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REVIEW ARTICLE

Asbestos Exposure in Occupational and Environmental Settings Following the 2023 Earthquake in Türkiye: A Focused Review

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SUMMARY

The earthquakes centred in Kahramanmaraş on 6 February 2023 caused the collapse of a large number of buildings in Türkiye and the generation of vast amounts of debris, thereby turning environmental and occupational asbestos exposure into a significant public health concern. During post-earthquake debris removal, demolition, and reconstruction activities, asbestos fibres released from the fragmentation of asbestos-containing building materials pose a serious exposure risk not only to search and rescue teams, debris workers, and construction workers, but also to the local population. This review aims to evaluate the potential public health impacts of increased exposure during post-disaster periods by focusing on scientific studies addressing environmental and occupational asbestos exposure following the 2023 earthquakes. In this context, the toxicological properties of asbestos associated with inhalation exposure, as well as asbestos-related diseases—primarily asbestosis, lung cancer, and malignant mesothelioma—are briefly summarized. The review also examines post-earthquake debris management, occupational exposure prevention, and regulatory frameworks to support effective risk management and disease prevention.

Keywords: *Asbestos, earthquakes, earthquake-related asbestos exposure, lung neoplasms, mesothelioma.*

Türkiye'de 2023 Depremi Sonrası Mesleki ve Çevresel Ortamlarda Asbest Maruziyeti: Odaklanmış Bir Derleme

ÖZ

6 Şubat 2023 tarihinde Kahramanmaraş merkezli meydana gelen depremler, Türkiye'de çok sayıda yapının yıkılmasına ve büyük miktarda enkazın açığa çıkmasına neden olarak, çevresel ve mesleki asbest maruziyetini önemli bir halk sağlığı sorunu haline getirmiştir. Deprem sonrası enkaz kaldırma, yıkım ve yeniden inşa süreçlerinde, asbest içeren yapı malzemelerinin parçalanması sonucunda ortaya çıkan lifler; başta arama-kurtarma ekipleri, enkaz işçileri ve inşaat çalışanları olmak üzere, bölge halkı için de ciddi bir maruziyet riski oluşturmaktadır. Bu derleme, 2023 depremleri sonrasında ortaya çıkan çevresel ve mesleki asbest maruziyetine odaklanan bilimsel çalışmaları temel alarak, afet sonrası süreçlerde artan maruziyetin halk sağlığı üzerindeki olası etkilerini değerlendirmeyi amaçlamaktadır. Bu bağlamda, asbestin solunum yoluyla maruziyette ortaya çıkan toksikolojik etkileri ve başta asbestozis, akciğer kanseri ve malign mezotelyoma olmak üzere neden olduğu hastalıklar kısaca özetlenmiştir. Bu derleme ayrıca deprem sonrası enkaz yönetimini, mesleki maruziyetin önlenmesini ve düzenleyici çerçeveleri, etkili risk yönetimi ve hastalıkların önlenmesini desteklemek amacıyla incelemektedir.

Anahtar Kelimeler: *Asbest, deprem, depremle ilişkili asbest maruziyeti, akciğer neoplazmaları, mezotelyoma.*

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INTRODUCTION

Asbestos is a group of naturally occurring metamorphic minerals characterized by a fibrous crystalline structure. Owing to their distinctive physicochemical properties—such as resistance to fire and high temperatures, chemical stability, mechanical strength, and effective electrical insulation—asbestos minerals have historically been incorporated into a wide range of industrial and construction materials (Van Gosen, 2007).

The widespread use of asbestos-containing materials increased markedly during the early and mid-20th century, reaching its peak between the 1970s and 1980s. During this period, asbestos was extensively utilized in the construction sector, especially in asbestos–cement products used for roofing and wall systems, drywall and joint compounds, vinyl flooring and adhesives, panels, pipes, acoustic ceilings, fireproofing materials, thermal insulation, and heating, ventilation, and air conditioning systems (Curado et al., 2024). As a result, asbestos became an integral component of many residential and public buildings, particularly those constructed before regulatory restrictions were introduced.

Despite its advantageous material properties, asbestos poses significant risks to human health. The International Agency for Research on Cancer (IARC) has classified asbestos as "carcinogenic to humans," based on strong evidence linking exposure to severe and often fatal diseases (IARC, 2012; Sen, 2015). The primary route of asbestos exposure is inhalation, whereby airborne fibres are deposited in the respiratory tract. Once inhaled, these fibres can persist in lung tissue and pleural membranes for decades, leading to diseases such as asbestosis, lung cancer, and malignant mesothelioma. Ingestion may occur secondarily; however, inhalation remains the dominant and most critical exposure pathway. A defining characteristic of asbestos-related diseases is their long latency period, with clinical symptoms typically emerging 20 years or more after initial exposure (OSHA, 2002).

International organisations such as the World Health Organization (WHO) and the International Labour Organization (ILO) emphasize that the elimination of asbestos use is the most effective strategy for preventing asbestos-related diseases. Nevertheless, asbestos exposure remains a global public health concern. In recent years, asbestos mining and consumption have continued in several countries, and both occupational and environmental exposures still contribute substantially to disease burden worldwide. It is estimated that asbestos-related occupational exposure accounted for more than 222,000 deaths in 2016, and the incidence of asbestos-related diseases is expected to rise due to past and ongoing exposures combined with long latency periods (Lin et al., 2018).

Beyond occupational settings, the degradation of aging buildings and the disturbance of asbestos-containing materials during structural damage represent major sources of environmental exposure. Earthquakes, in particular, pose a critical risk by causing the collapse of older structures that contain asbestos, resulting in the release of asbestos fibres into the air. The subsequent debris removal and reconstruction processes can further amplify airborne fibre concentrations if appropriate control measures are not implemented. Following the February 2023 earthquakes in Türkiye, investigations conducted by the Turkish Medical Association (TMA) and the Right to Clean Air Platform detected asbestos fibres in dust samples collected from affected areas. These findings demonstrate that insufficient precautions during debris management expose both workers and local populations to serious health risks, underscoring the urgent need for effective regulations and protective strategies in post-disaster settings (Varol, 2023).

In this context, the present study aims to contribute to the development of strategies for preventing asbestos-related health problems, to identify measures that reduce environmental and occupational exposure—particularly in post-earthquake scenarios—and to increase awareness to protect public health.

History of asbestos

The history of asbestos use dates back to ancient civilizations (Gochfeld, 2005; Vallyathan et al., 1985). In Ancient Greece, it was preferred in the production of tablecloths and garments due to its fire-resistant properties, and its ability to be cleaned by exposure to fire was considered remarkable at the time (Laufer, 1915). In Rome, asbestos was mainly employed in fabrics used to wrap bodies during cremation, thereby contributing to the preservation of the ashes (Browne, 2003).

The areas of asbestos use have diversified and expanded over the centuries. Particularly during the Industrial Revolution, the growing demand for fire-resistant and heat-insulating materials significantly increased interest in this mineral (Kośny & Yarbrough, 2022). During this period, asbestos came to be widely used in roofing materials, cement-based products, vehicle braking systems, and various insulation materials. By the 20th century, its usage had reached its peak, being incorporated into numerous applications within residential and industrial buildings as well as public infrastructure (Erker, 2014). However, in the following years, it was recognized that inhalation of asbestos fibres posed serious health risks, which led to a decline in its use and stimulated the development of safer alternatives. Therefore, the historical trajectory of asbestos began with its widespread use due to its exceptional physical properties and was even referred to as a "miracle mineral" (Curado et al., 2024) in the past; however, as its associated health risks became increasingly evident, its use was significantly restricted and subjected to various bans (Bolan et al., 2023).

Types of asbestos

Two families of asbestos minerals are known: amphibole and serpentine group asbestos types. The amphibole group consists of five members: crocidolite, amosite, actinolite, anthophyllite, and tremolite. The serpentine group includes types such as chrysotile, lizardite, and antigorite (Frank, 2020; Frank & van Zandwijk, 2024). The classification scheme of asbestos types is presented in Figure 1. Chrysotile, which belongs to the serpentine group, is the most commonly used commercial form of asbestos. This mineral has flexible and curly fibres and is typically employed in roof shingles, curbs, and cladding materials (Kanarek, 2011). In contrast, asbestos types in the amphibole group possess straighter and more rigid fibres compared to chrysotile. Among them, crocidolite stands out for its high durability and strength, yet due to its fine fibres and ease of inhalation, it is considered the most hazardous type for human health (Kusiorowski et al., 2012). The fibres that pose the greatest threat to human health are those capable of penetrating the deep tissues of the respiratory system and resisting removal by natural elimination mechanisms. Such fibres are typically longer than 5 μm, thinner than 3 μm in diameter, and have a length-to-diameter ratio generally exceeding 3:1 (Zaremba et al., 2010).

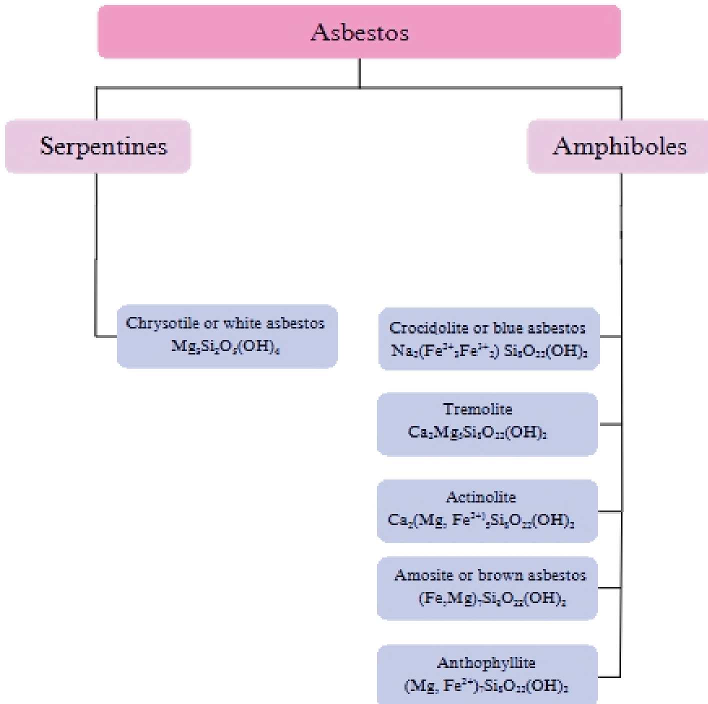

Figure 1. Classification scheme of asbestos main varieties (Virta, 2002)

Chrysotile (white asbestos), composed of fine, flexible, and silky fibres, exhibits high resistance to heat but is vulnerable to the effects of acids. More than 90% of the asbestos used today consists of chrysotile. Initially employed for fire protection and acoustic insulation, it has gradually found widespread applications in various industrial fields. To date, chrysotile has been identified in the composition of more than 5,000 products. It stands out as the most frequently used form in the construction sector (François & Michel, 2016; Rodríguez Elizalde, 2022).

Amphibole asbestos has a coarse, fibrous structure and is used less commercially compared to chrysotile. These fibres are of particular biological significance due to their chemical and crystallographic properties. The rigid and linear nature of the fibres increases the potential for the small subunits generated during fragmentation to cause harm to human tissue. Consequently, these structural characteristics play a critical role in assessing the potential health risks associated with amphibole asbestos (Craighead et al., 1980). Current evidence indicates that the genotoxic and carcinogenic properties of asbestos types vary, with amphibole fibres being most strongly associated with the development of mesothelioma (Virta, 2002).

Areas of asbestos use

Construction and building materials

In buildings constructed before 1980, it was commonly found in spray-applied coatings, cement-based boards (such as fibre cement), pipe and boiler insulation, ceiling and floor tiles, fire-resistant panels, gaskets, and chimney systems (Akboğa-Kale et al., 2017; IARC, 2023; Murgia et al., 2025). Types of asbestos, such as chrysotile and crocidolite, were specifically preferred in cement pipes, filler materials, and insulation products to provide resistance against heat and pressure (Akboğa-Kale et al., 2017). Common materials that may contain asbestos in industrial buildings are shown in Figure 2.

The areas of asbestos use have diversified over time, and it has gained significant prevalence in the construction sector. During this period, asbestos was employed in many building components, ranging from roof tiles to panels, from coating materials to asbestos–cement-based products. The 20th century witnessed a significant acceleration in asbestos production, driven both by the demands arising from the two World Wars and by the reconstruction activities that intensified in the post-war period. Particularly in developing countries, the rapidly expanding automotive industry and the surge in construction activities further supported this growth and led to the wider global prevalence of asbestos (Curado et al., 2024).

Industrial and occupational use

Asbestos minerals have been extensively employed across various industrial sectors due to their unique properties, including high heat resistance, thermal and acoustic insulation, and durability. The industrial potential of these minerals was recognized toward the end of the 19th century, initiating their commercial applications. In the early stages, their use was predominantly limited to serving as thermal insulation in steam engines and boilers (Frank & Joshi, 2014).

Asbestos was extensively used in many areas requiring insulation, primarily in the construction sector and the shipbuilding industry. On an industrial scale, its use expanded further, and asbestos was even employed in the filtration of beer, wine, and pharmaceutical products (Frank & Joshi, 2014).

Consumer products and other applications

Beyond the construction sector, it also became a preferred material in the production of brake pads, heat-resistant textile products, and various machinery and equipment parts. In addition to industrial applications, it was also present in various consumer products used in daily life. For instance, the internal components of toasters, hair dryers, and certain arts and crafts materials contained asbestos (Frank & Joshi, 2014).

Regulatory awareness and decline in use

From the second half of the 20th century onward, mounting scientific evidence regarding the adverse health impacts of asbestos revealed its strong association with severe diseases such as asbestosis, malignant mesothelioma, and lung cancer. Consequently, many countries introduced strict regulations and implemented bans on its use, import, and export (Curado et al., 2024; Damiran & Frank, 2018; Michaels, 2008).

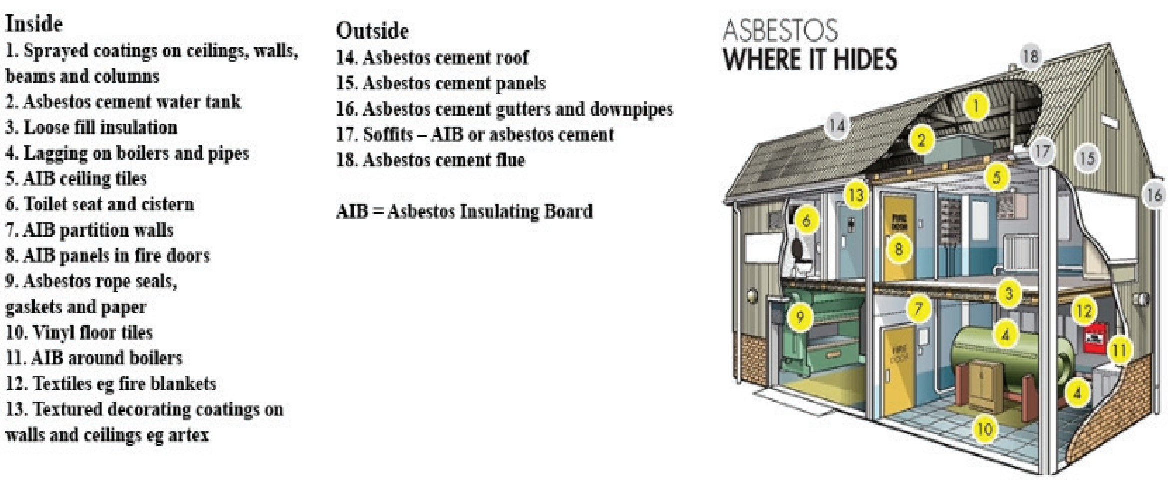

Figure 2. Common materials used in the ındustrial building where we can find asbestos (Rodríguez Elizalde, 2022)

Asbestos exposure

Asbestos exposure is a significant environmental and occupational risk factor that affects millions of people worldwide and leads to serious respiratory diseases, particularly mesothelioma and lung cancer (Altuntaş et al., 2009). Over the past fifty years, the majority of malignant mesothelioma cases diagnosed worldwide have been primarily associated with occupational exposure. However, a significant number of cases also result from para-occupational, domestic, and environmental exposures (Linton et al., 2012). From a public health perspective, construction-related asbestos exposure becomes particularly critical in earthquake-prone regions, where structural damage transforms previously contained materials into widespread environmental and occupational hazards. Today, one of the most concerning sources of exposure is debris generated after earthquakes. Asbestos fibres released into the air during the demolition of old buildings pose a serious health risk to search and rescue teams, residents, and debris removal workers. This situation highlights that asbestos is not merely a problem of the past but remains an active public health threat in post-disaster settings as well (Güneş et al., 2017).

Occupational asbestos exposure

Workers in the shipbuilding and repair sector face a high risk of asbestos exposure due to the widespread use of asbestos in insulation and thermal protection materials. Construction workers are also at risk, as they may encounter asbestos fibres during building demolition, renovation, and insulation activities. In the automotive industry, employees involved in the manufacturing and maintenance of brake pads and clutch components have historically been exposed to asbestos over extended periods. Additionally, the mining sector represents a significant risk for asbestos exposure, particularly during the extraction and processing of naturally occurring asbestos-containing rocks (Cruz et al., 2018; Kim et al., 2015; Noonan, 2017; Wu et al., 2015). While 125 million workers around the world continue to be exposed to asbestos, approximately 250,000 asbestos-related deaths are reported annually (Frank & van Zandwijk, 2024). Therefore, the protection of workers, proper training and education, and implementation of regular health screenings are of critical importance (Barbiero et al., 2018; Vicari et al., 2023). A summary of the potential pathways of asbestos exposure worldwide is presented in Figure 3.

Environmental and para-occupational exposure

Workers directly exposed to asbestos bear the highest health risks due to intense exposure; however, the risk is not limited to this group alone. Individuals working near asbestos-containing environments—such as in the construction and shipbuilding industries—may also be affected through indirect exposure. Furthermore, asbestos fibres carried home on workers' clothing can lead to diseases among spouses and children. Such domestic exposures have been documented since the 1960s, and early regulations recommended that workers clean themselves before returning home. Additionally, residing near asbestos-related facilities also poses a risk of environmental exposure, which has been reported in various countries (Frank & Joshi, 2014).

Earthquake-related asbestos exposure

The uncontrolled release of asbestos from debris following the February 6, 2023, Kahramanmaraş earthquakes has posed a serious public health threat in the affected regions (Turan & Alpaydın, 2024). Asbestos, which was commonly used in buildings constructed before the regulatory framework established after the 2010 asbestos ban and subsequent occupational safety regulations introduced in 2013, may become respirable in fibrous form during debris removal operations, posing a significant health risk for both workers and nearby residents (Hancı & Kepekli, 2022). Therefore, identifying asbestos-containing structures, ensuring their removal by specialized teams, and enforcing the use of Personal Protective Equipment (PPE) are of vital importance and must be carried out in accordance with Regulation No. 28539 (Hancı & Kepekli, 2022).

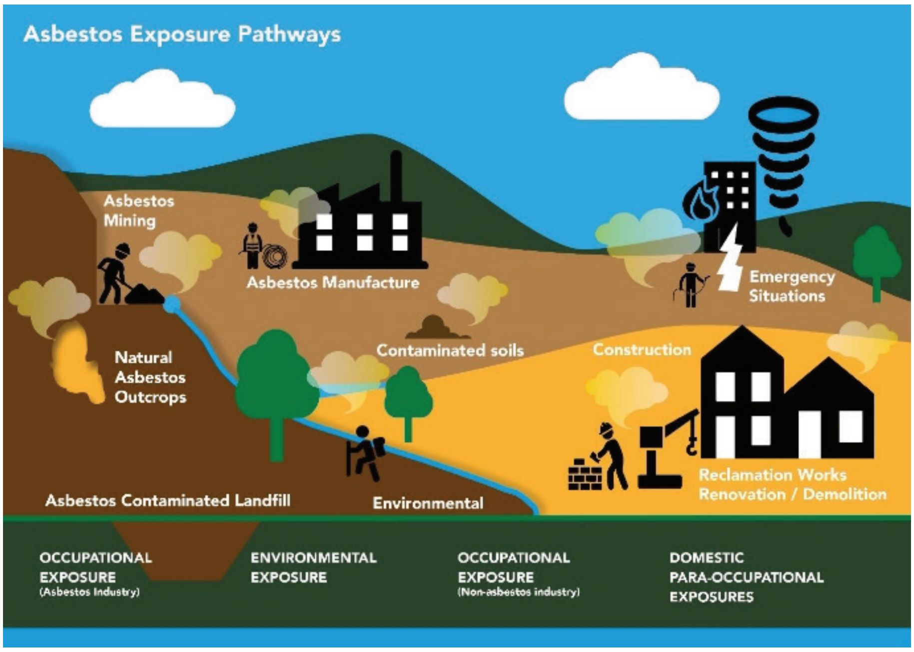

Figure 3. A summary of potential exposure pathways for asbestos exposure globally (Berry et al., 2022)

Health effects of asbestos

The respiratory system constitutes the primary pathway through which asbestos enters the human body (Berry et al., 2022). Due to their small size, fine structure, and fibrous morphology, asbestos fibres can remain airborne for prolonged periods, facilitating inhalation and deep penetration into lung tissues. Their resistance to biological degradation allows these fibres to persist in the body for many years, resulting in long-term biological effects (Bernstein & Pavlisko, 2017). After a long latent period, these fibers can lead to serious diseases, including mesothelioma, lung cancer, and asbestosis (Akboğa & Baradan, 2011; IARC, 2012). Classic epidemiological investigations have long established the carcinogenicity of asbestos, particularly with respect to mesothelioma and lung cancer (Frank & Joshi, 2014; Selikoff et al., 1968). Although most epidemiological data originate from occupational cohorts, these findings constitute the primary scientific foundation for evaluating environmental asbestos exposure, including scenarios involving widespread structural damage after earthquakes.

Population-based epidemiological studies consistently demonstrate a strong association between asbestos exposure and both mesothelioma and lung cancer, indicating that mesothelioma risk is largely independent of smoking, whereas lung cancer risk is modified by concurrent tobacco exposure (Offermans et al., 2014; Taeger et al., 2022).

A key determinant in the development of asbestos-related diseases is the latency period. Mesothelioma risk has been shown to increase primarily with time since first exposure, while lung cancer risk is more closely related to cumulative exposure over time (Pira et al., 2007). Population-based cohort evidence further supports an exposure duration–related increase in lung cancer risk following asbestos exposure (Barbiero et al., 2018). This long latency period is particularly important in post-earthquake settings, where environmental asbestos exposure following building collapse and debris removal may not result in immediately observable health effects.

Consistent with epidemiological findings from large cohort studies, IARC has classified asbestos as causally associated with lung, laryngeal, mesothelial (mesothelioma), and ovarian cancers (Camargo et al., 2011; IARC, 2023; Singh et al., 2023). Several biological mechanisms have been proposed to explain the epidemiologically observed association between asbestos exposure and cancer. The inability of phagocytic cells to eliminate the fibres enhances oxidative stress and free radical production, thereby increasing cellular damage and tumor formation risk (Pugnaloni et al., 2013). Moreover, numerous studies conducted in different biological systems have demonstrated that oxidative stress contributes significantly to the pathogenesis of many diseases (Ökçesiz & Bucurgat, 2021).

The carcinogenic effects of asbestos vary according to the structural properties of the fibres as well as individual susceptibility factors (Celsi et al., 2019; van Zandwijk et al., 2020). The process by which asbestos induces cancer involves a complex interplay of genetic mutations, oxidative stress, inflammation, and epigenetic alterations (Bogen, 2023). In addition to its carcinogenic effects, prolonged asbestos exposure has been associated with adverse psychological outcomes in environmentally contaminated settings, primarily due to persistent health-related uncertainty and concern (Yiğitalp & Saka, 2017). Figure 4 illustrates the structural differences between a healthy respiratory system and one severely affected by asbestos-related diseases.

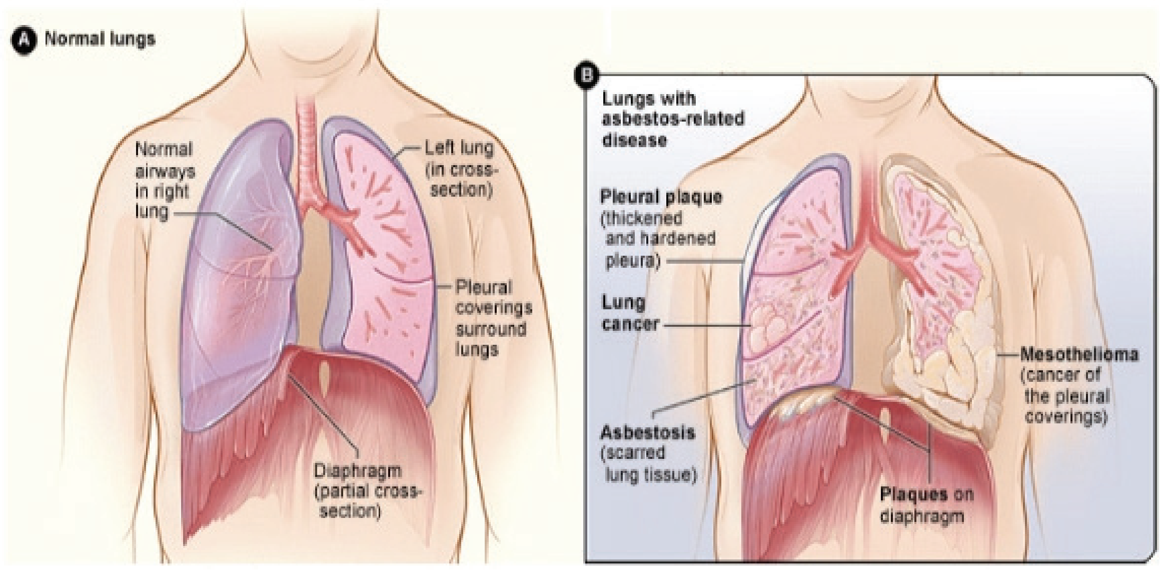

Figure 4. Normal, healthy respiratory system (left) and a respiratory system affected by severe asbestos-related diseases (right) (Rodríguez Elizalde, 2022)

Post-earthquake asbestos exposure: evidence from global studies and Türkiye

Earthquakes and large-scale disasters constitute critical scenarios for asbestos exposure due to the sudden collapse of buildings, extensive debris generation, and uncontrolled demolition activities. In regions where asbestos-containing materials were historically used in construction, seismic events can lead to the widespread release of asbestos fibres into the environment, posing serious occupational and environmental health risks. Evidence from different earthquakes worldwide consistently demonstrates that the magnitude of structural damage, the age and composition of buildings, and the effectiveness of post-disaster management practices are key determinants of asbestos exposure levels.

Comparative analyses of major seismic events reveal a consistent post-disaster pattern of increased airborne particulate matter and asbestos fibre release.

This pattern has been documented following the 1995 Great Hanshin (Kobe) earthquake in Japan, the 2009 L'Aquila earthquake in Italy, the 2011 Tohoku earthquake in Japan, the 2002 Sultandağı earthquake in Türkiye, and the 2023 Kahramanmaraş earthquakes.

In the aftermath of the Great Hanshin (Kobe) earthquake, approximately 18 million tons of debris were generated. Environmental measurements confirmed the presence of asbestos fibres in ambient air. Notably, asbestos removal accounted for a substantial proportion of total debris management costs, indicating both the scale of contamination and the economic burden associated with delayed preventive measures (Yavuz, 2024). Similar challenges were observed after the 2011 Tohoku earthquake, where elevated concentrations of respirable particles were reported, contributing to severe respiratory outcomes among exposed individuals (Balbay et al., 2024).

Across these international case studies, certain population groups consistently emerged as the most vulnerable to asbestos exposure. Demolition and debris removal workers, security personnel, and residents living in proximity to damaged structures were frequently exposed to airborne fibres under conditions of insufficient awareness and inadequate protective measures. Reports from L'Aquila and Tohoku highlighted that occupational exposure often exceeded recommended limits, largely due to the absence of systematic asbestos risk assessments and the lack of enforced use of personal protective equipment during emergency response and reconstruction phases.

In line with these observations, measurements conducted at demolition sites in post-disaster settings demonstrated that airborne asbestos fibre concentrations could exceed permissible occupational limits, reinforcing the critical need for continuous monitoring and preventive measures to protect worker health (Stevulova et al., 2020).

Evidence from Türkiye aligns closely with these international observations while providing original insights into post-earthquake asbestos exposure under local conditions. Field investigations conducted after the 2023 Kahramanmaraş earthquakes detected various types of asbestos fibres in debris and environmental samples collected from severely affected provinces such as Adıyaman, Kahramanmaraş, Elbistan, and Hatay (Varol, 2023). Similarly, post-earthquake assessments following the İzmir earthquake identified chrysotile asbestos in a considerable proportion of examined buildings, underscoring the persistence of asbestos-containing materials in the existing building stock (Tetik et al., 2024). These findings indicate that asbestos exposure following earthquakes in Türkiye is not incidental but represents a systematic risk associated with the characteristics of the built environment and post-disaster practices.

Further reinforcing this concern, a recent study assessing asbestos awareness among demolition workers, security staff, and nearby residents after the 2023 Kahramanmaraş earthquakes revealed critically low levels of knowledge regarding asbestos-related health risks and protective measures. The study also demonstrated that existing safety regulations were inadequately implemented during debris removal and demolition processes (Süzergöz & Doğan, 2025). These results suggest that regulatory frameworks alone are insufficient without effective field-level enforcement and targeted training programmes.

Taken together, international and national evidence highlights that asbestos risk is a recurrent yet often underestimated component of post-earthquake environments. The consistent identification of similar high-risk groups and exposure pathways across different disasters suggests the need to reconsider current disaster response planning strategies. Asbestos risk management should be systematically integrated into national disaster preparedness, emergency response, and debris management protocols. This integration should include pre-disaster identification of asbestos-containing structures, mandatory asbestos risk assessments before demolition, strict enforcement of personal protective equipment use, and continuous training programmes for all personnel involved in post-disaster operations. Embedding asbestos control strategies into disaster management frameworks is essential to prevent avoidable long-term health consequences following future earthquakes.

Worldwide and Türkiye regulations on asbestos

Worldwide regulations on asbestos

Throughout the 20th century, asbestos was widely used worldwide due to its high heat resistance, thermal and acoustic insulation properties, and long-lasting durability. However, from the last quarter of the century onward, as scientific evidence increasingly demonstrated that exposure to this mineral is strongly associated with serious health issues, particularly lung diseases and cancer, many countries imposed restrictions on or completely banned its use (Murray, 1990). Although asbestos has been completely banned in many regions today, it is still being extracted and used in a limited manner under regulatory frameworks in certain countries (Ali et al., 2017; Lee et al., 2008).

The majority of European Union member states have completely banned the use of asbestos in accordance with European Commission Directive 1999/77/EC. This prohibition has been expanded to cover a wide range of asbestos-containing products throughout the Union (European Commission, 1999a). In the Fifty-eighth World Health Assembly held in 2005, Member States were urged to implement measures aimed at reducing cancer risks associated with chemical exposures in workplaces, households, and other living environments. Within this context, asbestos was particularly emphasized as the most significant carcinogen, being responsible for nearly half of occupational cancer deaths (WHO, 2005). This issue has also been examined in epidemiological studies investigating occupational cancer mortality associated with asbestos exposure (Curado et al., 2024; Nicholson, 1996). Member states were required to phase out the use of chrysotile asbestos by January 1, 2005, although a limited exemption was granted for its use in diaphragms until 2008 (European Commission, 1999b). Under Directive 2009/148/EC, as amended by Directive (EU) 2023/2668, the binding occupational exposure limit for asbestos was reduced to 0.01 fibres/cm^3 as an eight-hour time-weighted average (TWA) (European Parliament and the Council, 2023). The adequacy of this limit and the need for lower exposure thresholds and additional protective measures, particularly for asbestos present in existing buildings, have been examined in the scientific literature (Takala, 2022).

Regulations on asbestos in Türkiye

In Türkiye, the import, production, and use of asbestos were gradually restricted starting in 1993 (T.C. Resmî Gazete, 1993), and with the regulation published in 2010, the extraction, use in products, and sale of all types of asbestos, including chrysotile, were completely banned (T.C. Resmî Gazete, 2010). Regulations issued by the Ministry of Labour and Social Security in 2003 and 2013 established exposure limits and occupational safety measures, and in 2015, training for asbestos removal specialists was made mandatory (T.C. Resmî Gazete, 2003; T.C. 28539 sayılı Resmî Gazete, 2013). However, the presence of asbestos-containing materials in the existing building stock reveals a public health issue that cannot be addressed solely through legislation, but must also be supported by active field implementation and enforcement (Çil et al., 2021). Therefore, to reduce the public health risks of asbestos, there is a need not only for bans but also for comprehensive strategies that include the identification of high-risk structures, safe removal practices, and effective disposal processes.

In Türkiye, the legally defined TWA exposure limit for asbestos is 0.1 fibres/cm^3 (T.C. 28539 sayılı Resmî Gazete, 2013; T.C. 28812 sayılı Resmî Gazete, 2013). This value is substantially higher than the exposure levels recommended by international organisations such as the WHO, which propose limits ranging between 0.001 and 0.0001 fibres/cm³ (Peña-Castro et al., 2023). The discrepancy between national and international reference values indicates a markedly less stringent regulatory threshold in Türkiye. While such limits are defined for controlled occupational environments, their adequacy becomes particularly questionable in high-uncertainty settings, such as post-earthquake debris zones, where asbestos-containing materials may be extensively disturbed, and airborne fibre concentrations are difficult to monitor. In these contexts, reliance on comparatively higher legal exposure limits may underestimate actual health risks, potentially increasing uncontrolled exposure among workers, volunteers, and the general population involved in debris removal and recovery activities.

CONCLUSION

Occupational, environmental, and post-disaster asbestos exposure causes permanent and severe toxicological effects on human health. As strongly demonstrated in the literature, asbestos exposure is directly associated with fatal diseases such as asbestosis, malignant mesothelioma, and lung cancer (Markowitz, 2015; Türk Tabipleri Birliği, 2023). Specifically in Türkiye, the effects of approximately 500,000 tons of asbestos, which was extensively used in the past, still pose a significant risk today (Metintaş and Yılmaz Demirci, 2015). Although the use of asbestos was officially banned in 2010, inadequate enforcement in practice continues to threaten public health—particularly during urban transformation projects and post-disaster debris management processes (Allen, 2010; Yavuz, 2024). Indeed, asbestos fibres identified in the rubble following the February 6, 2023, Kahramanmaraş earthquakes have revealed serious shortcomings in safe waste management and occupational health measures (Türk Tabipleri Birliği, 2023; Yavuz, 2024). Minimizing asbestos-related health risks during post-earthquake debris removal requires the systematic identification of asbestos-contaminated structures before intervention, the engagement of trained professionals adhering to established asbestos removal protocols, the provision of appropriate personal protective equipment for workers, comprehensive education on asbestos-related hazards and safe work practices, and the implementation of continuous environmental and air quality monitoring to effectively control airborne fibre exposure (Koyunoğlu, 2024). In this context, the effective management of toxicological risks associated with asbestos should not be limited to the existence of legal regulations alone; it must also be supported by rigorous on-site enforcement, the development of a competent and certified workforce, and the promotion of public awareness and preventive health behaviours (Akgün, 2015). Furthermore, asbestos safety should be addressed as a specific component within disaster management processes, and logistical capacity should be strengthened for the provision of protective equipment, the implementation of safe removal techniques, and the proper disposal of asbestos waste. The coordinated and sustainable implementation of all these measures will play a critical role in reducing the incidence of asbestos-related diseases, both now and in the future (Metintaş & Yılmaz Demirci, 2015; Türk Tabipleri Birliği, 2023; Yavuz, 2024).

AUTHOR CONTRIBUTION STATEMENT

Determination of the subject, literature research, preparation of the manuscript (HD), Determination of the subject, literature research, reviewing the manuscript, and supervision (AÖH).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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