



Vol.6 No.2 | Agustus 2023

JURNAL BIOMEDIKA DAN KESEHATAN

Publikasi dari Fakultas Kedokteran Universitas Trisakti

Editorial

Workplace Violence in Healthcare Service
Nany Hairunisa

Original Article

Levels of TGF- Serum Positively Correlated with Levels of IgM Anti PGL-1 In Household Contacts of Multibacillary Leprosy Patients
Putu Yunita Primasari, Luh Made Mas Rusyati, I Gusti Ayu Agung Dwi Karmila et al

Antioxidant Effectiveness Test of Olive Oil on Malondialdehyde in Hyperglycemic Rats
Ariani Zaltin Okvenda, Eti Yerizel, Raveinal et al

Correlation of Peat Water and Skin Disease Complaints in the Community of Handil Sohor Village, Indonesia
Nawan, Intan Wahyu Wulandari, Francisca Diana Alexandra et al

Prevalence and Sensitivity Pattern of *Acinetobacter baumannii* in the Intensive Care Unit of Private Hospital in Jakarta
Ade Dharmawan, Arleen Devita, Wani Devita Gunardi et al

The Difference in Blast Number Between Manual Count and Siemens Advia 2120i Automatic Hematology Analyzer
Mario, Paulus Budiono Notopuro

Molecular Epidemiology genes detection of *Klebsiella pneumoniae* Clinical Isolates from the Adult Patients with Comorbidities in Baghdad hospitals
Nuha B Kudaer, Mohsen Risan, Rasha Raheem, et al

Review Article

Prevention of Disability in Leprosy
Robert Thiodorus, Luh Made Mas Rusyati, Marrietta Sugiarti Sadeli

Occupational Asbestos Related Diseases in Indonesia: A Call for Urgent Action and Awareness
Ade Dwi Lestari, Nany Hairunisa, Alvin Mohamad Ridwan

Problematic *Clostridium difficile* infection
Conny Riana Tjampakasari, Deajeng Laras Hanayurianingtyas

The Role of Cytoglobin in Cancer
Deasyka Yastani, Novi Silvia H, Sri Widia A. Jusman

REVIEW ARTICLE


Occupational Asbestos Related Diseases in Indonesia: A Call for Urgent Action and Awareness

Penyakit Asbes Akibat Kerja di Indonesia: Himbauan untuk Segera Melakukan Tindakan dan Kesadaran

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 <https://doi.org/10.56186/jbk.224-234>

ABSTRACT

Despite many countries have either reduced or banned asbestos use, Indonesia has yet to ban the use of asbestos. Asbestos exposure poses significant health risks, particularly respiratory diseases such as asbestos-related lung cancer, mesothelioma, and asbestosis known as an asbestos-related disease. According to the World Health Organization (WHO), asbestos is a major global health concern with millions of people exposed to its hazards and resulting in a significant number of deaths each year. We conducted a literature review study on the topic of asbestos-related diseases in Indonesia. Based on our findings, due to the large amount of asbestos being handled, it is expected that there should be hundreds to a thousand cases of asbestos-related disorders in Indonesia each year. Unfortunately it is uncommon to find and diagnose cases of asbestos-related diseases in Indonesia. The lack of awareness, inadequate diagnosis, and underreporting of asbestos-related diseases contribute to the challenges faced in Indonesia. The study emphasizes the need for a comprehensive ban on asbestos, safer alternative materials, standardized medical surveillance for exposed workers, increased awareness and cooperation among stakeholders to eliminate asbestos-related diseases in Indonesia.

Keywords: Asbestos; Asbestos Related Diseases; Indonesia

ABSTRAK

Meskipun banyak negara telah mengurangi atau melarang penggunaan asbes, Indonesia masih belum melarang penggunaannya. Paparan asbes menimbulkan risiko kesehatan yang signifikan, terutama penyakit pernapasan seperti kanker paru terkait asbes, mesotelioma, dan asbestosis yang dikenal sebagai penyakit terkait asbes. Menurut Organisasi Kesehatan Dunia (WHO), asbes merupakan masalah kesehatan utama global dimana jutaan orang terpapar setiap tahunnya dan menyebabkan jumlah kematian yang signifikan. Kami melakukan studi literatur mengenai penyakit terkait asbes di Indonesia. Berdasarkan temuan kami dengan jumlah asbes yang ditangani cukup besar, diperkirakan terdapat ratusan hingga ribuan kasus penyakit terkait asbes di Indonesia setiap tahunnya. Namun sayangnya penyakit terkait asbes sangat jarang ditemukan dan didiagnosis di Indonesia. Kurangnya kesadaran, diagnosis yang tidak memadai, dan kurangnya pelaporan penyakit terkait asbes menjadi tantangan bagi Indonesia. Studi ini menekankan perlunya pelarangan penggunaan asbes secara komprehensif, penggunaan bahan pengganti asbes yang lebih aman, pemeriksaan kesehatan standar bagi pekerja yang

terpapar, peningkatan kesadaran dan kerja sama di antara para pemangku kepentingan untuk mengeliminasi penyakit terkait asbes di Indonesia.

Kata Kunci: Asbes; Penyakit terkait asbes; Indonesia

INTRODUCTION

According to the Central Bureau of Statistics in 2022, Indonesia's population is around 275 million people with 144 million of total labor among them. The number of workers increase about 4.2 million people compared to the previous year in 2021.^{1,2} In doing their job, worker are exposed with various hazard in their work-place that can cause many kinds of occupational diseases and accidents.

A study estimated 2.78 million of deaths annually across the world had been related to work. Mortality cause by work-related diseases is taken part about 2.4 million deaths. The three most causes of work-related mortality are circulatory diseases (31%), malignant neoplasms (26%) and respiratory diseases (17%). Asia was the highest contributor of mortality caused by work related diseases. It was about two-thirds of the global work-related mortality.³

Many cases of work-related mortality in respiratory diseases due to Chronic Obstructive Pulmonary Disease (COPD). It has become an important work-related problem but is often not well-recognized and underdiagnosed. COPD is caused by exposures to a multitude of vapors, gases, dusts and fumes (VGDF). COPD is also associated with specific occupational exposure agents such as asbestos, coal mine dust, silica, welding cutting gases and fumes, cement dust, diesel exhausts, spray painting, and organic solvents.³

The World Health Organization (WHO) statement on asbestos is very clear that asbestos is 1 of 10 substances of major global health concern.⁴ Approximately 125 million people worldwide are currently exposed to asbestos at work and at least 107.000 mortality per year caused by asbestos related lung cancer, mesothelioma, and asbestosis from occupational exposure. Despite occupational exposure is majority cause of mortality, there are nearly 400 deaths also been linked to non-occupational asbestos exposure.⁵ Occupational lung cancer estimated to be responsible for 17–29% of all lung cancer mortality and 55–85% of all occupational lung cancer cases is significantly cause by asbestos as carcinogenic agent.⁶

Currently Indonesia is among top five of country in the world that still using asbestos but in the other side the case of asbestos related disease (ARD), mesothelioma and asbestos related lung cancer are uncommon to be found and diagnosed in Indonesia.⁷ Other country for comparison like Great Britain as developed country that had banned the use of asbestos, the occupational mortality cause by ARD is about 4500 case peryear.⁸

The World Health Organization has recommended to prohibit the use of asbestos in any term because the deadly impact of asbestos. Currently more than 65 countries in the world have banned the use of all types of asbestos but not Include Indonesia.⁵

The purpose of this literature review is to identify gaps between existing research and the case of asbestos-related diseases in Indonesia. This literature review is to provide a comprehensive understanding of the current situation of asbestos-related diseases in Indonesia, the regulatory

framework, diagnostic challenges, occupational exposure risks, and potential solutions in Indonesia.

METHODS

We conducted a literature review based on the relevance of this topic. All databases were searched on Google Scholar, PubMed, and ResearchGate using the following keywords: asbestos related disease and Indonesia.

RESULTS

Asbestos

Asbestos is from Greek language means inextinguishable. Asbestos is a magnesium silicate mineral group and has a tendency to break down into fibers. The widely used of asbestos started from industrial revolution and World War II. As a fibrous silicate mineral with crystalline structures, asbestos is strong, flexible, stable, long-lasting, and resistant to deterioration from heat, chemicals, and organisms. It was utilized in many different items for more than a century. Respiratory issues linked to asbestos handling were already documented in the 19th century, even though at that time asbestos still rarely mined and used.⁴

There are six types minerals of asbestos. Chrysotile or white asbestos is a variant of the serpentine form, amphibole which includes crocidolite which is a variant of riebeckite, amosite a brown color asbestos which is a variant of cummingtonite grunerite, variants of other amphibole namely anthophyllite asbestos, actinolite asbestos and tremolite asbestos. Currently the most commonly used types of asbestos are chrysotile, followed by amosite and crocidolite.⁹

All forms of asbestos minerals can cause non-malignant asbestosis and *also proven as human carcinogen* by the International Agency for Research on Cancer (IARC). Chrysotile the most common currently used is the cause of asbestos related diseases (ARD) whether non-malignant or malignant such as pleural lung cancer (mesothelioma), lung cancer, laryngeal cancer and ovarian cancer.¹⁰ After the initial exposure of asbestos, it may require between 10 to 70 years for the diseases to occur and around 20 to 50 years for malignancy.¹¹

Table 1. Overview of the reviewed sources.

Authors	Purpose	Design study	Summary
Marsili D et al (2016) ⁷	Present a review of the asbestos health impact, to illustrate the arguments in favor and against continuing asbestos use, to discuss the role of epidemiological investigations in countries where asbestos is still used.	Literature Review	Approximately 50% of world asbestos is used by two countries, China and India, followed by Brazil, Indonesia and Russia. Currently total or partial asbestos ban legislation has been adopted by 54 countries.
Odgerel C et al (2017) ²⁵	Estimate global deaths cause by asbestos from the study period of 1994 to 2014, 230 countries into 59 countries grouped with quality mesothelioma mortality data suitable to be used for reference rates.	Data analysis	Indonesia should found about 548 (range 184 to 700) mesothelioma cases per year based on the amount of asbestos handled.

McCormack V et al (2012) ¹⁸	Estimating the asbestos-related lung cancer burden from mesothelioma mortality by estimated the ratio of asbestos-related lung cancers to mesothelioma deaths from asbestos cohorts.	Cohort	Every mesothelioma case in a country should expect about 2 to 6 cases of Asbestos-Related Lung Cancer (ARLC). Indonesia should expect about 1,096 to 3,288 ARLC cases.
Suraya A et al (2020) ¹²	A hospital-based study in Indonesia comparing occupational asbestos exposure to the risk of lung cancer development and the combined effect with smoking.	Case-Control	The study 696 subjects with 336 cases and 360 controls. Subject were patients who received a thoracic computed tomography and histology. The chance of lung cancer for subjects exposed to asbestos was doubled compared with unexposed.

Asbestos usage in Indonesia

Currently about 90% of world asbestos comes from Russia, China, Brazil and Kazakhstan. Approximately 50% of world asbestos is used by two countries, China and India, followed by Brazil, Indonesia and Russia.⁷ Asbestos has been imported to Indonesia legally since the 1950. The usage of asbestos in Indonesia increased rapidly from 20,000 tons in the 1980s to 50,000 tons in the 1990s, and then to 150,000 tons in the 2000s.¹²

Asbestos still widely use in Indonesia until now and economic is the main reason. Asbestos is used everywhere in Indonesia. Such as asbestos manufactures, shipbuildings, constructions, oil refineries, steel plants, power plants, and automotive industries. All of these industries are known as primary exposure sources in workplaces. As secondary exposure sources in society, asbestos materials are used as roofs, ceilings, pipes, cement, brake lining, consume water and food that has been contaminated by asbestos dust. The last tertiary sources of exposure is the asbestos dust in clothes, hair, or other body parts of a family member who exposed to asbestos at work.⁵

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Occupation with high risk factors for asbestos exposure are asbestos mining and milling, construction trades (including insulators, sheet metal workers, electricians, plumbers, pipefitters, and carpenters), power plant workers, boilermakers, and shipyard workers.¹³

Indonesia Regulation of Asbestos

Until now Indonesia has not completely banned the use of asbestos for any purpose. The first regulation issued by the government regarding the safety of asbestos usage is the regulation of the Minister of Manpower Number 01 of 1980. This regulation manage the construction workers and employers that asbestos may only be used if other less hazardous materials are not available and precautions must be taken if asbestos is used.,¹⁴

Indonesia indeed prohibits the use of crocidolite raw materials in the production process through the Minister of Manpower Regulation Number 03 of 1985 which regulates the occupational

health and safety in the use of asbestos. This Regulation is a special elaboration regarding the use of asbestos in the production process and the safety usage of asbestos.¹⁵

Other regulation from Ministry of Manpower Number 05 of 2018 concerning occupational health safety environment. This regulation set the threshold limit values for asbestos is 0.1 fiber/cc.¹⁶ Currently only the Ministry of Manpower has issued quite a number of regulations regarding the use of asbestos in the industry. There is no regulation higher than the ministry level that prohibit the use of asbestos in any form.

The newest regulation is Presidential Decree Number 7 of 2019 concerning occupational disease. Asbestosis is mentioned twice as occupational disease in part of respiratory diseases and malignancy. This regulation is a revision of the 1993 Presidential Decree which was declared asbestosis as an occupational disease¹⁷

Diagnosis of Asbestos Related Disease

Asbestos can cause non-malignant or malignant asbestos-related diseases. Non-malignant asbestos-related diseases include asbestosis, pleural thickening, asbestos-related pleural plaques or fibrosis and nonmalignant pleural effusion. The first suspected asbestos-related lung cancer cases were diagnosed in 1930 from the autopsies performed in two female who worked in asbestos textile industry. Both of them had asbestosis and lung cancer.¹²

According to a study which examined data from 55 asbestos cohort study around the world, asbestos fiber was the majority cause for two times prevalence of lung cancer and mesothelioma. A low mesothelioma burden for chrysotile, should not be taken as a low overall cancer burden.¹⁸

When asbestos mineral bond is disturbed, damaged, or destroyed, the microscopic asbestos fibers will be released into the air. These asbestos fibers that are inhaled into the lower airway will induce inflammation in both the pleura and alveoli causing significant and irreversible health effects. As the disease progresses, it can cause extensive and persistent pulmonary parenchymal fibrosis.¹⁹

Despite there are a lot of regulation regard to threshold limit value of asbestos, but it can be ascertained that there is no real-safe exposure level limit. A study of 590 of pulmonary asbestos fiber analysis found that the median asbestos concentration within dry lung tissue was 3.20 million fibers/gram (range: 0-1700 million fibers/gram). It also found that crocidolite and anthophyllite were the most asbestos fiber types detected. Total asbestos fiber concentration was associated with increased mortality and there is no difference between mortality and different fiber types.¹⁹ Study in China proof that mesothelioma patients were more likely to decease as a result of chrysotile exposure.²⁰

The diagnostic criteria for non-malignant asbestosis from the American Thoracic Society and the Helsinki Criteria can be perform in daily practice. Non-malignant asbestos-related disease refers to the following conditions: asbestosis, pleural thickening or asbestos-related pleural fibrosis (plaques or diffuse fibrosis), benign pleural effusion, and airflow obstruction.^{13,21}

It is understood that the symptoms maybe vague and may not be sufficiently advanced to be apparent on histology, imaging, or functional studies, but one of the most important criteria is having a history of asbestos exposure at least 10 years from the initial exposure.¹³ The main complaint that is often found in patients with asbestosis is shortness of breath when doing

activities. Patients may also experience complaints of prolonged cough with sputum and blood, chest pain and weight loss. On physical examination, rales and inspiratory crackles can be found in both lung basal areas with or without clubbing fingers and cyanosis. Changes in lung function to be restrictive or obstructive with spirometry as one of the most commonly used to measure lung function.^{13,21}

Other early diagnosis is performing the chest imaging with International Classification of Radiographs of Pneumoconiosis International Labour Organization (ILO) classification. However, an High-resolution Computed Tomography (HRCT) scan is performed if there are findings of borderline lung fibrosis (ILO 0/1-1/0) or discrepancies between the results of restricted lung function tests and normal radiological interpretations or extensive pleural abnormalities.²¹

Occupational Asbestos Related Disease

Initial step to diagnose an occupational diseases is to determine the clinical diagnosis of asbestosis related disease. Further step is to analyze whether the asbestosis in patient is occupational disease or not. Diagnosis of occupational disease can be done by using 7-step method. This is a standardized method in Indonesia that stated by the Ministry of Health regulation Number 56 of 2016.²²

The 7-step method includes step 1 is to determine the clinical diagnosis of asbestosis related disease. This involves evaluating the patient's medical history, symptoms, and conducting a physical examination. Diagnostic tests such as chest X-rays, CT scans, pulmonary function tests, and biopsy may be performed to confirm the presence of asbestos-related diseases such as asbestosis, mesothelioma, or lung cancer.

Step 2 is to determine the existing asbestos exposure in the work environment. Identify the patient's history of occupational exposure to asbestos by gathering information about the industries they worked in and job tasks performed.

Step 3 is to determine the relationship between occupational exposure and the disease. Establish a causal link between the patient's occupational asbestos exposure and the development of the disease. This step involves considering exposure duration, latency period, and the known association between asbestos exposure and specific diseases.

Step 4 is to determine the adequacy of exposure that cause the disease. Evaluate whether the level and duration of asbestos exposure experienced by the patient were sufficient to cause the diagnosed disease. In general, significant asbestos exposure for more than 10 years is considered a significant risk factor for asbestos-related diseases. It is also important to measure exposure levels and types of asbestos fibers in work environment.

Step 5 is to determine the presence or absence of individual factors. Identify any individual factors such as smoking history and pre-existing lung conditions that may contribute to the development or severity of the asbestos-related disease.

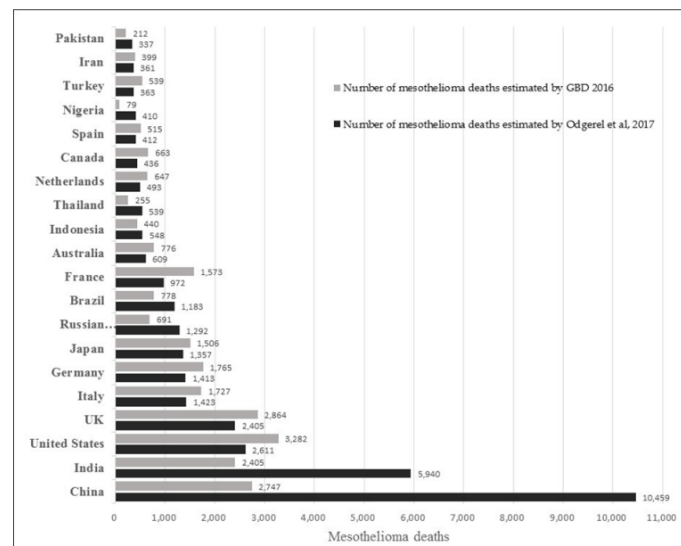
Step 6 is to determine factors outside of work that can cause the disease. Non-occupational sources of asbestos exposure is contact with asbestos-containing products in the environment, such as exposure to asbestos-containing roofing materials, brake linings, etc.

Step 7 is to define occupational or non-occupational asbestos-related diseases.²² Based on the information gathered from the previous steps, determine whether the diagnosed disease is primarily related to occupational asbestos exposure, non-occupational exposure, or a combination of both.

Current Situation in Indonesia

Various industries related to asbestos are found in Indonesia. Workers are at risk of being exposed to asbestos and experience the occupational diseases related to asbestos. The prevalence of asbestos related disease and mesothelioma is still unknown in Indonesia. Although Indonesia has not yet banned the use of asbestos, but it has documented the national situation of asbestos and asbestos-related diseases that published by the WHO and ILO. But nowadays Indonesia doesn't has updated reports regard to morbidity and mortality of mesothelioma or asbestosis.²³

The WHO predicted that Indonesia should have about 1000 cases of lung cancer and 400 cases of mesothelioma in 2017 based on the amount of asbestos handled.^{12,24} Other study estimated that Indonesia should have about 548 (range 184 to 700) mesothelioma cases per year.²⁵ Every mesothelioma case in a country should expect about 2 to 6 cases of Asbestos-Related Lung Cancer (ARLC). It means that Indonesia should expect about 1,096 to 3,288 ARLC cases.¹⁸



Picture 1. Comparison of global burden of mesothelioma deaths for leading countries in terms of mesothelioma deaths.²⁶

Currently only 6 case of non-malignant asbestos related diseases was diagnosed and approved as an occupational disease by the Indonesia government and being compensated by National Employees Social Security System or *BPJS Ketenagakerjaan*. All cases are diagnosed by the author. They came from one manufacturer company in Cibinong Indonesia which produced gland packing made from Chrysotile for 26 years. Currently this company had stopped using asbestos and substituted the chrysotile to non-asbestos material in their product.

The other case found was a patient who had worked in construction sector for more than 37 years. Construction sector is a high risk job to expose with asbestos-contained materials. The

sixty-eight years old man diagnose with lung adenocarcinoma. Thoracic computed tomography imaging showed lung nodule, pleural plaques, ground-glass opacity, and parenchymal bands. All findings is an evidence of lung disease related to asbestosis.²⁷

A first case-control study done in Indonesia compared the occupational asbestos exposure to the risk of lung cancer development and the combined effect with smoking. Subjects were patients who received a thoracic computed tomography and lung-biopsy examination. The chance of lung cancer for subjects exposed to asbestos was doubled compared with unexposed.¹²

In global before the implementation of the ICD 10, ARD and mesothelioma was rarely recognized and under reported. In Indonesia doctor rarely diagnosed ARD and mesothelioma. A consensus conducts by Ministry of Health done in 2019 mentioned that occupational ARD and mesothelioma should be diagnosed by general practitioner at first-level health care facilities.²⁸ Beside the diagnosis, the management also should be done at first-level health care facilities. Advanced level referrals will be done by occupational medicine Specialists.²² Currently only few doctors could identified and diagnosed the case. China also experiences with the same situation where two mesothelioma cases identified in large chrysotile exposed cohort study.²⁰

In Asia, only Singapore and Japan have enacted a complete asbestos ban. These two countries had comparatively low prevalences of mesothelioma and asbestosis, number of reported cases and cases that received compensation.²⁹ Significant hidden burden of ARD already exists caused by past abundant asbestos use.

Indonesia has a regulation regards to medical surveillance of workers in pre-employment, annually and pre-retirement, but medical surveillance of worker who exposed to asbestos is not standardized yet. Learning from Great Britain that has established a guidance for doctors on how to conduct medical surveillance of workers exposed to asbestos. There are two type of work activities exposed to asbestos licensed work an unlicensed work.

Licensed work refers to activities involving higher-risk asbestos-containing materials and can only be conducted by trained and licensed professionals who have undergone specific asbestos training and obtained the necessary qualifications. The licensed work require a license or permit to ensure proper handling and control of asbestos exposure. Unlicensed work involves lower-risk asbestos-containing materials and don't pose a significant risk of fiber release. Even for unlicensed work, individuals should still receive asbestos awareness training to understand the risks, proper handling, and appropriate precautions

Both licensed and unlicensed workers are required to undergo medical surveillance, which includes initial and regular medical examinations. Medical examination must be conducted no more than two years for licensed work and no more than three years for unlicensed work before initial expose to asbestos.^{8,30}

The threshold limit value for asbestos in Indonesia is 0.1 fiber/cc. The threshold limit value various from 0.1 to 5.0 fiber/cc in ten Asian nations (China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, and Vietnam).²⁹ Low limit value doesn't mean no harm for workers' health and low case of diseases.

Despite the threshold value of 0.1 fiber/cc has been established, exposure to this level of asbestos is still considered unsafe for human health. According to a research study that analyzed the probability, frequency, and intensity of asbestos exposure, this exposure level is categorized as

low to medium. Meanwhile there is no safe limit for asbestos. Preventing the worker by provide them personal protective equipment and control the exposure to asbestos in work place is not a solution. There is no threshold limit value regarding the minimal amount of asbestos exposure that is safe for humans and to be free from the risk of ARD and mesothelioma.³¹

According to the ILO, majority of deaths still occurred in western nations where the use of asbestos has either ended or been significantly decreased. It is thought that the peak of mortality has not yet been reached due to the lengthy latency period.²⁷

A study revealed that the highest consumption of asbestos occurred during the period between 1920 and 2012. Countries that have stopped utilizing asbestos will likely see a reduction in the prevalence of diseases associated to asbestos exposure. On the other hand, due to their historical and current high levels of asbestos usage, countries that have not yet ban asbestos are likely to face a significant burden of asbestos-related disease in the future.³² In Asia especially Indonesia is still continued to struggle with the identification and detection of asbestos-related disorders on a fundamental level.

Replacement materials for asbestos that are safer and more affordable should be introduced. For example, polyvinyl alcohol and cellulose fibers can be substitute materials for building like flat and corrugated fiber-cement sheets, which are used for roofs, internal walls, and ceilings. In Brazil, fiber-cement products have been produced using polypropylene and cellulose fibers rather than asbestos. Other alternatives include clay tiles and galvanized iron roofs and ductile iron pipe, high-density polyethylene pipe, and metal-wire reinforced concrete pipes are alternatives to asbestos-cement pipe.³³

Another challenges encountered in Indonesia related to the insufficient knowledge regarding asbestos hazards and the proper safety procedures for handling asbestos among workers and general community. Majority of worker has insufficient knowledge about their occupation and job description. Only few workers know about raw material and products containing asbestos that are used in their workplace. A study conduct in asbestos manufacture company in Indonesia investigated there is significant inadequate workers' knowledge about asbestos hazard and inadequate workers' behavior on handling the asbestos contain material.³⁴

CONCLUSION

The most efficient way to eliminate asbestos related diseases is to stop using all types of asbestos. There are safe and affordable viable substitute materials for asbestos that have been used in some countries which banned the use of asbestos . Indonesia needs to develop economic and technological mechanisms for replacement material of asbestos. It is urgently required awareness and cooperation from all stakeholder including government, employers, worker, union, researchers, scientist, doctor and society to eliminate asbestos in Indonesia like some developed countries.

ACKNOWLEDGEMENT

None to be declare.

AUTHORS CONTRIBUTION

Idea owner of this literature review – AD. Lestari, N. Hairunisa, AM Ridwan; writing and submitting manuscript: AD. Lestari; editing and approval of final draft: all authors.

FUNDING

No funding.

CONFLICT OF INTEREST

All authors declared no conflicts of interest.

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Occupational Asbestos Related Diseases in Indonesia: A Call for Urgent Action and Awareness

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Submission date: 03-Nov-2023 01:17PM (UTC+0700)

Submission ID: 2216064408

File name: Occupational_Asbestos-Jurnal.pdf (345.17K)

Word count: 5184

Character count: 29620

REVIEW ARTICLE

Occupational Asbestos Related Diseases in Indonesia: A Call for Urgent Action and Awareness

Penyakit Asbes Akibat Kerja di Indonesia: Himbauan untuk Segera Melakukan Tindakan dan Kesadaran

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<https://doi.org/10.56186/jbk.xx-xx>

ABSTRACT

Despite many countries have either reduced or banned asbestos use, Indonesia has yet to ban the use of asbestos. Asbestos exposure poses significant health risks, particularly respiratory diseases such as asbestos-related lung cancer, mesothelioma, and asbestosis known as an asbestos-related disease. According to the World Health Organization (WHO), asbestos is a major global health concern with millions of people exposed to its hazards and resulting in a significant number of deaths each year. We conducted a literature review study on the topic of asbestos-related diseases in Indonesia. Based on our findings, due to the large amount of asbestos being handled, it is expected that there should be hundreds to a thousand cases of asbestos-related disorders in Indonesia each year. Unfortunately it is uncommon to find and diagnose cases of asbestos-related diseases in Indonesia. The lack of awareness, inadequate diagnosis, and underreporting of asbestos-related diseases contribute to the challenges faced in Indonesia. The study emphasizes the need for a comprehensive ban on asbestos, safer alternative materials, standardized medical surveillance for exposed workers, increased awareness and cooperation among stakeholders to eliminate asbestos-related diseases in Indonesia.

Keywords: Asbestos; Asbestos Related Diseases; Indonesia

ABSTRAK

Meskipun banyak negara telah mengurangi atau melarang penggunaan asbes, Indonesia masih belum melarang penggunaannya. Paparan asbes menimbulkan risiko kesehatan yang signifikan, terutama penyakit pernapasan seperti kanker paru terkait asbes, mesotelioma, dan asbestosis yang dikenal sebagai penyakit terkait asbes. Menurut Organisasi Kesehatan Dunia (WHO), asbes merupakan masalah kesehatan utama global dimana jutaan orang terpapar setiap tahunnya dan menyebabkan jumlah kematian yang signifikan. Kami melakukan studi literatur mengenai penyakit terkait asbes di Indonesia. Berdasarkan temuan kami dengan jumlah asbes yang ditangani cukup besar, diperkirakan terdapat ratusan hingga ribuan kasus penyakit terkait asbes di Indonesia setiap tahunnya. Namun sayangnya penyakit terkait asbes sangat jarang ditemukan dan didiagnosis di Indonesia. Kurangnya kesadaran, diagnosis yang tidak memadai, dan kurangnya pelaporan penyakit terkait asbes menjadi tantangan bagi Indonesia. Studi ini menekankan perlunya pelarangan penggunaan asbes secara komprehensif, penggunaan bahan pengganti asbes yang lebih aman, pemeriksaan kesehatan standar bagi pekerja yang

36
terpapar, peningkatan kesadaran dan kerja sama di antara para pemangku kepentingan untuk mengeliminasi penyakit terkait asbes di Indonesia.

Kata Kunci: Asbes; Penyakit terkait asbes; Indonesia

INTRODUCTION

According to the Central Bureau of Statistics in 2022, Indonesia's population is around 275 million people with 144 million of total labor among them. The number of workers increase about 4.2 million people compared to the previous year in 2021.^{1,2} In doing their job, worker are exposed with various hazard in their work-place that can cause many kinds of occupational diseases and accidents.

A study³ estimated 2.78 million of deaths annually across the world had been related to work. Mortality²⁶ cause by work-related diseases is taken part about 2.4 million deaths. The three most causes of work-related mortality are circulatory diseases (31%), malignant neoplasms (26%) and respiratory diseases (17%). Asia was the highest contributor of mortality caused by work related diseases. It was about two-thirds of the global work-related mortality.³

Many cases of work-related mortality in respiratory diseases due to Chronic Obstructive Pulmonary Disease (COPD).³ It has become an important work-related problem but is often not well-recognized and underdiagnosed. COPD is caused by exposures to a multitude of vapors, gases, dusts and fumes (VGDF). COPD is also associated with specific occupational exposure agents such as asbestos, coal mine dust, silica, welding cutting gases and fumes, cement dust, diesel exhausts, spray painting, and organic solvents.³

⁵ The World Health Organization (WHO) statement on asbestos is very clear that asbestos is 1 of 10 substances of major global health concern.⁴ Approximately 125 million people worldwide are currently exposed to asbestos at work and at least 107.000 mortality per year caused by asbestos related lung cancer, mesothelioma, and asbestosis from occupational exposure. Despite occupational exposure is majority cause of mortality, there are nearly 400 deaths also been linked to non-occupational asbestos exposure.⁵ Occupational lung cancer estimated to be responsible for 17–29% of all lung cancer mortality and 55–85% of all occupational lung cancer cases is significantly cause by asbestos as carcinogenic agent.⁶

Currently Indonesia is among top five of country in the world that still using asbestos but in the other side the case of asbestos related disease (ARD), mesothelioma and asbestos related lung cancer are uncommon to be found and diagnosed in Indonesia.⁷ Other country for comparison like Great Britain as developed country that had banned the use of asbestos, the occupational mortality cause by ARD is about 4500 case peryear.⁸

⁵ The World Health Organization has recommended to prohibit the use of asbestos in any term because the deadly impact of asbestos. Currently more than 65 countries in the world have banned the use of all types of asbestos but not Include Indonesia.⁵

²⁴ The purpose of this literature review is to identify gaps between existing research and the case of asbestos-related diseases in Indonesia. This literature review is to provide a comprehensive understanding of the current situation of asbestos-related diseases in Indonesia, the regulatory

framework, diagnostic challenges, occupational exposure risks, and potential solutions in Indonesia.

METHODS

We conducted a literature review based on the relevance of this topic. All databases were searched on Google Scholar, PubMed, and ResearchGate using the following keywords: asbestos related disease and Indonesia.

RESULTS

Asbestos

Asbestos is from Greek language means inextinguishable. Asbestos is a magnesium silicate mineral group and has a tendency to break down into fibers. The widely used of asbestos started from industrial revolution and World War II. As a fibrous silicate mineral with crystalline structures, asbestos is strong, flexible, stable, long-lasting, and resistant to deterioration from heat, chemicals, and organisms. It was utilized in many different items for more than a century. Respiratory issues linked to asbestos handling were already documented in the 19th century, even though at that time asbestos still rarely mined and used.⁴

There are six types minerals of asbestos. Chrysotile or white asbestos is a variant of the serpentine form, amphibole which includes crocidolite which is a variant of riebeckite, amosite a brown color asbestos which is a variant of cummingtonite grunerite, variants of other amphibole namely anthophyllite asbestos, actinolite asbestos and tremolite asbestos. Currently the most common used types of asbestos are chrysotile, followed by amosite and crocidolite.⁹

All forms of asbestos minerals can cause non-malignant asbestosis and also proven as human carcinogen by the International Agency for Research on Cancer (IARC). Chrysotile the most common currently used is the cause of asbestos related diseases (ARD) whether non-malignant or malignant such as pleural lung cancer (mesothelioma), lung cancer, laryngeal cancer and ovarian cancer.¹⁰ After the initial exposure of asbestos, it may require between 10 to 70 years for the diseases to occur and around 20 to 50 years for malignancy.¹¹

Table 1. Overview of the reviewed sources.

Authors	Purpose	Design study	Summary
Marsili D et al (2016) ⁷	Present a review of the asbestos health impact, to illustrate the arguments in favor and against continuing asbestos use, to discuss the role of epidemiological investigations in countries where asbestos is still used.	Literature Review	Approximately 50% of world asbestos is used by two countries, China and India, followed by Brazil, Indonesia and Russia. Currently total or partial asbestos ban legislation has been adopted by 54 countries.
Odgerel C et al (2017) ⁵	Estimate global deaths cause by asbestos from the study period of 1994 to 2014, 230 countries into 59 countries grouped with quality mesothelioma mortality data suitable to be used for reference rates.	Data analysis	Indonesia should found about 548 (range 184 to 700) mesothelioma cases per year based on the amount of asbestos handled.

McCormack V et al (2012) ⁸	Estimating the asbestos-related lung cancer burden from mesothelioma mortality by estimated the ratio of asbestos-related lung cancers to mesothelioma deaths from asbestos cohorts.	Cohort	Every mesothelioma case in a country should expect about 2 to 6 cases of Asbestos-Related Lung Cancer (ARLC). Indonesia should expect about 1,096 to 3,288 ARLC cases.
Suraya et al (2020) ²⁸	A hospital-based study in Indonesia comparing occupational asbestos exposure to the risk of lung cancer development and the combined effect with smoking.	Case-Control	The study subjects with 36 cases and 360 controls. Subject were patients who received a thoracic computed tomography and histology. The chance of lung cancer for subjects exposed to asbestos was doubled compared with unexposed.

Asbestos usage in Indonesia

Currently about 90% of world asbestos comes from Russia, China, Brazil and Kazakhstan. Approximately 50% of world asbestos is used by two countries, China and India, followed by Brazil, Indonesia and Russia.⁷ Asbestos has been imported to Indonesia legally since the 1950. The usage of asbestos in Indonesia increased rapidly from 20,000 tons in the 1980s to 50,000 tons in the 1990s, and then to 150,000 tons in the 2000s.¹²

Asbestos still widely use in Indonesia until now and economic is the main reason. Asbestos is used everywhere in Indonesia. Such as asbestos manufactures, shipbuildings, constructions, oil refineries, steel plants, power plants, and automotive industries. All of these industries are known as primary exposure sources in workplaces. As secondary exposure sources in society, asbestos materials are used as roofs, ceilings, pipes, cement, brake lining, consume water and food that has been contaminated by asbestos dust. The last tertiary sources of exposure is the asbestos dust in clothes, hair, or other body parts of a family member who exposed to asbestos at work.⁵

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Occupation with high risk factors for asbestos exposure are asbestos mining and milling, construction trades (including insulators, sheet metal workers, electricians, plumbers, pipefitters, and carpenters), power plant workers, boilermakers, and shipyard workers.¹³

Indonesia Regulation of Asbestos

Until now Indonesia has not completely banned the use of asbestos for any purpose. The first regulation issued by the government regarding the safety of asbestos usage is the regulation of the Minister of Manpower Number 01 of 1980. This regulation manage the construction workers and employers that asbestos may only be used if other less hazardous materials are not available and precautions must be taken if asbestos is used.¹⁴

Indonesia indeed prohibits the use of crocidolite raw materials in the production process through the Minister of Manpower Regulation Number 03 of 1985 which regulates the occupational

health and safety in the use of asbestos. This Regulation is a special elaboration regarding the use of asbestos in the production process and the safety usage of asbestos.¹⁵

Other regulation from Ministry of Manpower Number 05 of 2018 concerning occupational health safety environment. This regulation set the threshold limit values for asbestos is 0.1 fiber/cc.¹⁶ Currently only the Ministry of Manpower has issued quite a number of regulations regarding the use of asbestos in the industry. There is no regulation higher than the ministry level that prohibit the use of asbestos in any form.

The newest regulation is Presidential Decree Number 7 of 2019 concerning occupational disease. Asbestosis is mentioned twice as occupational disease in part of respiratory diseases and malignancy. This regulation is a revision of the 1993 Presidential Decree which was declared asbestosis as an occupational disease.¹⁷

Diagnosis of Asbestos Related Disease

Asbestos can cause non-malignant or malignant asbestos-related diseases. Non-malignant asbestos-related diseases include asbestosis, pleural thickening, asbestos-related pleural plaques or fibrosis and nonmalignant pleural effusion. The first suspected asbestos-related lung cancer cases were diagnosed in 1930 from the autopsies performed in two female who worked in asbestos textile industry. Both of them had asbestosis and lung cancer.¹²

According to a study which examined data from 55 asbestos cohort study around the world, asbestos fiber was the majority cause for two times prevalence of lung cancer and mesothelioma. A low mesothelioma burden for chrysotile, should not be taken as a low overall cancer burden.¹⁸

When asbestos mineral bond is disturbed, damaged, or destroyed, the microscopic asbestos fibers will be released into the air. These asbestos fibers that are inhaled into the lower airway will induce inflammation in both the pleura and alveoli causing significant and irreversible health effects. As the disease progresses, it can cause extensive and persistent pulmonary parenchymal fibrosis.¹⁹

Despite there are a lot of regulation regard to threshold limit value of asbestos, but it can be ascertained that there is no real-safe exposure level limit. A study of 590 of pulmonary asbestos fiber analysis found that the median asbestos concentration within dry lung tissue was 3.20 million fibers/gram (range: 0-1700 million fibers/gram). It also found that crocidolite and anthophyllite were the most asbestos fiber types detected. Total asbestos fiber concentration was associated with increased mortality and there is no difference between mortality and different fiber types.¹⁹ Study in China proof that mesothelioma patients were more likely to decease as a result of chrysotile exposure.²⁰

The diagnostic criteria for non-malignant asbestosis from the American Thoracic Society and the Helsinki Criteria can be perform in daily practice. Non-malignant asbestos-related disease refers to the following conditions: asbestosis, pleural thickening or asbestos-related pleural fibrosis (plaques or diffuse fibrosis), benign pleural effusion, and airflow obstruction.^{13,21}

It is understood that the symptoms maybe vague and may not be sufficiently advanced to be apparent on histology, imaging, or functional studies, but one of the most important criteria is having a history of asbestos exposure at least 10 years from the initial exposure.¹³ The main complaint that is often found in patients with asbestosis is shortness of breath when doing

activities. Patients may also experience complaints of prolonged cough with sputum and blood, chest pain and weight loss. On physical examination, rales and inspiratory crackles can be found in both lung basal areas with or without clubbing fingers and cyanosis. Changes in lung function to be restrictive or obstructive with spirometry as one of the most commonly used to measure lung function.^{13,21}

Other early diagnosis is performing the chest imaging with International Classification of Radiographs of Pneumoconiosis International Labour Organization (ILO) classification. However, an High-resolution Computed Tomography (HRCT) scan is performed if there are findings of borderline lung fibrosis (ILO 0/1-1/0) or discrepancies between the results of restricted lung function tests and normal radiological interpretations or extensive pleural abnormalities.²¹

Occupational Asbestos Related Disease

Initial step to diagnose an occupational diseases is to determine the clinical diagnosis of asbestosis related disease. Further step is to analyze whether the asbestosis in patient is occupational disease or not. Diagnosis of occupational disease can be done by using 7-step method. This is a standardized method in Indonesia that stated by the Ministry of Health regulation Number 56 of 2016.²²

The 7-step method includes step 1 is to determine the clinical diagnosis of asbestosis related disease. This involves evaluating the patient's medical history, symptoms, and conducting a physical examination. Diagnostic tests such as chest X-rays, CT scans, pulmonary function tests, and biopsy may be performed to confirm the presence of asbestos-related diseases such as asbestosis, mesothelioma, or lung cancer.

Step 2 is to determine the existing asbestos exposure in the work environment. Identify the patient's history of occupational exposure to asbestos by gathering information about the industries they worked in and job tasks performed.

Step 3 is to determine the relationship between occupational exposure and the disease. Establish a causal link between the patient's occupational asbestos exposure and the development of the disease. This step involves considering exposure duration, latency period, and the known association between asbestos exposure and specific diseases.

Step 4 is to determine the adequacy of exposure that cause the disease. Evaluate whether the level and duration of asbestos exposure experienced by the patient were sufficient to cause the diagnosed disease. In general, significant asbestos exposure for more than 10 years is considered a significant risk factor for asbestos-related diseases. It is also important to measure exposure levels and types of asbestos fibers in work environment.

Step 5 is to determine the presence or absence of individual factors. Identify any individual factors such as smoking history and pre-existing lung conditions that may contribute to the development or severity of the asbestos-related disease.

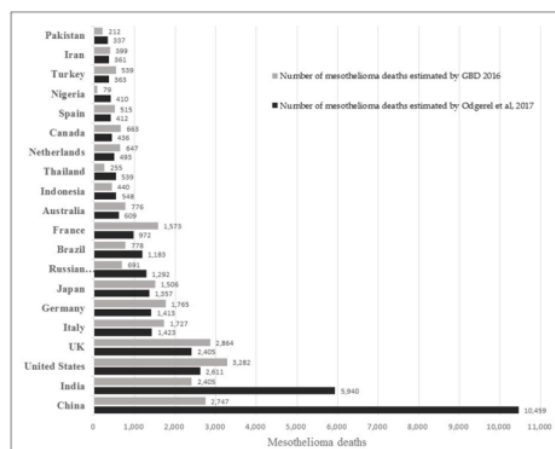
Step 6 is to determine factors outside of work that can cause the disease. Non-occupational sources of asbestos exposure is contact with asbestos-containing products in the environment, such as exposure to asbestos-containing roofing materials, brake linings, etc.

Step 7 is to define occupational or non-occupational asbestos-related diseases.²² Based on the information gathered from the previous steps, determine whether the diagnosed disease is primarily related to occupational asbestos exposure, non-occupational exposure, or a combination of both.

Current Situation in Indonesia

Various industries related to asbestos are found in Indonesia. Workers are at risk of being exposed to asbestos and experience the occupational diseases related to asbestos. The prevalence of asbestos related disease and mesothelioma is still unknown in Indonesia. Although Indonesia has not yet banned the use of asbestos, but it has documented the national situation of asbestos and asbestos-related diseases that published by the WHO and ILO. But nowadays Indonesia doesn't has updated reports regard to morbidity and mortality of mesothelioma or asbestosis.²³

The WHO predicted that Indonesia should have about 1000 cases of lung cancer and 400 cases of mesothelioma in 2017 based on the amount of asbestos handled.^{12,24} Other study estimated that Indonesia should have about 548 (range 184 to 700) mesothelioma cases per year.²⁵ Every mesothelioma case in a country should expect about 2 to 6 cases of Asbestos-Related Lung Cancer (ARLC). It means that Indonesia should expect about 1,096 to 3,288 ARLC cases.¹⁸



Picture 1. Comparison of global burden of mesothelioma deaths for leading countries in terms of mesothelioma deaths.²⁶

Currently only 6 case of non-malignant asbestos related diseases was diagnosed and approved as an occupational disease by the Indonesia government and being compensated by National Employees Social Security System or BPJS Ketenagakerjaan. All cases are diagnosed by the author. They came from one manufacturer company in Cibinong Indonesia which produced gland packing made from Chrysotile for 26 years. Currently this company had stopped using asbestos and substituted the chrysotile to non-asbestos material in their product.

The other case found was a patient who had worked in construction sector for more than 37 years. Construction sector is a high risk job to expose with asbestos-contained materials. The

sixty-eight years old man diagnose with lung adenocarcinoma. Thoracic⁷ computed tomography imaging showed lung nodule, pleural plaques, ground-glass opacity, and parenchymal bands. All findings is an evidence of lung disease related to asbestosis.²⁷

A¹ first case-control study done in Indonesia compared the occupational asbestos exposure²³ to the risk of lung cancer development and the combined effect with smoking. Subjects were patients who received a thoracic computed tomography and lung-biopsy examination. The chance of lung cancer for subjects exposed to asbestos was doubled compared with unexposed.¹²

In global before the implementation of the ICD 10, ARD and mesothelioma was rarely recognized and under reported. In Indonesia doctor rarely diagnosed ARD and mesothelioma. A consensus conducts by Ministry of Health done in 2019 mentioned that occupational ARD and mesothelioma should be diagnosed by general practitioner at first-level health care facilities.²⁸ Beside the diagnosis, the management also should be done at first-level health care facilities. Advanced level referrals will be done by occupational medicine Specialists.²² Currently only few doctors could identified and diagnosed the case. China also experiences with the same situation where two mesothelioma cases identified in large chrysotile exposed cohort study.²⁰

³⁴ In Asia, only Singapore and Japan have enacted a complete asbestos ban. These two countries had comparatively low prevalences of mesothelioma and asbestosis, number of reported cases and cases that received compensation.²⁹ Significant hidden burden of ARD already exists caused by past abundant asbestos use.

Indonesia has a regulation regards to medical surveillance of workers in pre-employment, annually and pre-retirement, but medical surveillance of worker who exposed to asbestos is not³⁰ standardized yet. Learning from Great Britain that has established a guidance for doctors on how to conduct medical surveillance of workers exposed to asbestos. There are two type of work activities exposed to asbestos licensed work an unlicensed work.

Licensed work refers to activities involving higher-risk asbestos-containing materials and can only be conducted by trained and licensed professionals who have undergone specific asbestos training and obtained the necessary qualifications. The licensed work require a license or permit to ensure proper handling and control of asbestos exposure. Unlicensed work involves lower-risk asbestos-containing materials and don't pose a significant risk of fiber release. Even for unlicensed work, individuals should still receive asbestos awareness training to understand the risks, proper handling, and appropriate precautions

Both licensed and unlicensed workers are required to undergo medical surveillance, which includes⁴⁵ initial and regular medical examinations. Medical examination must be conducted no more than two years for licensed work and no more than three years for unlicensed work before initial expose to asbestos.^{8,30}

The threshold limit value for⁴ asbestos in Indonesia is 0.1 fiber/cc. The threshold limit value various from 0.1 to 5.0 fiber/cc in ten Asian nations (China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, and Vietnam).²⁹ Low limit value doesn't mean no harm for workers' health and low case of diseases.

Despite the threshold value of 0.1 fiber/cc has been established, exposure to this level of⁴⁶ asbestos is still considered unsafe for human health. According to a research study that analyzed the probability, frequency, and intensity of asbestos exposure, this exposure level is categorized as

low to medium. Meanwhile there is no safe limit for asbestos. Preventing the worker by provide them personal protective equipment and control the exposure to asbestos in work place is not a solution. There is no threshold limit value regarding the minimal amount of asbestos exposure that is safe for humans and to be free from the risk of ARD and mesothelioma.³¹

According to the ILO, majority of deaths still occurred in western nations where the use of asbestos has either ended or been significantly decreased. It is thought that the peak of mortality has not yet been reached due to the lengthy latency period.²⁷

A study revealed that the highest consumption of asbestos occurred during the period between 1920 and 2012. Countries that have stopped utilizing asbestos will likely see a reduction in the prevalence of diseases associated to asbestos exposure. On the other hand, due to their historical and current high levels of asbestos usage, countries that have not yet ban asbestos are likely to face a significant burden of asbestos-related disease in the future.³² In Asia especially Indonesia is still continued to struggle with the identification and detection of asbestos-related disorders on a fundamental level.

Replacement materials for asbestos that are safer and more affordable should be introduced. For example, polyvinyl alcohol and cellulose fibers can be substitute materials for building like flat and corrugated fiber-cement sheets, which are used for roofs, internal walls, and ceilings. In Brazil, fiber-cement products have been produced using polypropylene and cellulose fibers rather than asbestos. Other alternatives include clay tiles and galvanized iron roofs and ductile iron pipe, high-density polyethylene pipe, and metal-wire reinforced concrete pipes are alternatives to asbestos-cement pipe.³³

Another challenges encountered in Indonesia related to the insufficient knowledge regarding asbestos hazards and the proper safety procedures for handling asbestos among workers and general community. Majority of worker has insufficient knowledge about their occupation and job description. Only few workers know about raw material and products containing asbestos that are used in their workplace. A study conduct in asbestos manufacture company in Indonesia investigated there is significant inadequate workers' knowledge about asbestos hazard and inadequate workers' behavior on handling the asbestos contain material.³⁴

CONCLUSION

The most efficient way to eliminate asbestos related diseases is to stop using all types of asbestos. There are safe and affordable viable substitute materials for asbestos that have been used in some countries which banned the use of asbestos. Indonesia needs to develop economic and technological mechanisms for replacement material of asbestos. It is urgently required awareness and cooperation from all stakeholder including government, employers, worker, union, researchers, scientist, doctor and society to eliminate asbestos in Indonesia like some developed countries.

ACKNOWLEDGEMENT

None to be declare.

AUTHORS CONTRIBUTION

Idea owner of this literature review – AD. Lestari, N. Hairunisa, AM Ridwan; writing and submitting manuscript: AD. Lestari; editing and approval of final draft: all authors.

FUNDING

No ²⁹ funding.

CONFLICT OF INTEREST

All authors declared no conflicts of interest.

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PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11