Approaches to developing exposure estimates that reflect temporal trends in total particulate matter in aluminium smelters

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 modeling to discrete modeling 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 (mg/m³) 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 trend. Future work will explore regression modelling as a way to explain any remaining time trends in TPM.

Pesticide use and relative telomere length in the agricultural health study

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 = 0.03), 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 exposure 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 mg/m³. The difference was 2.9% (p = 0.01) using the 10th percentile cut-off of 0.10 mg/m³. For the fabrication workers, the differences were 0.1% (p = 0.47) using the median cut-off of 0.20 mg/m³ and 2.5% (p < 0.01) for the 10th percentile cut-off of 0.06 mg/m³. 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.
Work-Related Mortality and Hospital Admissions among Migrant Workers in Australia, 1991–2010

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 (WRI) 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.

Taking Risks and Survival Jobs: Foreign-Born Workers and Work-Related Injuries in Australia

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 (OHS) 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.