

randomly selected from 9 regions in a population based case-control study in Spain (MCC-Spain study) with demographic details, information on potential confounders and a comprehensive employment history. Each case of leukaemia may have one or more occupations. All occupations were coded by Occupational National Code (CNO 94) and The International Standard Classification of Occupations (ISCO-88). Associations between occupation and leukaemia were analysed using logistic regression adjusting for gender, age, and smoking.

**Results** We analysed the 27,4% of leukaemias. 6% never had occupation with risk of leukaemia and 41% were worked at least one occupation with probable exposure to carcinogens for leukaemia. Analysis is ongoing and results will be presented at the conference.

**Conclusions** In summary, our study showed some evidence supporting the role of some kind of occupation in the development of leukaemia. However, given the relative low numbers the results have to be interpreted with some caution. We have analysed the exposure on these occupations.

#### 0435 PRIMARY SELECTION AND IMPACT OF SHIFT WORK ON CARDIOVASCULAR RISK FACTORS

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**Objectives** A potential "healthy worker effect" may bias the studied effect of shift work on health. The observed differences in health behaviour and health outcomes might be caused by: (i) primary selection, (ii) influence from the shift work related environment, and (iii) impact of shift work. We aimed to study these potential sources.

**Method** A cohort of 4754 male trainees who had finished their professional training and started their career in the production between 1995 and 2012 was identified. Among them, 1348 (28%) were involved in rotating shift work and 3406 (72%) in a day working time. Information on lifestyle and blood pressure (BP), body mass index, and measurements of laboratory parameters were retrieved from the data of medical examinations. These were then compared at (i) the beginning, (ii) the end of training, and (iii) 3 years after the job began, in relation to the working time.

**Results** At the beginning of the training, the prevalence of smokers was higher among shift workers (26% vs. 21%). During the training and the first 3 years of job, marginal decline of systolic BP and elevation of triglyceride were observed among the shift workers, after the adjustment for age at begin, duration between the examinations, and the measurements at the baseline. No difference was found with respect to other risk factors for cardiovascular diseases.

**Conclusions** Our findings do not support a primary selection in favour of shift workers. A potential impact of shift work on lifestyle and health will be studied prospectively.

#### 0438 DIFFERENCES IN OCCUPATIONAL INJURY RATES BY AGE GROUP, INDUSTRY AND INJURY TYPE

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**Objectives** The US workforce, like workforces around the globe, is ageing - which creates new challenges for occupational health researchers and practitioners. Throughout their working lives, workers experience changes in occupational exposures, behaviours and time demands. The ways in which age-related changes in specific injury risk factors interact to influence injury risk are complex. Data reported in Morbidity and Mortality Weekly Reports Data collected by the United States Bureau of Labour Statistics was analysed to compare age-related differences in occupational injury rates across several industrial sectors and subsectors.

**Method** Occupational injury incidence rate estimates were developed to compare age-related patterns by industry and injury type. Injury count data from 2010, stratified by age group, industry sector and injury type, were provided by the US Bureau of Labour Statistics Survey of Occupational Injuries and Illnesses. The Current Population Survey was used to develop estimates of at-risk experience. Data from a diverse collection of industry subgroups (defined by NAICS codes) were analysed, including agriculture, transportation and warehousing, private hospitals, nursing and residential care facilities, police protection and construction.

**Results** There are significant differences in the rates of occupational injuries when stratified by age group, industry and injury type.

**Conclusions** Additional research should explore the reasons why occupational injury rates differ by age group, industry and injury type. Occupational safety programs and policies should consider age-related differences in injury risks when allocating resources toward prevention efforts.

#### 0440 A SYSTEMIC REVIEW AND META-ANALYSIS OF EXHALED NITRIC OXIDE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE: RELATIONSHIP TO PULMONARY FUNCTION

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**Objectives** Fractional exhaled nitric oxide (FeNO) has been implicated as a pulmonary biomarker in various respiratory diseases, including COPD. Measurement of FeNO is a simple, non-invasive tool for assessing airway inflammation. Nevertheless, the usefulness of FeNO measurements in COPD patients in clinical practice is unclear. The objective of this review was to evaluate the efficacy of management of COPD based on FeNO in comparison with pulmonary function test.

**Method** Cochrane library (CENTRAL), MEDLINE, EMBASE and reference lists of articles were searched. The last searches were in July 2013. Results of searches were reviewed against predominantly criteria for inclusion. Relevant studies were selected, assessed and data extracted independently by two people. Participant articles with COPD management based on pulmonary function test compared with FeNO measurement were selected. Risk of bias for each study was assessed using the QUADAS (quality assessment of studies of diagnosis accuracy included in systematic reviews) scale.

**Results** Finally, eight studies were included. Of the eight studies, four were a negative and one was a positive correlation between

FeNO and pulmonary functions. Three studies were not significant correlation. The various results of studies were effected by characteristics of the patients (COPD severity, smoking status, treatment status) and differences in FeNO measurement methods.

**Conclusions** The studies includes in this review highlight the difficulties of correlation between FeNO and pulmonary function. So, the role of add-on monitoring of FeNO to pulmonary function test is less clear because of the absence of conclusive double-blind, randomised, control studies concerning potential clinical benefits in the management of COPD. Further randomised controlled trials are required.

#### 0441 PARENTAL INCOME IS MORE IMPORTANT THAN PARENTAL EDUCATION TO CHILDREN'S HEALTH AND WELLBEING IN ADULTHOOD: EVIDENCE FROM THE TROMSØ STUDY

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**Objectives** The aim of this research was to estimate and compare the direct and indirect influence (mediated by respondents' education) of three indicators of CSES (childhood financial conditions, mothers' education, fathers' education) on: i) the generic health dimensions included in the EQ-5D; ii) self-rated health (SRH), iii) age-comparative self-rated health (ASRH), and; iv) subjective wellbeing.

**Method** The data was analysed using Stata command Paramed. Log-linear regression was used for the health and life satisfaction outcomes to estimate the natural direct effects (NDE), natural indirect effects (NIE) and marginal total effects (MTE) as risk ratios (RR). Statistically significant interaction ( $p < 0.05$ ) was observed between the CSES exposures and gender, regressed on the health and wellbeing outcomes, therefore the analysis was conducted separately for men and women.

**Results** Childhood financial conditions was associated (NDE) with all health measures. Men had a higher risk of being unhealthy on the composite EQ-5D measure, and the anxiety/depression dimension, but women had a higher risk of being unhealthy on the dimensions self-care, usual activities, pain/discomfort, as well as on SRH. Childhood financial conditions had no statistically ( $p > 0.05$ ) significant NIE mediated by respondents' education, on any health measure. While almost all NDEs of parental education on health outcomes were not statistically significant ( $p > 0.05$ ), most of the NIEs of parental education were statistically significant ( $p < 0.05$ ).

**Conclusions** Childhood financial conditions have a strong direct effect on later health and wellbeing, independent of respondents' education, while parental education has an indirect effect on later health mediated by respondents' education.

## Symposiums

#### 0112 COMPONENTS OF THE HEALTHY WORKER EFFECT WITH QUANTIFICATION FOR DIFFERENT REFERENT COMPARISONS

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**Objectives** The healthy worker effect (HWE) is widely known to bias standardised risk estimates from occupational cohort studies. Multiple factors contribute to HWE bias that is commonly characterised as confounding due to the selection of individuals with "better health status" who are more likely to gain and retain employment relative to a general population including non-employed persons. Comparisons between standardised mortality ratios (SMRs) estimated from reference population rates with different characteristics allow for quantitative evaluation of different components of the HWE.

**Method** Data from over five decades for a company-wide mortality registry comes from life insurance claims, and deaths are validated against the U. S. National Death Index. Average person-years at risk during five-year calendar periods for the occupational cohort population are estimated. The expected mortality counts are specific to age, sex, race, and calendar-time period strata. SMRs are calculated based on the mortality rates for the general U. S. population and the company-wide population.

**Results** From 1956 through 2012, the annual US employee population has ranged from 29 000 to 108 000 workers. The mortality registry includes over 80 000 deaths validated through 2010, 25% due to malignant neoplasms and 37% due to cardiovascular diseases.

**Conclusions** The HWE influences the interpretation of standardised estimates from occupational studies. Comparisons for different reference populations can evaluate differential HWE bias of associations between occupational exposure and mortality. Analyses based on company reference rates identify contributions from components of the HWE based on comparable demographic characteristics, a similar likelihood of obtaining and retaining employment, and an equivalent potential for ascertainment of mortality outcomes.

#### 0114 A BAYESIAN APPROACH TO ACCOUNT FOR THE HEALTHY WORKER SELECTION EFFECT

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**Objectives** We propose a Bayesian method to adjust for the component of the healthy worker effect that arises from selection of healthier individuals into workforce to allow correct estimation of the standardised mortality ratio (SMR) and associated credible intervals.

**Method** Information on general populations is typically used to generate expected counts for outcomes in SMR calculations but an occupational cohort is not a random sample of the general population. The alternative is to use the expected number of outcomes from industrial cohorts known to experience the outcome of interest but free of the exposures that defined the observed cohort. In Bayesian terms, we can view "expected counts of outcomes given the observed age-sex-period structure" as the target of inference for which we seek a posterior distribution. We show that the problem reduces to elucidation of a prior distribution: we propose using expert opinions about relative rates of mortality outcomes of interest in the observed cohort relative to general population rates and direct estimation of reference rates from occupational cohort studies.

**Results** Data from DuPont on 320 000+ active and former employees with work histories in the US from 1955 will be used. This registry allows for the calculation of expected