

( $p = 0.006$ ). Increasing daily hours of vacuuming was associated with increased odds of lower- ( $p = 0.03$ ) and upper- ( $0.003$ ) respiratory symptoms.

**Conclusions** Custodian dermatological, respiratory, and musculoskeletal symptoms are consistent with task related exposures and follow a dose-related pattern with increasing odds of symptoms related to increased exposure duration.

**0122 APPROACHES TO DEVELOPING EXPOSURE ESTIMATES THAT REFLECT TEMPORAL TRENDS IN TOTAL PARTICULATE MATTER IN ALUMINIUM SMELTERS**

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**Objectives** To evaluate different approaches for including time trends in quantitative exposures to total particulate matter (TPM) in an aluminium smelter for use in epidemiologic evaluation of incident heart disease, we compared the use of regression modelling to discrete modelling of changes in the workplace environment.

**Method** We used an industrial hygiene database containing results for sampling conducted over 30 years and information on workplace environment (e.g. personal protective equipment policy, ventilation modifications, changes to materials or work organisation). The effects of these changes were tested with an analysis of variance model using log-transformed TPM concentrations. We compared the outcome of this approach to the use of a regression model for TPM concentrations over time.

**Results** Time trends in 57 jobs in an aluminium smelter were evaluated by using 1123 TPM samples collected from 1984–2012. There was an overall decline in median TPM concentrations ( $\text{mg}/\text{m}^3$ ) at the smelter (3.7% per year). The trend was not observed in the majority individual jobs. The decreasing trend was concentrated in 14% of the jobs. The majority of jobs (61%) had no change over the time period, 19% had no consistent pattern of change, and 5% increased in TPM concentrations.

**Conclusions** Applying a global trend to worker exposures would result in misclassification error in epidemiologic evaluations. When possible, process changes should be used to define changes in worker exposures rather than using a facility- or industry-wide time trend. Future work will explore regression modelling as a way to explain any remaining time trends in TPM.

**0124 PM2.5 AND HEART DISEASE IN A COHORT OF ALUMINIUM WORKERS: AN APPLICATION OF LONGITUDINAL TARGETED MAXIMUM LIKELIHOOD-BASED ESTIMATION (TMLE)**

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**Objectives** We estimated the effect of cumulative exposure to PM2.5 on the incidence of ischaemic heart disease (IHD) in aluminium workers followed for 15 years, adjusting for the healthy worker survivor effect. In previous analyses, higher cumulative

exposure was found to be associated with lower mortality in this population.

**Method** We used longitudinal TMLE to estimate the cumulative risk of ischaemic heart disease in the cohort if constantly exposed above an exposure cut-off and compared it to the risk if constantly exposed below. We stratified all analyses by work process because exposures were an order of magnitude higher in smelters than fabrication facilities.

**Results** We selected cut-offs a priori at the median and 10th percentile exposure within each sub-cohort. Among the smelter workers, we estimated an increase in IHD risk of 2.1% ( $p = 0.22$ ) after 15 years, comparing the always exposed to never exposed cohort using the median cut-off of  $1.77 \text{ mg}/\text{m}^3$ . The difference was 2.9% ( $p = 0.01$ ) using the 10th percentile cut-off of  $0.10 \text{ mg}/\text{m}^3$ . For the fabrication workers, the differences were 0.1% ( $p = 0.47$ ) using the median cut-off of  $0.20 \text{ mg}/\text{m}^3$  and 2.5% ( $p < 0.01$ ) for the 10th percentile cut-off of  $0.06 \text{ mg}/\text{m}^3$ . Results are presented as adjusted survival curves, describing the estimated cumulative risk for each cohort under each exposure regimen.

**Conclusions** The TMLE estimator allows us to observe an association between cumulative PM2.5 exposure and heart disease that was not visible using standard analytical techniques. This work represents the first application of longitudinal TMLE to the field of occupational epidemiology.

**0127 PESTICIDE USE AND RELATIVE TELOMERE LENGTH IN THE AGRICULTURAL HEALTH STUDY**

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**Objectives** Epidemiologic studies have linked pesticide use to various health outcomes, including cancer, but underlying mechanisms remain unclear. In a previous analysis from the Agricultural Health Study (AHS), a prospective cohort study of pesticide applicators in the US, use of certain pesticides was linked to shorter relative telomere length (RTL) measured in buccal cell DNA. In this analysis we examined the associations between occupational pesticide use and RTL measured in blood DNA.

**Method** We conducted an analysis of 80 pesticides and RTL in 568 cancer-free male participants aged 31–94 years in the AHS. We used self-reported pesticide use information collected at study enrollment (1993–1997) and two follow-up questionnaires administered approximately 5 years apart to construct exposure metrics, including intensity-weighted lifetime days (lifetime days\*intensity score). Blood samples were collected in 2006–2008, and RTL was measured in DNA using qPCR. Multivariable linear regression was used to evaluate the associations between individual pesticide use and RTL, adjusting for age at blood draw and other pesticides associated with RTL.

**Results** Increasing tertiles of intensity-weighted days of alachlor were associated with longer RTL ( $p$ -trend = 0.01). In contrast, increasing tertiles of intensity-weighted days of 2,4-D ( $p$ -trend = 0.05), diazinon ( $p$ -trend = 0.01) and aldrin ( $p$ -trend = 0.01) were associated with shorter RTL.

**Conclusions** We found two herbicides (alachlor, 2,4-D) and two insecticides (diazinon, aldrin) significantly associated with alterations in RTL. These pesticides have been linked to increased

cancer risk in epidemiological and/or animal studies. Consistent with our finding, shorter RTL with 2,4-D use was previously observed in an analysis of buccal cells in the AHS.

**0129 WORK RELATED MORTALITY AND HOSPITAL ADMISSIONS AMONG MIGRANT WORKERS IN AUSTRALIA, 1991–2010**

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**Objectives** One in four of the Australian population is born abroad, with skilled migration encouraged since the mid-1990s. The shift from an industrial to a service based economy has seen a decline in recent decades of work-related injuries (WRIs) and related mortality in Australia. We examine deaths and hospital admissions from WRI, among foreign and Australian-born workers.

**Method** Work-related mortality and hospital admission rates were derived from tabulated data from the 1991 to 2011 censuses, 1991–2002 national deaths and hospital admissions for 2001–2010. Comparisons across country of birth groups were conducted using incidence rate ratios (IRRs). Gender specific mortality and hospital admission rates were directly standardised (DSRs) using the World Standard Population. Negative binomial regression models compared the country-specific mortality and hospital admission rates of the foreign-born workers with those of Australian-born workers.

**Results** DSRs and IRRs were generally higher for Australian-born than foreign-born workers. A notable exception was New Zealand born men, among whom there was a 10% (95% CI 9.1–13.1) excess mortality and 24% (95% CI 12.2–12.6) excess hospital admissions. Adjusting for age, gender, year and skill level removed the differences in risk of WRI death between Australian and foreign-born workers.

**Conclusions** These findings show a reversal of the historic trend of foreign-born workers being at higher risk than the local-born. They signal a need to promote healthy work environments in all industries to further reduce the risk of WRI to all workers in Australia.

**0131 TAKING RISKS AND SURVIVAL JOBS: FOREIGN-BORN WORKERS AND WORK-RELATED INJURIES IN AUSTRALIA**

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**Objectives** Higher rates of work-related injuries (WRI) have been reported among foreign-born workers in many countries, but little is known about the situation in Australia. The aim of the study was to examine WRI among foreign-born workers in Australia.

**Method** This was a two phase mixed methods study. The first stage used the 2005/6 and 2009/10 Australian national Multi-Purpose Household Survey (MPHS) information on WRI occurring in the previous year (N = 36 702). Logistic regression examined the relationship between WRI and region of birth (Australia born =baseline), and whether the effect varied by period of arrival in Australia, age, sex, industry and working conditions. In the second stage, purposively sampled foreign-born workers and stakeholders from 22 countries took part in individual interviews (n = 17) or focus groups (n = 75). A concurrent thematic analysis was conducted.

**Results** In the MPHS, more WRI were reported by workers in agriculture, manufacturing, construction, hospitality and transport industries than in the service industry, and by those in unfavourable working conditions (e.g. unpaid leave). Migrant status, regardless of region of birth, was generally not associated with higher WRI reporting. Qualitative interviews suggested that understanding and practice of Occupational Health and Safety (OH&S) was influenced by education, skill level, job security, dependent relatives in home countries and by social ties in communities.

**Conclusions** Whereas the MPHS point to higher risks related to area of work rather than migrant status, qualitative interviews suggest under-reporting of WRI among low income migrants mainly due to fear of losing their jobs.

**0133 INCREASED RISK OF SPONTANEOUS ABORTION AND MENSTRUAL ABERRATIONS IN FEMALE WORKERS IN SEMICONDUCTOR INDUSTRY, SOUTH KOREA**

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**Objectives** Since a series of papers to report reproductive problems among semiconductor workers in mid-2000s, there have been few studies to monitor such issues in spite of global expansion and technical development of semiconductor industry. In such a context, we examined reproductive risk among female workers in Korea.

**Method** Based on the claim data of the National Health Insurance from 2008 to 2012, we estimated age-specific rates of spontaneous abortion (SA) and menstrual aberration (MA) among women aged 20 to 39 years, and then compared them between exposure and control groups using relative risk (RR). Semiconductor workers were defined as exposure group, and three different groups were used as controls; first, economically inactive women, second, working population in total, and last, workers employed in bank industry.

**Results** Female workers in semiconductor industry have significantly higher risk for SA (RR 1.57 and 1.58 for 20–29 and 30–39 years old, respectively) and MA (RR 1.54 and 1.25 for 20–29 and 30–39 years old, respectively) compared to economically inactive population. RRs for SA (RR 1.40 and 1.67) and MA (RR 1.38 and 1.35) were significantly higher compared to working population in total. RRs for SA and MA also were significantly higher compared to workers employed in bank except for RR of SA for the twenties.

**Conclusions** In spite of technical innovations and health and safety measures taken by semiconductor industry, workers seem to be still exposed to reproductive risk, at least in Korea. Further studies to identify specific hazards should be launched.