new exposure assessment tool that could be used to estimate IIE exposure for epidemiology.

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DOSE-RESPONSE RELATIONSHIP BETWEEN A PARTICULAR FORM OF CRYPTOCRYSTALLINE SILICA AND THE INCIDENCE OF SILICOSIS

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Objectives It has been known for centuries that crystalline silica induces silicosis. However, there are different entities of crystalline silica. Siliceous earth is a worldwide unique blend of amorphous and cryptocrystalline silica and lamellar kaolinite. This retrospective cohort study is the first that investigated the silicosis risk of siliceous earth.

Methods The cohort consists of employees exposed to siliceous earth in one company in Bavaria, Germany. Their job activities were collected from personnel files. Workers were included, if they had worked at least one year from the date of recruitment to the end of the study in 2008. The disease data were collected from occupational disease records of the Raw Materials and Chemical Industry Employers' Liability Insurance Association (BG RCI). Two pneumologists reviewed the radiographic findings independently on the basis of reports of radiological findings according to ILO 2000. Workers with an ILO profusion $\geq 1/1$ (p, q, r) were considered to have silicosis. Using the existing 709 measurement records of the years 1961–2008 exposure to silica was assessed for each subject with a job-exposure matrix. To determine the risk of silicosis Poisson regression was performed and to determine the dose-response relationship cubic splines were applied.

Results In total 675 persons were enumerated, including 84 women. Among women, there were no silicosis but 55 among men. The evaluation of the exposed men showed a silicosis risk at a cumulative exposure of more than 6 mg/m³xyears (RR = 25; 95% CI 5.3–111.5) and especially in underground mining (RR = 12; 95% CI 4.9–28.6). In addition, a dose-response relationship with increasing cumulative exposure was found.

Conclusions We found a dose-response relationship between silicosis and cumulative exposure to siliceous earth. The silicosis risk of siliceous earth is according to these results not higher than that described in the literature for crystalline or cryptocrystalline silica.

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SILICA DUST AND MORTALITY FROM NON-MALIGNANT RESPIRATORY DISEASES IN THE GERMAN WISMUT MINERS COHORT, 1946–2008

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Objectives To investigate possible associations between silica dust exposure and death from chronic obstructive pulmonary diseases (COPD) and silicosis in German uranium miners.

Methods The cohort consists of 58,672 miners comprising 2,167,600 person-years and 25,239 deaths in the follow-up period 1946–2008. A detailed job-exposure matrix was used to estimate the cumulative exposure to crystalline silica in mg/m³-years. The total numbers of underlying causes of death from COPD (ICD-10 code: J40-J44) or silicosis (J62-J65) was determined based on certificates of death and autopsy files. Internal Poisson regression with baseline-stratification by age, calendar year and duration of employment was used to estimate the relative risk (RR) and 95% confidence limits (CI) in different categories of cumulative exposure to silica dust for mortality from COPD and silicosis.

Results Nearly all cohort members were exposed to silica dust at some stage with a wide exposure range (mean = 5.9, max = 56 mg/m³-years). No increase in risk with increasing cumulative silica dust was found for COPD as underlying cause of death only (n = 719), whereas statistically significantly increased RR's in exposure categories above 10 mg/m³-years were found when COPD was considered as underlying or contributing cause of death (n = 2,675). The corresponding RR in the highest exposure category of 30 or more compared to less than 0.5 mg/m³-years was 2.2 (95% CI: 1.6–2.8). The RR for silicosis as underlying cause of death (n = 976) compared to the reference category 0–2 mg/m³-years increased systematically with increasing exposure from RR = 2.8 (95% CI: 1.03–4.6) to 118.1 (95% CI: 50.3–188.0) in the exposure categories 2–5 and 30 or more mg/m³-years, respectively.

Conclusions Mortality of silicosis is confirmed to be associated with cumulative silica dust exposure even at low levels. Results indicate that death from COPD is related to silica dust, when considering underlying and contributing causes of death.

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UPDATED RESULTS ON THE RISK OF DEATH FROM LUNG CANCER BY SILICA DUST IN GERMAN WISMUT URANIUM MINERS, 1946–2008

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Objectives To investigate the exposure-response relationship between silica dust and lung cancer mortality within German uranium miners in the extended follow-up period from 1946 to 2008. The cohort consists of 58,672 miners including 2.2 Mio person-years and 3,477 lung cancer deaths.

Methods Individual information on occupational exposure to crystalline silica in mg/m³-years and the potential confounders radon and arsenic is available for all cohort members based on a detailed job-exposure matrix. Internal Poisson regression with baseline-stratification by age and calendar year was used to estimate the excess relative risk (ERR) per mg/m³-year. Several spline functions were applied to investigate the exposure-response relationship. Detailed adjustment for cumulative radon and arsenic exposure was conducted. Effect modification by age, time and exposure-rate was tested. Additionally detailed risk analyses with specific focus on the low dose range have been performed.

Results All miners were exposed to crystalline silica at any time. The mean cumulative silica exposure was 5.9 mg/m³-years with a maximum of 56 mg/m³-years. A piece-wise linear spline function with a knot at 10 mg/m³-years provided the best model fit. After full adjustment for radon (continuous variable with

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consideration of time since median exposure and dose rate) and arsenic no increase in risk below 10 mg/m³-years was observed. Fixing the parameter estimate of the ERR in this range at 0 provided the best model fit with an ERR of 0.065 (95% CI: 0.043, 0.087) above 10 mg/m³-years. The silica-induced lung cancer risk decreased with increasing attained age. Data of a nested case-control study did not indicate a major correlation between silica and smoking status.

Conclusions The study confirms a positive exposure-response relationship between silica and lung cancer, particularly for high exposures. No clear evidence was observed in the low-dose range. Confounding by smoking is unlikely but residual confounding cannot be fully excluded.

363 DOES INHALATION OF SILICA DUST CAUSE CHRONIC RENAL DISEASE? - A SYSTEMATIC REVIEW

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Objective To prove the evidence for a causal relationship between exposure to silica dust and chronic renal disease, in particular Glomerulonephritis (GN)

Methods The review is based on a search of the Medline database for relevant epidemiological studies published between 1987 and 2012. The quality of selected papers was evaluated based on the Newcastle-Ottawa Scale and the CASP checklist. Meta-analyses were performed separately for cohorts of workers compensated for silicosis and for industry-based cohorts. In addition, synopses were undertaken for studies based on quantitative exposure estimates and for studies using end-stage renal disease (ESRD) as the outcome.

Results The review includes 10 cohorts of silicotics, 12 industry-based cohort studies, 5 case-control-studies and one pooled analysis. The pooling of the cohorts of silicotics did not show any excess risk for renal diseases (ICD-9: 580–589; SMR = 1,00 [0.84–1.18]_{95%}). By contrast, the meta-analysis of the industry-based cohort studies showed an elevated risk (SMR = 1,42 [1.15–1.75]_{95%}) when applying a random effects model to account for the strong heterogeneity of these studies. Five of those studies investigated the incidence of ESRD as the outcome. The corresponding relative risk estimators were in the range of 0.77 to 1.97, two of them were significantly elevated ($p < 0.05$). Three studies went further and investigated GN as the outcome. They resulted in markedly higher risk estimators (SIR in the range of 3.85 to 4.27) then for ESRD. Results could have been affected by a possible diagnostic bias and confounding by other occupational risk factors.

Conclusion The review does not provide sufficient evidence for establishing a causal link between exposure to silica dust and chronic renal disease. To clarify this relationship, further longitudinal studies are needed, which should make use of clinical or even pre-clinical data, including data of health surveillance programs for workers with high exposure to silica dust.

364 SMOKING CESSATION AND LUNG CANCER MORTALITY IN A HISTORICAL COHORT OF WORKERS WITH SILICOSIS IN HONG KONG, 1981–2006

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Objectives To evaluate the impact of smoking cessation on the risk of lung cancer mortality among workers with silicosis.

Methods We recruited all 3202 incident cases of silicosis in Hong Kong from 1981 to 2005 and followed up them till 2006 to ascertain the causes of death. The follow-up rate was 97.5%. We collected each worker's socio-demographics, lifetime smoking habits, lifetime occupational history, and medical history at the initial assessment of diagnosis. We obtained the most recent information on smoking status from medical record. Multiple Cox's regression analysis was performed to examine the impact of smoking cessation.

Results A total of 1562 deaths (48.8%) occurred and 157 of them were from lung cancer. Lung cancer mortality was strongly associated with smoking [former smoking: hazard ratio (HR) = 3.41, 95% CI: 1.23 - 9.46; current smoking: HR = 5.80, 95% CI: 2.13 - 15.74], and a significantly positive gradient was indicated with smoking pack-year and the years of smoking. Lung cancer mortality tended to decreasing at the 10th year of cessation (HR = 0.64, 95% CI: 0.40 - 1.04) and a substantial decrease was observed after the abstinence of smoking for 20 or more years (HR = 0.22, 95% CI: 0.11 - 0.44). Relative to never smokers, the hazard ratio for lung cancer mortality for silicotics who had never quit smoking was 7.09 (95% CI: 2.57 - 19.59) and it became 4.75 (95% CI: 1.71 - 13.16) for the new quitters who changed their behaviour during the follow-up period, whilst a relatively lower risk (HR = 3.47, 95% CI: 1.25 - 9.61) was found among the persistent quitters.

Conclusions Lung cancer mortality decreased substantially with smoking cessation in workers with silicosis, particularly for those who persistently quit smoking for a longer period.

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365 PREDICTORS OF SILICOSIS IN AN INDUSTRY WIDE STUDY IN THE SOUTH AFRICAN GOLD MINING INDUSTRY

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Objectives Despite the scale of the silicosis problem in the South African goldmining industry, studies in active miners are scarce. A large randomised cluster trial of isoniazid tuberculosis prophylaxis provided an opportunity to investigate the predictors of silicosis and variation in silicosis prevalence across goldmining shafts.

Methods This analysis was based on a random sample of routine annual chest radiographs of active miners entering the trial, taken between 2004 and 2009. All were read for silicosis using the ILO classification by an experienced lay reader. All films classified as abnormal and a random sample of normals were re-read by a 'B'-reader and these readings substituted for those of the lay reader in case of disagreement. The association between silicosis defined as ILO > 1/0 and age at radiograph, years since first employment, shaft and other occupational markers, was analysed.

Results A total of 14,434 radiographs from 15 goldmining shafts were read. Silicosis prevalence varied from 0.68% to 6.28% across shafts; 7.8 fold across the range in adjusted analysis. Silicosis showed a strong dose response relationship with years since