Background A causal association between exposure to radon and its progeny and lung cancer is well established. However, a better knowledge on effect modification by time, age and exposure rate and on risk at low exposures or exposure rates is of high importance.

Method We analysed 58 974 male uranium miners of the German Wismut cohort with a mortality follow-up from 1946 to 2013 and a sub-cohort of 26 765 miners hired after 1960 characterised by radon values at low exposure-rates. Internal Poisson regression was applied to estimate the Excess Relative Risk (ERR) per unit of cumulative radon exposure in Working Level Months (WLM) with exponential time-related effect modifiers.

Results In the full cohort the crude ERR/WLM was 0.0019 (95% confidence interval (CI): 0.0017;0.0022) based on 3.947 lung cancer deaths. Age at median exposure, time since median exposure, and exposure-rate were strong effect modifiers. Taking them into account led to an estimate of 0.0067 (95%CI: 0.0052;0.0087) for an age at median exposure of 30 years, a time since median exposure of 20 years, and an exposure-rate of 3 WL (strong inverse exposure-rate effect). In the 1960+ sub-cohort, the crude ERR/WLM was 0.0111 (95%CI: 0.0064;0.0173) based on 495 lung cancer deaths. In this relatively young sub-cohort, time since median exposure was also a strong modifier, leading to an ERR/WLM of 0.0165 (95%CI: 0.0083;0.0247) at time since median exposure of 20 years.

Conclusion The present findings provide evidence for an increased lung cancer risk also at low exposures or exposure rates among miners.

Poster Presentation

Exposure Assessment

0240

MONITORING OF ASBESTOS FIBRE DISPERSION FROM A FACTORY TO SURROUNDING RESIDENTIAL ENVIRONMENT

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10.1136/oemed-2017-104636.191

Background Although many studies on occupational or environmental exposure levels of asbestos have been published, it is hard to find studies that checked asbestos levels of both of inside and outside of asbestos factory. This fact make epidemiologists connect occupational and environmental asbestos exposure and health outcome simultaneously. One large asbestos textile factory, which was moved from Japan around year 1970, moved from Korea into Indonesia around year 1990.

Methods The study was conducted during 26-28th August 2008 in Cibinong, Indonesia. The field survey was carried out to check current workers' and environmental exposure level of the factory that was moved from Korea. The observed asbestos environmental asbestos levels were compared with atmospheric dispersion models (AERMOD).

Results Inside of the factory, the highest airborne asbestos concentration was 86 times higher than the permit level 0.1fiber/cc. The working condition was similar with 80 s' of Korean working condition. Dispersion pattern of asbestos from a factory was related with wind direction. The correlation coefficient (r) and determination coefficient (r²) between air monitoring data and simulation data with AERMOD were 0.85 and 0.72 respectively.

Conclusion We confirm that asbestos workers in Indonesia had high exposure level of asbestos without proper protecting devices. Substantial level of environmental dispersion of asbestos from asbestos factory were found. This data can be used for basis of environmental exposure assessment for environmental asbestos related diseases. In addition, it is needed to transfer knowledge to protect hazards of asbestos with efforts to ban it to asbestos using countries.

Oral Presentation

Working Conditions

0241

RESULTS OF A SYSTEMATIC REVIEW ON THE EFFECTS OF CLIMATE CHANGE ON THE HEALTH AND PRODUCTIVITY OF WORKERS

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10.1136/oemed-2017-104636.192

Introduction Climate change can impact on workers' health in different ways: the increase of ambient temperature can generate heat-related illnesses, cardiovascular, respiratory and kidney diseases; extreme weather conditions can cause traumatic injuries and acute deaths; the expansion of vectors habitat can cause the increase of vector-borne diseases. In addition, the reduced work capacity can result in a lower labour productivity. The aim of the systematic literature search we are conducting as part of the EU-funded Project HEAT-SHIELD is to explore the effects of climate change on the health and productivity of workers.

Methods Four separate search strategies were conducted. The first three were focused on the health impacts of, respectively, increased ambient temperatures, extreme weather conditions, expansion of vectors habitats; the fourth was aimed to assess the effect of climate change on labour productivity.

Results For each retrieved study, we are gathering specific information. From a preliminary assessment of the literature retrieved, the population more frequently studied is the working population as a whole, followed by miners and farm workers. The most studies health outcomes are heat-related illness, physiological parameters and workers hydration status (using urine specific gravity as a proxy).

Conclusions The results of our systematic reviews will be useful for policy makers to adequately plan and coordinate actions involving particularly the strategic industries targeted by the HEAT-SHIELD Project (manufacturing, construction, transportation, tourism and agriculture), and will therefore serve as a tool to prevent heat-related illnesses and promote labour productivity, innovation and implementation in the EU.

Oral Presentation

Methodology

0242 MEASURING AND ESTIMATING PHYSIOLOGICAL RESPONSES TO OCCUPATIONAL HEAT EXPOSURE

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10.1136/oemed-2017-104636.193

There are direct and indirect health and performance detriments associated with occupational heat stress. This presentation will review methods and tools that can be used to examine physiological responses to occupational heat stress and highlight future directions for practice and research.

Technological advancements have opened new opportunities for the capture and monitoring of physiological responses and metrics, particularly in the field. Continued validation of new technologies is necessary to benchmark the reliability and validity of field-based measures and methods.

Measures of body temperature, metabolic workload, hydration status and psychophysiological responses can yield important information as to the strain induced from working in a hot environment. While there are a range of measurement techniques and methods to measure or estimate physiological responses, there are limitations that must be considered. These include the sensitivity, reliability and practicality of proposed measures. For example, gastro-intestinal temperature measures via a telemetric pill allows for direct, wireless, non-invasive measurement of deep internal temperature. However, water ingestion can influence telemetric pill readings while it remains in the stomach and the expense of such a system makes it prohibitive to use in large cohorts.

Continued validation of new technologies is necessary to benchmark the reliability and validity of field-based measures and methods with the ultimate goal being to better quantify exposure-response and exposure-effect relationships for workers' health, wellbeing and productivity. Importantly, more comprehensive assessments of the heat strain experienced by different populations would aid the interpretation of climate change impact on worker's health at a local and global level.

Oral Presentation

Shift Work

0243 ROTATING SHIFT WORK AND PREVALENCE OF DIABETES MELLITUS AND PREDIABETES IN MALE EMPLOYEES OF A LARGE GERMAN CHEMICAL COMPANY: RESULTS OF A CROSS-SECTIONAL STUDY

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10.1136/oemed-2017-104636.194

Purpose The aim of the study was to investigate the association between rotating shift work (RSW) and prevalence of diabetes and prediabetes in male employees of a large chemical company.

Methods We used cross-sectional data, surveyed in health checks between January 1st2011 and December 31st2014 at BASF SE in Ludwigshafen (Germany). A blood sample, physical examination and anamnesis by a medical officer as well as a written questionnaire were part of the health-check. Diabetes status (no diabetes, prediabetes, diabetes) was assessed via HbA_{1c}-value and information provided by employees themselves. Shift status was surveyed using company records. Partial proportional odds models for ordinal response variables were applied to assess the association of RSW with diabetes status.

Results Data on 9765 male employees (40.4% rotating shift workers) with a mean age of 44.3 years (SD: 9.6) could be used for analyses. Prevalence of diabetes and prediabetes in rotating shift workers were 6.4% and 14.2% respectively. Corresponding figures for day workers were 3.6% and 11.5% ($p < 0.001$). Unadjusted analyses yielded an Odds Ratio of 1.85 (95%-CI: 1.53–2.22) for RSW (comparing diabetes with prediabetes/no diabetes). The effect attenuated in the fully adjusted multivariable model (aOR: 1.38; 95% CI: 1.11–1.70) but remained significant. The association between RSW and diabetes status varied by BMI and occupational status. The association was stronger in skilled/supervisory workers and respondents with a BMI < 30 kg/m².

Conclusions The present study found a significant association between RSW and diabetes which differed by BMI and occupational status.

Declaration of potential conflict of interest: All authors are employees of BASF SE.

Poster Presentation

Respiratory

0244 THE DIAGNOSIS OF PNEUMOCONIOSIS USING A SENSOR ARRAY TECHNIQUE

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10.1136/oemed-2017-104636.195

Pneumoconiosis is a traditional occupational disease and has reemerged in recent years. Current medical surveillance program have flaws that may result in poor detection of early pneumoconiosis around the world. Pneumoconiosis could generate specific volatile organic compounds (VOCs) that may constitute a specific breath print for diagnosis. The objective of this study was to develop a breath test for pneumoconiosis using a sensor array technique. We conducted a case-control study that enrolled 36 asymptomatic cases of pneumoconiosis and 64 healthy controls between October and November 2016 to construct the prediction model. One liter of breath air was collected after five minutes of tidal breathing through a non-rebreathing valve with inspiratory VOC-filter, and storage by a Tedlar bag. The air was analysed by a 32