among a large (n = 24 830) 20-year cohort (1989–2008) of union carpenters in Washington State. Mean payments, costs rates and adjusted rate ratios based on hours worked were calculated using negative binomial regression to evaluate cost patterns based on age, union tenure, type of carpentry work and calendar time after adjusting and discounting to 2011 dollar values.

**Results** FFH accounted for \$66.6 million in WC payments (a burden of \$0.35 per hour worked) over the 20-year period. FFH were responsible for 5.5% of injuries but 15.1% of costs. Marked cost declines were observed over time, but not in a monotonic fashion. Reductions were more pronounced for indemnity than for medical care. Mean costs per fall were unchanged in the latter years of observation from those observed 1995–1996. Individuals performing millwrighting or drywall installation had cost rates over twice as high as commercial construction. Mean costs were 2.3 times greater among carpenters