

# How conflicted authors undermine the World Health Organization (WHO) campaign to stop all use of asbestos: spotlight on studies showing that chrysotile is carcinogenic and facilitates other non-cancer asbestos-related diseases

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The silicate mineral asbestos is categorized into two main groups based on fiber structure: serpentine asbestos (chrysotile) and amphibole asbestos (crocidolite, amosite, anthophyllite, tremolite, and actinolite). Chrysotile is used in more than 2 000 applications and is especially prevalent in the construction industry. Although its use is banned or restricted in more than 52 countries, an estimated 107 000 workers die from asbestos exposure each year, and approximately 125 million workers continue to be exposed. Furthermore, ambient exposures persist to which the public is exposed, globally. Today, the primary controversies regarding the use of asbestos are the potencies of different types of asbestos, as opposed whether or not asbestos causes morbidity and mortality. The asbestos industry has promoted and funded research based on selected literature, ignoring both clinical and scientific knowledge. In this piece, we highlight a prominent example of a conflicted publication that sought to undermine the World Health Organization (WHO) campaign to stop the use of all forms of asbestos, including chrysotile asbestos. Independent and rigorous scientific data provide sufficient evidence that chrysotile asbestos, like other forms of asbestos, is a cause of asbestos-related morbidity and premature mortality

**Keywords:** asbestos related diseases, white asbestos, chrysotile, lung cancer, conflict-of interests, WHO campaign to end all use of asbestos

## Introduction

Chrysotile, also known as white asbestos, accounts for 95% of all produced asbestos. It is used in more than 2 000 applications, particularly in the construction industry.<sup>1,2</sup> Although the use of asbestos is banned or restricted in more than 52 countries, an estimated 107 000 or more workers die from asbestos exposure each year, and approximately 125 million workers continue to be exposed.<sup>3,4</sup> Furthermore, beside occupational exposures, also environmental ambient exposures persist to which the public is exposed, globally. The

silicate mineral asbestos is divided into two groups based on fiber structure: serpentine asbestos (chrysotile) and amphibole asbestos (crocidolite, amosite, anthophyllite, tremolite, and actinolite). Current controversies regarding asbestos are about the relative mesothelioma and lung cancer potencies of the different types of asbestos and not about causality.

## Rationale and Discussion

The asbestos industry promotes the notion that chrysotile asbestos is safer than other forms of asbestos. This is reflected in a recently published paper by Bernstein on health risks of chrysotile asbestos.<sup>5</sup> However, this paper is scientifically flawed, including only selected literature and limited clinical and

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scientific knowledge. Based mainly on his own published animal studies, frequently with a limited follow-up of 90–360 days, the author concludes that when properly controlled, cement workers can safely use chrysotile asbestos.<sup>5</sup>

However, available literature provides abundant evidence to the contrary. Many studies demonstrate adverse health effects from chrysotile asbestos in human beings and animals. Based on this evidence, the International Agency for Research on Cancer (IARC) has classified chrysotile as a group 1 carcinogen.<sup>6,7</sup> Furthermore, the Joint Policy Committee of the Societies of Epidemiology (JPC-SE) in its 2012 Position Statement on Asbestos states “A rigorous review of the epidemiologic evidence confirms that all types of asbestos fibers are causally implicated in the development of various diseases and premature death.”<sup>8</sup> Numerous well-respected international and national scientific organizations, through an impartial and rigorous process of deliberation and evaluation, have concluded that all forms of asbestos are capable of inducing mesothelioma, lung cancer, asbestosis, and other diseases. Conclusions are based on the full body of evidence, including the epidemiology, toxicology, industrial hygiene, biology, pathology, and other related literature published to the time of the respective evaluations.

Similar statements have been published by the American Thoracic Society (all fiber types can cause lung cancer) (2004), and the Agency for Toxic Substances and Disease Registries (U.S. Public Health Service 2001), as well as in a review by the International Program on Chemical Safety (1998) on chrysotile asbestos that concluded that exposure to chrysotile asbestos poses increased risks for asbestosis, inducing mesothelioma, lung cancer, and other diseases.<sup>9</sup> No reputable scientific organization supports the industry funded “safe use of chrysotile” position. Based on these findings, most Western countries have banned or limited the use of asbestos. This is an even larger concern in developing countries, where safety equipment, training, and oversight are likely to be lacking.

In a recent review of the literature, including *in vitro* and animal experiments and epidemiological studies, authors of this manuscript (XB, JS, HJW) concluded that “As shown by epidemiological studies, chrysotile causes less pleural fibrosis and mesotheliomas when compared with other asbestos types.<sup>10</sup> However, its otherwise inflammatory, toxic, carcinogenic, and fibrosis-inducing effects correspond to those of other occupationally relevant asbestos types. This is based on clinical, animal, as well as on *in vitro* findings. This means that denying a causal relationship, e.g. in a case with lung fibrosis (=asbestosis) or lung cancer with an asbestos load of 25 fiber-years in the absence of identification of a significant concentration of asbestos

fibers or asbestos bodies in the lung (see so-called “hit and run” phenomenon), contradicts the medical-scientific knowledge.”

A recent meta-analysis by Lenters *et al.*<sup>11</sup> found that the differences in adverse lung cancer effects between chrysotile and amphibole asbestos diminish when high-level methodological studies are considered. Bernstein ignored this work and studies with similar conclusions. The following studies are example of excluded empirical studies from Bernstein’s review:<sup>5</sup>

1. Studies from U.S. textile factory workers<sup>12–15</sup> (with a cohort of 6 000 workers from four textile plants in North Carolina, USA). Employees were followed-up from 1950 to 2003 and the authors found a lung cancer standardized mortality ratio (SMR) 2.0 (95% CI 1.7–2.2), mesothelioma SMR 11.1 (95% CI 3.0–28.4); Relative risk (RR) increased with time since first employment and duration of employment and showed also an increased risk of asbestosis.<sup>14</sup>
2. Stayner *et al.*<sup>16</sup> with a cohort of 3 072 workers from one textile plant in South Carolina, USA, followed from 1940 to 2001. Lung cancer was most strongly associated with exposure to thin (<0.25 µm) and longer (>10 µm) asbestos fibers (transmission electron microscopy test, TEM);
3. Mirabelli *et al.*<sup>17</sup> and Magnani *et al.*<sup>18</sup> data from Italian tremolite-free chrysotile mine. This cluster of 14 mesothelioma cases among workers who were active in the Balangero mine in Italy and 13 among others exposed to Balangero chrysotile. This study added further evidence to the carcinogenicity of tremolite-free chrysotile.
4. The recently published 37-year follow-up cohort studies with chrysotile asbestos miners and textile workers in China by Wang *et al.*<sup>19–22</sup> and Deng *et al.*<sup>23</sup> showing significant dose-dependent mortality of mesothelioma/lung (SMR 1.46; 95% CI, 0.50, 4.30,  $P < 0.001$ ), larynx, and other cancers as well as of non-malignant disorders<sup>24</sup>. Lung cancer increased with employment years at entry to the study by 3.5-fold in 10 years, and 5.3-fold in 20 years. A similar trend was demonstrated for non-malignant respiratory diseases. Mortality rates of smokers were significantly increased already at  $\geq 20$  (fiber-years)/ml. The authors showed significant exposure–response relationship with causal links between chrysotile asbestos exposure and lung cancer and non-malignant respiratory diseases.<sup>19–23</sup>

The strength of these latter studies by Wang *et al.*<sup>19–22</sup> is that subjects were exposed to relatively pure chrysotile. As a result of geographical features with the remote location of the mine, workers usually remained with the mine for a lifetime with little opportunity to change their job, eliminating exposure to other occupational carcinogens. The miners and millers in Quebec, Canada, textile workers in North and South Carolina, USA, Chinese chrysotile production and textile workers, and Italian Balangero cement workers were all exposed primarily to chrysotile asbestos. Although some natural chrysotile asbestos may be contaminated by other asbestos

types (e.g. tremolite), this does not explain the adverse health effects.<sup>8</sup>

With an apparent high regard for his work and relying heavily on one-year rat exposure studies, Bernstein, the industry-funded researcher, draws conclusions on lifetime human asbestos-related disorders. Bernstein<sup>5</sup> also ignores the carcinogenic effects of chrysotile asbestos found by other research groups in large animal studies (1974–2014), such as those by Davies *et al.*,<sup>25</sup> Wagner *et al.*,<sup>26</sup> Fuijtani *et al.*,<sup>27</sup> and Pott *et al.*<sup>28</sup> Another important flaw is Bernstein's statement<sup>5</sup> on the absence of chrysotile fibers in the pleura, because animal studies have shown the predominance of chrysotile fibers in the pleura. Again, results that do not support Bernstein's argument are not mentioned and possible reasons given for the discrepancies are not discussed. On the other hand, Suzuki and Yuen<sup>29</sup> provide evidence that short chrysotile fibers reach the pleura. This is supported by the identification of pleural plaques in chrysotile asbestos workers, by Broaddus *et al.*<sup>30</sup>

## Conclusion

The asbestos industry has promoted and funded research contradicting established knowledge. Bernstein's<sup>5</sup> most recent publication is based on selected literature and ignores both clinical and scientific knowledge. It undermines the World Health Organization (WHO) campaign to stop the use of all asbestos types, including chrysotile asbestos (all kinds of asbestos are carcinogenic<sup>4,6,7,9</sup>). Independent, sound scientific findings provide evidence that chrysotile, like other forms of asbestos, is causative in asbestos-related morbidity and premature mortality.

## Disclaimer Statements

**Contributors** XB, CLS, RAL, JS; HJW, LTB: developed the concept and performed the literature analysis; XB, LTB: wrote the draft of the manuscript; XB, LTB, CLS: finalized the manuscript; XB, RAL, CLS, JS, HJW, LTB: corrected and approved the final version of the manuscript.

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authors and not necessarily the opinions of organizations they represent.

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