

Research of Medical Literature to Support Litigation

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Environmental Health Perspectives Volume 103, Number 2, February 1995 Environmental Health Perspectives (EHP) is a monthly journal of peer-reviewed research and news on the impact of the environment on human health.

(Excerpt)

...More than 30 epidemiologic papers considering the relationship between silica, silicosis, and lung cancer have been published since the IARC review. However, only about one-third of the studies are of reasonably satisfactory design and presentation and primarily concerned with the effects of crystalline silica exposure on lung cancer risk. Fewer than 10 studies provided some evidence of excess risk in exposed workers. Three papers provide results which, although individually unambiguous, are nonetheless as a whole inconsistent.

Taken as a whole, the epidemiologic evidence on crystalline silica exposure per se inducing lung cancer in the absence of lung fibrosis must still be considered scanty and inconsistent, although biologically plausible.

The extent to which any lung cancer risk associated with silica exposure is confined to those with silicosis cannot be answered at this stage.

OROSHA: "Criteria for Updating the Crystalline free silica PEL" Oregon OSHA, a division of the Oregon Department of Consumer and Business Services, operates under a state-plan agreement with federal OSHA.

(Excerpt)

...Epidemiologic studies focus on chronic silicosis, which develops years after exposure to relatively low concentrations of respirable crystalline silica. Epidemiologic studies have found that chronic silicosis may develop or progress even after occupational exposure has ceased. Over a 40- or 45-year working lifetime, workers have a significant chance (at least 1 in 100) of developing radiographic silicosis when exposed to respirable crystalline silica at the occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL), the Mine Safety and Health Administration (MSHA) PEL, or the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL).

The carcinogenicity of crystalline silica in humans has been strongly debated in the scientific community. In 1996, the International Agency for Research on Cancer (IARC) reviewed the published experimental and epidemiologic studies of cancer in animals and workers exposed to respirable crystalline silica and concluded that there was “sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources”. In the same year, directors of the American Thoracic Society (ATS) adopted an official statement that described the adverse health effects of exposure to crystalline silica, including lung cancer [24]. The ATS found that “the available data support the conclusion that silicosis produces increased risk for bronchogenic carcinoma.” However, the ATS noted that less information was available for lung cancer risks among silicotics who had never smoked and for silica-exposed workers who did not have silicosis. They also stated that it was “less clear” whether silica exposure was associated with lung cancer in the absence of silicosis. NIOSH has reviewed the studies considered by IARC and ATS, and NIOSH concurs with the conclusions of IARC and the ATS. These conclusions agree with NIOSH testimony to OSHA, in which NIOSH recommended that crystalline silica be considered a potential occupational carcinogen.

Oxford Journal: Occupational Medicine Volume 59, Number 2, pp. 89-95 Occupational Medicine is an international peer-reviewed journal which provides vital information for the promotion of workplace health and safety

(Excerpt)

Silica exposure, smoking, silicosis and lung cancer—complex interactions

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Establishing a clear relationship between workplace exposures and cancer is often difficult. The latent period for cancer development can make it difficult to establish a definite cause–effect relationship. The picture is further complicated by variable job histories, concomitant exposure to other carcinogens and other factors such as genetic susceptibility and poor nutrition.

...Further research is needed in order to understand the complex pattern of interactions leading to lung cancer among silica-exposed workers (and cancers and workplace exposures in general) and to understand whether and to what extent other workplace lung carcinogens, total respirable dust and total surface size and age of silica particles affect the carcinogenic potential of silica. In addition, the apparent paradox of a lower lung cancer risk in some workplaces with high-level silica exposure needs further investigation.

Multifactorial Aetiology of Lung Cancer Among Silica-exposed Workers

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Annals Academy of Medicine Singapore 2001; 30:468-74

Abstract

In 1997, the International Agency for Research on Cancer (IARC) upgraded its evaluation of crystalline silica to a Group 1 human carcinogen. Criticism against such decision is based on the lack of consistency in experimental results across animal species, violation of an important principle for causality, such as the replication of findings under different circumstances of exposure, and the lack of a clear dose-response curve. The most recent epidemiological literature on the silica-silicosis-lung cancer link replicates the inconsistent findings that have been characterising 50 years of scientific debate in the occupational arena. Exposure circumstances capable of modifying the silica-lung cancer association include chronic bronchitis, composition of the dust mixing, particularly concerning co-occurrence of other known or probable lung carcinogens, total respirable dust, concentration of silica in respirable dust, type of crystalline silica and particle surface characteristics. The hypothesis of a silicosis-mediated pathway points toward an unspecific mechanism shared with other fibrotic conditions, for which silica might be just one of the triggers. In envisaging a multivariate multistep model of lung cancer among silica exposed workers, silica might be considered as a “passive components of the sufficient cause”, i.e., one of the associated risk factors, concurrent or subsequent to the “active component(s) of the sufficient cause” (including, for instance, smoking, asbestos, radon-daughters, arsenic, hexavalent chromium, nickel, polycyclic aromatic hydrocarbons (PAH), and diesel exhausts among the external risk factors; and DNA repair enzymes polymorphism and spontaneous inactivation of tumour suppressor

genes among the internal risk factors), which adds up in modulating the tumoral development in not easily predictable directions. If silica acts as a human lung carcinogen depending on certain occupational exposure circumstances, perhaps those circumstances and not silica itself should be classified for their human carcinogenicity potential.

WORLD HEALTH ORGANIZATION INTERNATIONAL AGENCY FOR RESEARCH ON CANCER

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans

Volume 68

Silica : Summary of Data Reported and Evaluation

(Excerpt)

5.2 Human carcinogenicity data :Quarries and granite works

Six cohort studies were available for review. These studies provide important information on cancer risks because the workplace environments were generally free of reported exposures to potentially confounding agents (e.g., radon). All studies revealed lung cancer excesses. Direct quantification of silica dust exposure concentrations in relation to lung cancer risk was not conducted in any of these studies, mainly due to sparse occupational hygiene measurement data. However, some studies provided indications of exposure-response associations when surrogate dose data, such as duration of employment and category of exposure, were used. For example, findings for lung cancer include a nearly twofold mortality elevation among long-term granite shed workers in Vermont, United States, an eightfold elevation among sandstone workers in Copenhagen, Denmark, and a relative risk of roughly 3.5 among crushed granite stone workers in the United States with long duration of exposure and time since exposure onset. One study of German slate quarry workers indicated a more prominent relationship between employment duration and lung cancer among workers with silicosis than among workers without silicosis. The Working Group regarded radiographic evidence of silicosis as a marker of high exposure to silica.

Health Considerations for Workplace Exposure to Silica

June 1997 :MN Department of Labor and Industry

Occupational Safety and Health Division

(Excerpt, p.4-5)

Cancer:

The issue of crystalline silica exposure and cancer is a complicated one with disagreement in the literature (Lilis, 1992). In worst case, exposure to respirable crystalline silica dust has been associated with lung cancer (Lilis, 1992; IARC, 1987; Checkoway

et al., 1993; Goldsmith, 1994; Hnizdo & Sluis-Cremer, 1991; McLaughlin et al., 1992; Winter, et al. 1990). There also has been the

suggestion of stomach cancer associated with ingestion of crystalline silica (Lippmann,1995). The International Agency for Research on Cancer (IARC), in examining the carcinogenesis of crystalline silica, has published monographs regarding crystalline silica and some silicates. IARC determined that there is sufficient evidence for carcinogenicity in experimental animals with limited evidence for carcinogenicity in humans and has classified silica as a 2B carcinogen (1987). IARC is in the process of revisiting the crystalline silica carcinogen issue based upon recent epidemiological studies. Studies have demonstrated a statistically significant, dose-related increase in lung cancer in several occupationally exposed groups. Winter et al. (1990) observed that the lung cancer risk for pottery workers increased with estimated cumulative exposure to low levels of silica found in potteries. Another study also found that the risk of lung cancer among pottery workers was related to exposure to silica, although the dose-response gradient was not significant (McLaughlin et al., 1992). An adjustment for possibly confounding exposure to polycyclic aromatic hydrocarbons slightly raised the odds ratio for exposure to silica. This study also analyzed lung cancer risk in tin miners in China and found a significant trend of increasing lung cancer with increasing cumulative respirable silica exposure. A significant dose-response relationship between death from lung cancer and silica dust particle-years has also been demonstrated for South African gold miners (Hnizdo and Sluis-Cremer, 1991). In this study a synergistic effect on lung cancer risk was found for silica exposure and smoking. Lung cancer risk among workers in the diatomaceous earth industry has been studied by Checkoway et al. (1993). Results showed increasing risk gradients for lung cancer with cumulative exposure to crystalline silica. The authors felt that this finding indicated a causal relation. Several studies have demonstrated a relationship between the degree of silicosis disability and risk for lung cancer (Goldsmith, 1994). Since severity of silicosis reflects silica exposure, this may also indicate a dose response relationship for silica exposure and lung cancer (Checkoway et al., 1993).

PubMedCentral: Occupational & Environmental Medicine

1998 April; 55(4): 243–248

(Excerpt)

OBJECTIVES: Silica has recently been reclassified as carcinogenic to humans based largely on the observed increase in rates of lung cancer in subjects with silicosis. Other recent reviews have arrived at different conclusions as to whether silicosis or silica itself is carcinogenic. This study aims to examine exposure-response relations between exposure to silica and subsequent silicosis and lung cancer in a cohort of goldminers.

...CONCLUSIONS: The incidence of silicosis was clearly related to exposure to silica and the onset of silicosis conferred a significant increase in risk for subsequent lung cancer, but there was no evidence that exposure to silica caused lung cancer in the absence of silicosis.

Oxford Journals: Annals of Oncology

Volume 17, Number 7, pp. 1039-1050

Occupational silica exposure and lung cancer risk: a review of epidemiological studies 1996–2005

(Excerpt)

Background: In 1997, a Monograph from the International Agency for Research on Cancer (IARC) classified occupational exposure to crystalline silica as carcinogenic to humans. Large amounts of epidemiological data have been published subsequently....

Conclusions. In this re-analysis, the association with lung cancer was consistent for silicotics, but the data were limited for non silicotic subjects and not easily explained for undefined silicosis status workers. This leaves open the issue of dose–risk relation and pathogenic mechanisms and supports the conclusion that the carcinogenic role of silica per se in absence of silicosis is still unclear.