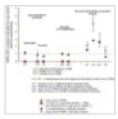

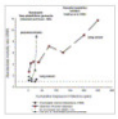

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An evaluation of the risks of lung cancer and mesothelioma from exposure to amphibole cleavage fragments

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Abstract

Amphiboles are hydrated mineral silicates five of which occur in asbestiform habits as asbestos grunerite (amosite) asbestos, riebeckite (crocidolite) asbestos, anthophyllite asbestos, tremolite asbestos and actinolite asbestos] and non-asbestiform habits (grunerite, riebeckite, anthophyllite, tremolite and actinolite). The asbestiform varieties are characterized by long, thin fibers while non-asbestiform varieties such as cleavage fragments form short fibers with larger widths. The U.S. regulatory method for counting asbestos fibers (aspect ratio ⩾3:1, length ⩾5 μm) does not distinguish between asbestos and cleavage fragments. The method biases toward increased counts of non-asbestiform cleavage fragments compared to long, thin asbestos fibers. One consequence of this regulatory approach is that workers can be erroneously classified as exposed to concentrations of asbestos (asbestiform amphiboles) above the U.S. 0.1 f/mL exposure standard when in fact they are not exposed to asbestos at all but non-asbestiform amphibole cleavage fragments. Another consequence is that the known carcinogenic effects of asbestos may be falsely attributed to non-asbestiform amphibole cleavage fragments of the same mineral. The purpose of this review is to assess whether amphibole cleavage fragments pose the same risk of lung cancer and mesothelioma characteristic of amphibole asbestos fibers.

We identified three groups of workers exposed to non-asbestiform amphiboles: two groups exposed to grunerite (Homestake gold miners and taconite miners) and one group exposed to industrial talc containing non-asbestiform tremolite and anthophyllite in St. Lawrence County, NY. In addition to assessing strength of association and exposure–response trends in the non-asbestiform amphibole cohorts, comparisons were also made with cohorts exposed to the asbestiform counterpart (positive control) and cohorts exposed to the mineral (e.g. talc) that does not contain amphiboles (negative controls).

The cohorts exposed to non-asbestiform amphiboles had no excesses of lung cancer or mesothelioma. Similar results were observed in the negative control groups, in stark contrast to the excess risks of asbestos-related disease found in the asbestos cohorts. The only possible exception is the twofold increased risk of lung cancer where exposure was to industrial talc containing cleavage fragments of tremolite and anthophyllite. However, this risk is not considered attributable to the talc or amphibole cleavage fragments for several reasons. A similar increased risk of lung cancer was found in Vermont talc workers, studied in the same time period. Their exposure was to relatively pure talc. There was no relationship between lung cancer mortality and exposure measured as mg/m^3 years and years worked. A case–control study reported that all the lung cancer cases were smokers (or former smokers) and attributed the excess to smoking. There were two mesothelioma cases among the NY State talc workers exposed to cleavage fragments of tremolite and anthophyllite, but talc is not a plausible cause because of too short latency and potential for previous asbestos exposure. The positive controls of tremolite asbestos and anthophyllite asbestos exposed workers showed excess risks of both lung cancer and mesothelioma and positive exposure–response trends. St. Lawrence, NY talc does not produce mesotheliomas in animals while amphibole asbestos does. In sum, the weight of evidence fully supports a conclusion that non-asbestiform amphiboles do not increase the risk of lung cancer or mesothelioma.

Keywords

Amphiboles; Cleavage fragments; Lung cancer; Mesothelioma; Asbestos; Non-asbestiform amphiboles; Grunerite; Talc