International Agency for Research on Cancer

World Health Organization

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Cancer mortality in chrysotile miners and millers, Russian Federation: main results (Asbest Chrysotile Cohort Study)

Questions and Answers (Q&A)

1. What was the reason for conducting the study?

This is the first comprehensive study of the workforce of the world's largest active chrysotile mine, which currently produces more than 20% of the world's chrysotile. Even without extensive industrial use, chrysotile is present in the environment and will remain there for many more decades. Therefore, the results of the study are informative for public health at both the local and global scales. Before the study was started, an assessment was made of whether sufficient new scientific insights would be expected. This was indeed the case, because (i) it was the first large-scale study in this particular setting of the world's largest chrysotile producer; (ii) for the first time, a cohort study of chrysotile miners and millers included a large number of female workers, to investigate their cancer risk; (iii) more data were needed to more precisely quantify the chrysotile-related cancer risk, including for well-established asbestos-related cancer sites such as mesothelioma and lung cancer; and (iv) cancer sites with less clear or little evidence could be investigated.

2. What was the involvement of the funder of the study?

In the Memorandum of Understanding between the International Agency for Research on Cancer (IARC) and the Ministry of Health and Social Development of the Russian Federation (an IARC Participating State), which was the funder of this study, support through IARC's expertise in conducting large-scale epidemiological studies was requested by the Ministry of Health and Social Development for a cohort study of long-term exposed workers in chrysotile mining and processing. Pilot work was carried out, from which IARC concluded that the available data sources for conducting such a study were sufficient for good epidemiological practice, but that the access to those data sources and their quality needed to be monitored. The study was presented to and approved by the IARC Scientific Council and the IARC Governing Council, which is made up of all IARC Participating States, under the condition of strict quality control (see question 4). In a joint World Health Organization (WHO)–IARC statement in February 2013, both organizations expressed that the study "will supply important scientific information to better quantify the risk of cancers already known to be related to chrysotile as well as additional cancers suspected to be related to chrysotile".

3. When was the study carried out?

When the Memorandum of Understanding was signed in 2009, the above-mentioned pilot work was carried out. After a site visit by IARC scientists to Asbest in November 2011, it was decided to start the main study because

it was concluded that the study would be informative for cancer prevention. Data from company archives stretching back to the 1940s were extracted and entered into the study database of raw data from 2012, and data on vital status, migration, and causes of death from the respective authorities was collected for an end date of follow-up at the end of 2015. Preparing the data for risk analyses, such as calculating the individual cumulative exposure of workers, and thorough checking of data quality was completed in 2019 and was followed by statistical analysis until 2021.

4. How was the study quality monitored?

Progress and performance were monitored by an international Scientific Advisory Board, which met on an annual basis, including a site visit, and presented regular reports to the IARC Ethics Committee. Intermediate steps in the conduct of the study, such as the development of the exposure metrics or the coding and plausibility checking of the causes-of-death data, were published immediately in the peer-reviewed literature, for the highest level of transparency (https://asbest-study.iarc.who.int/publications/). Internal quality assurance measures included double entry of samples of employment records and dust measurement data, cross-checking with other independent sources of information (e.g. the size of the cohort in a given year with salary payment records, or using two sources of death certificate information for the time period for which they were available), and using multiple sources of information whenever possible (e.g. for vital status). Raw data on dust measurements and parallel dust and fibre measurements were provided by the Izmerov Research Institute of Occupational Health (IRIOH) in Moscow (Russian Federation) to IARC, where the individual exposure assessment was developed and carried out. Raw original death certificate information was provided by IRIOH to IARC, where all causes of death where coded in a unified way according to international guidelines. Exposure and outcome data were linked at IARC only at the stage when data were ready for the risk analyses to be carried out.

5. What are the strengths of the study?

The main strength of the study is the reconstruction of the lifetime cumulative occupational exposure of each individual worker to airborne dust particles. Epidemiological studies often rely on so-called exposure proxies, derived from measurements of only limited samples of workers surveyed during only a limited time period, or, more indirectly, by assigning typical exposures measured for certain jobs but from measurements carried out at places other than the facilities to which the exposure metric is applied. In this study, the full occupational history was available for every worker and could be linked to the dust measurement carried out at the location closest to the workplace. The coverage of the work history years with dust measurements (88% in the factories and 76% in the mine) was unprecedented. Another major strength was having access to the original texts of the death certificates, for a unified classification of causes of death. Further major strengths are the large numbers of workers with a long elapsed time since their first exposure, to investigate also slowly developing diseases such as mesothelioma, and for the first time being able to investigate a large female workforce in a cohort of miners and millers.

6. What are the weaknesses of the study?

Observational studies of historical data have intrinsic limitations, mostly because the data were collected for purposes other than for the study, and therefore not all information that would be ideal to have is available. The main limitation is a lack of individual information on other risk factors for cancer, because if they were associated with dust exposure, this may affect the analysis of the relationship between dust exposure and cancer. For instance, tobacco smoking is related to more than 10 different types of cancer and is the dominant cause of lung cancer, which is also the most common cancer known to be associated with asbestos exposure. In a survey carried out in Asbest with active and retired workers of the mine and its factories, it was seen that in men smoking habits did not differ across different categories of dust exposures, and thus the impact on the relationship between dust exposure and lung cancer mortality is considered to be small. Few women smoked in the distant past, when dust exposures were highest. The stronger association between dust exposure and lung cancer mortality seen in men than in women, together with the observed differences in smoking habits, may hint that the combined exposure to smoking and dust poses a larger risk than the combined risk from being exposed to the two carcinogens alone, especially at lower cumulative exposure levels, but, because of the lack of individual smoking data, this possible synergistic effect could not be formally analysed. The numbers of alcohol-related deaths decreased with increasing cumulative dust exposure, possibly because the company's strict anti-alcohol policies led to re-assignment of workers with notified alcohol problems to less specialized jobs with lower exposure levels. This may have attenuated the association with laryngeal cancer. Another limitation is that systematic measurements were made for airborne dust particles, but data directly measuring chrysotile fibres were available only for a few years from more recent time periods. For this reason, cumulative exposure to fibres is mainly modelled based on dust–fibre conversion factors derived from the available parallel measurements, and therefore could be more prone to some exposure error compared with the dust exposure. However, because measured cumulative dust exposure and modelled cumulative fibre exposure were highly correlated, this concern was unlikely to have relevant practical impact in the risk analyses.

7. What is the relevance of the research?

All forms of asbestos are known to cause cancer in humans, as concluded in the *IARC Monographs on the Identification of Carcinogenic Hazards to Humans* in 2009 (https://asbest-study.iarc.who.int/about/about-asbestos/). Therefore, prevention of asbestos-related diseases, including cancer, remains a global high priority. Notably, even in countries that have implemented bans on all forms of asbestos, exposure has been reduced but has not been eliminated. This is because asbestos was so commonly used that it is still found, for instance in many older buildings, and exposure to asbestos still occurs for workers in the asbestos removal industry or for construction workers working in buildings where the asbestos has not been removed. Thus, even in the absence of continued mining and use of chrysotile, exposure to chrysotile would be expected to continue worldwide because of the persistence of this mineral fibre in the environment. This fact endorses that studies like this one to better understand and quantify the risks remain informative for disease prevention and merit further research.

For more information, please contact

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The International Agency for Research on Cancer (IARC) is part of the World Health Organization. Its mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships. If you wish your name to be removed from our press release emailing list, please write to com@iarc.who.int.