children's paraoccupational exposure to chlorpyrifos or 2,4-Dichlorophenoxyacetic Acid (2,4-D) in a study of farm families who used one of these pesticides as part of their usual practice.

Methods The sample included 34 applicators applying 2,4-D (n=53 children) or chlorpyrifos (n=50 children). Sequential 24 hour urine samples were collected on the day preceding application through the third day after application of chlorpyrifos or 2,4-D. Maximum post-application urine concentrations of 3,5,6-trichloropyridinol (TCP), a chlorpyrifos metabolite, and 2,4-D (log-transformed) were used to examine the association of children's exposure with applicator exposure using mixed model regression including a random intercept for farm to account for correlation. The final adjusted model included children's age, gender, and presence during the application as covariates. Separate models were fit based on children's presence or absence during the application.

Results Adjusted models revealed positive associations between children's exposure with applicators' exposure (TCP: $\beta=0.257$; 95% CI=0.052, 0.462; 2,4-D: $\beta=0.593$, 95% CI=0.364, 0.822). The association persisted among children who were absent during the application process (TCP: $\beta=0.218$, 95% CI=-0.029, 0.466; 2,4-D: $\beta=0.547$, 95% CI=0.283, 0.811).

Conclusions Specific pesticide exposure pathways to children living on farms are difficult to identify, but these data indicate that applicator exposure is associated with exposures to their children absent any known direct exposure to the children. Applicators protecting themselves from exposures may also protect their children.

Oral Presentation

Cancer

0321

ASSOCIATION BETWEEN OCCUPATIONAL EXPOSURE TO ASBESTOS AND CHOLANGIOCARCINOMA: A POPULATION-BASED NESTED CASE-CONTROL STUDY

¹Andrea Farioli*, ²Kurt Straif, ³Giovanni Brandi, ¹Stefania Curti, ⁴Kristina Kjaerheim, ⁴Jan Ivar Martinsen, ⁵Pär Sørensen, ^{6,7}Laufey Laufey Tryggvadottir, ⁵Elisabete Weiderpass, ³Guido Biasco, ¹Francesco Saverio Violante, ¹Stefano Mattioli, ^{8,9}Eero Pukkala. ¹Department of Medical and Surgical Sciences (DIMEC), University of Bologna, Bologna, Italy; ²International Agency for Research on Cancer, Lyon, France; ³Department of Experimental, Diagnostic, and Specialty Medicine, S. Orsola-Malpighi University Hospital, Bologna, Italy; ⁴Department of Research, Cancer Registry of Norway, Institute of Population-Based Cancer Research, Oslo, Norway; ⁵Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden; ⁶Icelandic Cancer Registry, Reykjavik, Iceland; ⁷Faculty of Medicine, University of Iceland, Reykjavik, Iceland; ⁸Faculty of Social Sciences, University of Tampere, Tampere, Finland; ⁹Finnish Cancer Registry, Institute for Statistical and Epidemiological Cancer Research, Helsinki, Finland

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Objective To investigate the association between occupational exposure to asbestos and the risk of cholangiocarcinoma (CC) using data from the Nordic Occupational Cancer (NOCCA) cohort.

Methods We conducted a nested case-control study of 1458 intrahepatic CC (ICC) and 3972 extrahepatic (ECC) cholangiocarcinoma cases registered among subjects born 1920 or later in Finland, Iceland, Norway and Sweden. Five population controls were individually matched by birth year, gender, and country to each case. We applied the NOCCA job exposure matrix to job titles from national population censuses

(1960, 1970, 1980/81, and 1990) to estimate the cumulative exposure to asbestos. We estimated odds ratios (OR) and 95% confidence intervals (CI) by conditional logistic regression models adjusted by printing industry work.

Results The risk of ICC was increased among workers with high cumulative exposure to asbestos: never exposed, OR=1.0 (reference category); 0.1–4.9 f/ml * years, OR=1.1 (95%CI 0.9–1.3); 5.0–9.9 f/ml * years, OR=1.3 (95%CI 0.9–2.1); 10.0–14.9 f/ml * years, OR=1.6 (95%CI 1.0–2.5); ≥ 15.0 f/ml * years, OR 1.7 (95%CI 1.1–2.6). We did not observe an association between cumulative asbestos exposure and ECC.

Conclusions Our study supports the hypothesis that occupational exposure to asbestos is a risk factor for ICC, while we did not observe evidence of an association between exposure to asbestos and ECC. Further studies, such as pooled analysis of asbestos cohorts, are necessary to assess the strength of the association between asbestos and ICC and clarify the observed differences between ICC and ECC.

Oral Presentation

Cancer

0322

CANCER INCIDENCE IN FIREFIGHTERS IN SWEDEN – PRELIMINARY FINDINGS FROM AN UPDATED COHORT STUDY

¹Cecilia Kullberg, ¹Tomas Andersson, ¹Per Gustavsson, ¹Jenny Selander, ²Göran Tornling, ¹Annika Gustavsson, ¹Carolina Bigert*. ¹Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden; ²Respiratory Medicine Unit, Department of Medicine Solna and CIMM, Karolinska Institutet and Karolinska University Hospital Solna, Stockholm, Sweden

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Objectives Firefighters are potentially exposed to carcinogens during work, such as benzene, benzo(a)pyrene, arsenic, asbestos and silica dust. There are previous studies indicating an increased cancer risk among firefighters. The aim was to study risk of cancer in Swedish firefighters.

Methods We updated a previous cohort study of firefighters in Stockholm, comprising 1 080 men who worked at least 1 year as a firefighter during 1931–1983. They were followed regarding cancer incidence (in the National Cancer Register) from 1958–2012, adding 26 years of follow-up compared to the previous study. We also updated the information of employment duration, by annual records at the fire stations. We calculated standardised incidence ratios (SIR) with the male population in Stockholm as reference.

Results The overall cancer incidence was low (SIR=0.81, 95% CI=0.71–0.91), but there was a trend of increasing cancer incidence with increasing employment duration ($p=0.03$). There was an increased incidence of stomach cancer (SIR=1.89, 95% CI=1.25–2.75). The risk was significantly low for prostate cancer (SIR=0.68, 95% CI=0.52–0.87) and for malignant melanoma of the skin (SIR=0.30, 95% CI=0.06–0.88).

Conclusions We found no increased cancer incidence overall in Swedish firefighters, although the increasing incidence with increasing work duration indicates a possible carcinogenic effect of exposures at work. The cause of the increased incidence of stomach cancer is uncertain but could possibly be due to exposure to asbestos or silica dust, although this is quite speculative.

Oral Presentation

Cancer

0323 OCCUPATIONAL EXPOSURE TO BENZENE, TOLUENE, XYLENE AND STYRENE, AND RISK OF PROSTATE CANCER

Audrey Blanc-Lapierre, Mounia Senhaji Rhazi, Hugues Richard, Marie-Élise Parent*. *INRS – Institut Armand-Frappier, Laval, Quebec, Canada*

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Little data exist on prostate cancer (PCa) risk associated with exposure to monocyclic aromatic hydrocarbons (MAHs), although several of them are classified as definite or possible carcinogens to humans. We examined PCa risk in relation to lifetime occupational exposure to benzene, toluene, xylene and styrene in a population-based case-control study in Montreal, Canada.

Incident cases diagnosed with PCa between 2005 and 2009 (n=1902, aged ≤ 75 years) and population controls frequency-matched on age (n=1958) provided detailed work histories during in-person interviews. Chemists evaluated the certainty, frequency and concentration of exposure to chemical agents in each job held using semi-quantitative indicators. Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI) for PCa risk, adjusting for several potential confounders.

Applying a 5 year lag, the proportions of subjects ever exposed to MAHs (any), benzene, toluene, xylene and styrene were 31%, 11%, 12%, 10% and 2%, respectively. The risk of aggressive PCa (Gleason score >7 or $[4+3]$) was not increased with greater duration of exposure or with cumulative exposure to any of the MAHs. However, the risk of non-aggressive PCa was increased with ≥ 25 years of exposure to any (OR=1.59, 95% CI:1.09–2.34) or substantial (OR=2.34, 95% CI:1.22–4.50) level of benzene, to substantial level of styrene (OR=2.44, 95% CI:1.16–5.13), and with high cumulative exposure to benzene (OR=1.68, 95% CI:1.16–2.44) or xylene (OR=1.51, 95% CI:1.01–2.25). Similar results were observed in the subset of subjects recently screened for PCa.

Our results suggest that high duration and level of exposure to benzene, xylene or styrene may increase the risk of non-aggressive PCa.

Poster Presentation

Injuries

0324 MISCLASSIFICATION OF ANIMAL HANDLING INJURIES TO SWINE WORKERS

Jessica Evanson, Deirdre Green, Bruce Alexander*, Jeff Bender. *University of Minnesota, Minneapolis, MN, USA*

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Background Injuries resulting from animal handling are the most frequent, serious, and costly injuries to swine workers. Characterising injury burden related to animal handling and developing and evaluating appropriate prevention measures

requires correct identification of injury cause. We examined the occurrence and consequences of animal handling injury misclassification in two large swine production companies in the U.S.

Methods Records for all potential animal related injuries and the injury event narratives were reviewed and independently coded based on the Occupational Injury and Illness Classification System (OIICS) coding tree. The original and re-coded data were evaluated for agreement in source and injury event for all injuries caused by animals. The resulting frequency of misclassified injuries and the potential cost burden were summarised based on medical and indemnity payments.

Results From a total of 1573 reported injuries, 331 were reported to be caused by animals. The re-coded data increased the number to 435. Re-coded data from companies accounted for an additional 104 injuries. It was more common for companies to under-ascertain animals as the source of injury (26%, 114/435) than it was to incorrectly assign animals as the source of injury (2%, 8/435). Costs related to the originally reported animal handling injuries totaled \$1,537,163, and an additional \$1 82 580 (12%) was added to the total with the re-classified injuries.

Conclusion Misclassification of cause of injury may result in an underestimate of total injury burden from animal related injuries and would hamper evaluation of the evaluation of strategies to prevent animal handling injuries.

Oral Presentation

Neurological Effects

0325 FUTURE DIRECTIONS FOR OCCUPATIONAL EPIDEMIOLOGICAL RESEARCH ON NEURODEGENERATIVE DISORDERS

^{1,2}Susan Peters*, ²Leonard van den berg, ²Jan Veldink, ¹Roel Vermeulen. ¹Utrecht University, Utrecht, The Netherlands; ²University Medical Centre Utrecht, Utrecht, The Netherlands

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Associations between occupational exposures and neurodegenerative disorders (including amyotrophic lateral sclerosis (ALS), Parkinson's and Alzheimer's diseases) have not been studied as extensively as cancer and respiratory diseases and their causes remain largely unknown.

Due to complicated clinical diagnosis and lack of registries, case ascertainment is a limiting factor when studying neurodegenerative disorders. Case-control studies are best suited for inclusion of incident cases, but prone to recall bias. Studies on neurodegenerative disorders may additionally suffer from lack of recall because of disease characteristics. Cohort studies are free from recall bias and offer opportunities to study associations with occupational exposures. Moreover, baseline blood may be informative about exposures (e.g. lead) well before disease onset. Although occupational information collected in most cohorts is limited, successful studies in cancer and respiratory epidemiology have shown that occupational studies in general populations can be informative.

For ALS, several efforts are being conducted to tackle the aforementioned challenges. Examples are: an ongoing nationwide case-control study in the Netherlands (PAN: