Current and future risks of asbestos exposure in the Australian community

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Background: Australia mined asbestos for more than 100 years and manufactured and imported asbestos products. There is a legacy of *in situ* asbestos throughout the built environment.
Methods: The aim of this study was to identify the possible sources of current and future asbestos exposure from the built environment. Telephone interviews with environmental health officers, asbestos removalists, and asbestos assessors in Australia sought information about common asbestos scenarios encountered.
Results: There is a considerable amount of asbestos remaining *in situ* in the Australian built environment. Potential current and future sources of asbestos exposure to the public are from asbestos-containing roofs and fences, unsafe asbestos removal practices, do-it-yourself home renovations and illegal dumping.
Conclusion: This research has highlighted a need for consistent approaches in the regulation and enforcement of safe practices for the management and removal of asbestos to ensure that *in situ* asbestos in the built environment is managed appropriately.

Keywords: Asbestos, Asbestos exposure, Built environment, Future exposure, Australia

Introduction

Asbestos use worldwide peaked in the 1970s, with approximately 25 countries mining it and 85 manufacturing asbestos products.[1] Common usage was for building products e.g. asbestos cement sheeting and corrugated roofing, insulation, gaskets, brake linings, electrical millboard, and incorporation into paints, plastics and asphalt. Its wide range of uses resulted from its durability and resistance to heat, cold, corrosion, alkalis, and acids and for its insulating properties. In total, asbestos was used commercially in more than 3000 products.[2]

Worldwide, an estimated 180,922,485 tons of asbestos were consumed between 1900 and 2003.[3] Between 1900 and 2003, Italy, Greece, Kazakhstan, and Russia consumed 75,115,490 tons while the United States used 3,288,343 tons, mainly for cement, flooring, and roofing. Other big consumers included Canada (61,165,286 tons), South Africa (9,939,807 tons), Zimbabwe (9,152,235 tons), China (8,659,684 tons), and Brazil (5,186,162 tons).[3]

Australia was a large producer and consumer of all types of asbestos. Between 1880 and 1985, Australia's consumption of mostly chrysotile asbestos was estimated to be 1,888,036 tons.[4] Australia mined crocidolite (blue asbestos) and chrysotile (white asbestos) for more than 100 years, manufactured its own asbestos products and imported raw chrysotile and amosite (brown asbestos) and manufactured products.[4] During the 1950s, Australia was the highest country consumer of asbestos per capita and every capital city had an asbestos cement manufacturing plant.[5] Over 60% of production and 90% of all asbestos consumption was through the asbestos cement manufacturing industry.[4] Until the 1960s, 25% of Australian houses were clad in asbestos cement.[6] In 1984, most states and territories in Australia introduced a ban on the mining of raw asbestos and the manufacture, importation, and installation of products containing crocidolite and amosite. Chrysotile in building products was banned in 1987 in most Australian states and territories.[4] The use, reuse, and selling of any type of asbestos were banned in Australia in 2003, but today the country is left with the legacy of past consumption. Many of the asbestos products installed in earlier decades remain *in situ* today, primarily in the form of asbestos "fibro" houses, water and sewage pipes, roofing of residential and industrial premises, and fencing.[6]

Exposure to asbestos is associated with a range of benign and malignant diseases including pleural plaques and thickening, asbestosis, malignant mesothelioma, and cancers of the lung, larynx and ovary. It may also cause cancers of the pharynx, colon and rectum and stomach but evidence is limited.[7] It may also cause autoimmune diseases e.g. scleroderma and lupus.[8] Given the legacy of past asbestos use, the concern for many countries is how to prevent current and future asbestos exposure to the community from the remaining *in situ* asbestos.

This *in situ* asbestos may be either friable or non-friable. Friable asbestos has been defined as loose asbestos, which can be easily crumbled into a fine dust. As the products are loosely held together, the asbestos fibers are easily

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released into the air. Non-friable (also known as bonded) asbestos contains asbestos with a bonding compound (such as cement) and includes products such as asbestos cement sheeting.[9] These products are solid and rigid, and cannot be easily crumbled. However, deterioration and damage to these products can result in the release of fibers.[10]

In Australia, asbestos removalists (people within Australia with a licence to remove asbestos) and assessors must be licensed to work and are regulated by State and Territory Governments. Although there is some variation in regulations between states and territories, generally asbestos licences are allocated to two different types of removalists – Class A and B. Class A licences permit the holder to remove all asbestos products, including friable asbestos. Class B only permits the removal of non-friable asbestos products such as asbestos cement sheeting. Class A licences are generally held by workers whose main occupation is asbestos removal while Class B licences may be held by builders or demolition workers who do the occasional small asbestos removal during a renovation or demolition.[11] The role of the asbestos assessor is to identify asbestos products, assess potential risks and provide recommendations for the safe management of asbestos. Licences are issued and a register is maintained by each State and Territory Government department responsible for workplace health and safety.

Environmental health officers (EHOs) in Australia assess health risks and regulate, enforce and manage regulations and laws governing public health. This includes both the natural and built environment. EHOs usually work within local governments or regions. Regarding asbestos, EHOs are usually the first point of contact for community members who are concerned. Although the roles and responsibilities of EHOs differ across the states and territories, generally EHOs are required to sample for asbestos, to conduct investigations into inappropriate asbestos management and removal procedures, to remove illegally dumped asbestos, and to provide professional advice to community members.[12]

This paper examines the literature on existing sources of asbestos in the Australian community in combination with interviews with EHOs and asbestos removalists and assessors to learn about current sources of exposure and practice, and to identify where future asbestos exposure in the built environment may occur.

Methods

Literature review

A literature review was conducted to identify where future asbestos exposure may occur from *in situ* asbestos including both friable and non-friable asbestos containing material (ACM).

The literature review was conducted through electronic databases, including Google Scholar, ProQuest, Science Direct, Informit and the Curtin University library catalogue. A combination of search terms were used, including "asbestos," "crocidolite," "amosite," "chrysotile," "risk," "exposure," "Australia," "sources," "friable," "materials," "contamination," "asbestos cement," "renovation," "do-it-yourself," "fire," "weathering," "corrosion," "fiber-release," "soil," "soil contamination," "dumping," "illegal dumping," "products," "asbestos public schools," "management," and "effects." The literature review was conducted between March and June 2015. Do-it-yourself refers to home renovations undertaken by homeowners.

Interviews

Telephone interviews were conducted with asbestos removalists and assessors and EHOs, located across rural and urban Australia. This included the states of New South Wales, Tasmania, Victoria, Queensland, Western Australia and South Australia, and the territories Northern Territory and Australian Capital Territory.

Findings from the literature review informed the topic guide and questions asked in the interviews. Participants were recruited through email and/or telephone contact, during which they were informed of the purpose of the study. Interviews were either conducted at that point in time, or a date was set at an alternative time that suited the participant. All interviews were recorded digitally with verbal permission. In total, 49 telephone interviews were conducted between May and July 2015. Recruitment and telephone interviews occurred concurrently and continued until topic saturation was achieved.

Asbestos removalists and assessors

Asbestos removalists were identified through each state and territory list of registered licence holders, available online, along with electronic telephone listings of businesses (Yellow Pages). Interviewees were selected through purposive sampling. A total of 25 asbestos removalists were interviewed, Class A (n = 19) and Class B (n = 6). To get another view point, asbestos assessors (n = 3) were additionally contacted through the same methods.

At the start of each interview, the state and business name of the asbestos removalist and/or assessor were recorded, their licence type (Class A, B or assessor) and the number of years they had worked in their profession. Removalists and assessors were asked about their general impression of *in situ* asbestos in their community, including types and amounts of asbestos products seen and its general condition and the frequency of seeing products that have been damaged by fire, storm, or cyclones. Questions on current practice included frequency and amount of asbestos removed; types of products removed; frequency and location of contaminated soil and illegal dumping; and observed trends in asbestos removal (see Supplementary Material). Questions on future exposure risks asked what asbestos products are not being removed; where future exposure is likely to occur; is dumping likely to increase;

is soil contamination, fires or weathering a future problem; and is asbestos removal likely to be a large part of your future work.

Environmental health officers

EHOs were identified by emailing and/or telephoning State Population Health Units, and rural and urban local government offices. Contacts were referred to us through Environmental Health, Australia and from other EHOs or local government officers. A total of 18 EHOs were interviewed. To obtain well-rounded information, a similar number of urban (n = 8) and rural (n = 10) EHOs were contacted. For further opinions, an interview with a member of the Australian Capital Territory Asbestos Response Taskforce and an additional two interviews with a Remote Program Officer and a Regional Waste Management Coordinator in the Northern Territory were also held.

EHOs were asked to provide their name, local council, and the number of years worked as an EHO. They were also asked about their confidence in identifying asbestos products. EHOs were asked similar questions to removalists and assessors on general impressions and future risks of asbestos exposure.

Results

In situ *asbestos in the built environment*

Interviews with removalists and EHOs, and results from the literature review found that most *in situ* asbestos remaining in the built environment in Australia is non-friable. Common non-friable asbestos products were asbestos cement sheeting used for internal walls or external cladding, fencing, roofing, and vinyl floor tiles in residential, public, and industrial properties.

Removalists servicing commercial and government buildings removed larger amounts of ACM than those servicing residential properties. One removalist reported removing upwards of 16,000 m^2 of asbestos flooring from a government building in Brisbane (Class B, Queensland). Domestic houses on average usually contained around 1 m^2 to around 100 m^2 of asbestos product, however roofs could be upward of four tons (Class A, South Australia).

Friable asbestos, although less common, was found behind stoves, as electrical millboard and as insulation around pipes in residential properties. Additionally, three removalists reported seeing friable asbestos insulation in commercial buildings.

"In commercial buildings it's mainly friable material … in insulation, that type of thing," (Class A, New South Wales).

Asbestos products in poor condition where release of fiber may be likely were seen by all removalists. Five removalists saw it monthly, ten removalists saw it weekly and six saw asbestos likely to release fibers daily. Among the EHOs, eight saw it monthly and three weekly. Asbestos in poor condition was mostly caused by the product deteriorating due to age, weathering, or accidental damage. Nine removalists commented that most of the products in poor condition were likely to be in commercial or industrial buildings.

One removalist and an assessor reported seeing loose fibers on the machinery and workers working below a badly maintained ceiling.

"We've found loose fibers on stock and inside warehouses that don't have an encapsulated ceiling," (Assessor, Australian Capital Territory).

One assessor spoke of the high amounts of friable asbestos in industrial buildings.

"At least 50% of properties we look at would have a friable asbestos situation," (Assessor, Australian Capital Territory).

Government buildings

The Australian Government owns a number of buildings including offices, housing, schools, and hospitals. Recent audits of several states' government public buildings showed that *in situ* asbestos were found in several department buildings. For example, the Western Australian Department of Corrective Services undertook asbestos surveys in all 18 sites in 2006. In this, 28,985 square metres, 458 linear metres, and 329 specific asbestos containing items were identified. Other items could not be quantified (e.g. buried water pipes).[13] In South Australia, a report on asbestos in government-owned buildings conducted in 2014 showed that 1% of asbestos needed urgent removal and 6% required removal as soon as practicable.[14]

Five removalists and EHOs said that schools and prisons containing ACM were sources of particular concern for current and future asbestos exposure, because of the age of the building and the high risk of damage to the asbestos from human activity. Four removalists had observed friable asbestos, used as insulation, in a range of different Government buildings.

One removalist spoke of asbestos insulating boards (AIBs) in poor condition in schools.

"It's really concerning … Obviously, the kids are underneath and it's releasing fibers right above them," (Class A, Queensland).

Eight EHOs and removalists commented that social housing often contained significant amounts of asbestos.

Asbestos products not being removed

Some asbestos products remain inaccessible until the structure is demolished and are therefore not feasible to remove. In some cases, removalists reported that homeowners did not want asbestos removed due to the high cost. Roofing was frequently seen as being too large and costly to be replaced, and therefore left *in situ*.

"[You] can't just remove it, [you] need to replace it. A roofing removal may be in excess of $50,000." (Class A, Northern Territory).

One removalist stated that the safety risks involved in the removal of roofing were too great and therefore asbestos containing roofing was being left *in situ*.

"It's extremely dangerous … We try to avoid getting involved," (Class A, Victoria).

Weathering

Corrosion of asbestos products through weathering (rain, sun, wind and/or frost, causing an alteration to the asbestos material over time) can cause a release of fibers within 15 years. Extreme weather conditions increase erosion effects.[15] Roofing materials are most susceptible, however all external building materials may be susceptible to weathering.[15–17]

Removalists disagreed about the risk for future exposure from weathering ACMs. Six removalists did not consider weathering to be a risk for asbestos exposure, stating that they thought the product was durable and would not weather, or that the amount exposed would be small and therefore not pose a health risk.

"I think asbestos is robust enough … When it's left alone and it's intact it's not really an issue," (EHO, Victoria).

Removalists who worked in areas close to the ocean were more concerned with weathering, due to salt and ocean breezes being thought to corrode asbestos products. Twenty removalists and EHOs commented on the number of asbestos roofs on domestic and commercial buildings in their area that had already begun to weather and become friable. External walls, eaves, and fencing had also been affected by weathering.

"Once the wind starts wearing down the outer layers of the fibro [asbestos cement sheeting], well there's definitely going to be asbestos dust blowing everywhere," (Class A, Queensland).

Removalists and EHOs from storm and cyclone prone areas of the country were concerned about the risk of exposure to asbestos during clean ups after such events. In many cases, small pieces of asbestos were spread across large areas. The public was often left to clean this up, and had been observed cutting or breaking ACM into smaller pieces to fit in trailers or bins for removal.

"People are cutting it to make it smaller for disposal. That's where the risk is," (EHO, Queensland).

Fire damage

EHOs and removalists disagreed about the risk of exposure and fiber release presented by fire-damaged ACMs. Two participants stated that asbestos was fire resistant, so could not be damaged; two stated that fire-damaged asbestos changed its chemical property and did not present a health risk; two commented that there would not be anyone around during a fire to breathe in the fibers; while 13 participants considered asbestos products to be friable after being burnt. These contrasting views were also found in Australian literature.[18,19] Safe Work Australia considers that fire-damaged asbestos has the potential to be friable and has the potential to pose a high risk of exposure, and should be assessed to determine if it has become friable.[20] Fire damage is not believed to change the chemical properties of asbestos.

Five participants commented on the risk to the public and firefighters during or after a fire. Three participants reported seeing firefighters, volunteers and the general public walking through damaged homes after the fire without proper protection, and prior to decontamination.

"Fire department and other people walking around the site after the fires been put out … with no dust mask, just sorting through the rubble," (Assessor, Tasmania).

An EHO commented on the lack of risk assessments conducted in warehouses that housed flammable chemicals and that also contained or were built from asbestos products. In general, EHOs were not involved in single house fire clean ups.

Illegal dumping

According to the Department of Environment and Climate Change New South Wales, construction and demolition businesses and homeowners dump asbestos because they are unwilling to pay higher landfill fees for proper disposal. Homeowners may also illegally dump due to a lack of knowledge on the health hazard of asbestos, or the strict legislative requirements relating to the way in which asbestos must be stored, transported, and disposed of.[21]

Both removalists and EHOs reported seeing illegally dumped asbestos. A majority saw small amounts, presumably coming from do-it-yourself home renovators, with amounts that ranged from being small enough to fit inside a domestic bin to a trailer load. Larger amounts of illegally dumped asbestos had also been found, with one removalist removing up to 15 tons from an illegal dump. Additionally, one removalist reported an entire asbestos-containing roof being illegally dumped, which resulted in a large and costly site decontamination, including soil remediation. Five interviewees suggested that large amounts of ACM are likely to have been dumped improperly by asbestos removalists to avoid paying disposal fees.

The main reasons suggested for the high frequency of illegal dumping of asbestos products throughout Australia was the high cost associated with the removal and legal disposal of asbestos and the small number of licenced waste disposal sites. Additionally, it was reported by participants that there is only one waste site in South Australia that accepts friable asbestos, and only two waste sites that accept any form of ACM in the Northern Territory, making legal disposal difficult.

"Some people have to drive up to 200 kms to actually dispose of it legally," (Class A, Victoria).

All participants, except one, thought that illegal dumping would increase in the future, due to increasing trends in home renovation and anticipated increases in the cost of removal and disposal.

Soil contamination

Contamination of soil with asbestos-containing material occurs for many reasons, including illegal burial, incorrect demolition or removal procedures, fire damage, storm damage or contamination from former asbestos waste sites.

On average, soil contamination was seen by removalists a few times a year, however some removalists reported seeing it at every removal job. The latter group was more likely to be Class A removalists whose main business is to remove asbestos. Removalists reported that soil contamination was often seen in residential areas where land was being redeveloped. There was discrepancy between interviewees on whether soil contamination would be a future issue, with some believing most contamination had been located and cleaned up, while others thought the work had just begun, and continued redevelopment would see further sites uncovered. In general, most EHOs and removalists believed soil contamination would be a future issue, with current illegal dumping contributing to future work.

"In the next 30 years … we'll have to go digging up that rubbish … They are under existing buildings, and we are only just starting to demolish and to discover the legacy of what's been buried … That's going to be huge," (Class A, Victoria).

Do-it-yourself renovation and asbestos removal

Do-it-yourself home renovations include work undertaken by homeowners themselves, rather than paid professionals (e.g. demolition of walls, painting, plumbing). During renovation or demolition, ACMs can be disturbed and damaged, with the potential to release fibers.[22] Do-it-yourself home renovations are common among Australian homeowners. A mailed questionnaire conducted in NSW in 2008 reported that 24% of homeowners who responded were do-it-yourself renovators.[23] Of those who identified as being a do-it-yourself renovator, 61% self-reported being exposed to asbestos.[23] Removalists and EHOs were concerned that home renovation programs on television inspiring homeowners to undertake their own do-it-yourself renovations were not reporting on asbestos risks adequately.

"How about show some of the asbestos you're going to damage when you put that new fence in?" (Class A, Western Australia).

An EHO commented that workplaces were heavily regulated, while governments did not interfere much with residential asbestos and that homeowners were legally allowed in several states and territories to remove and dispose of their own asbestos.

Other concerns raised in the interviews

Eight Class A removalists reported concern with the quality of work being undertaken by Class B removalists. In particular, they felt that future cases of asbestos-related diseases were likely to emerge among people being exposed to asbestos during or after poor quality asbestos removal and remediation. Two removalists reported redoing work done by a Class B licenced worker.

"We do a lot of remediation work on places that have already [had someone] come through and they've done a poor job." (Class A, Queensland).

One removalist reported Class B removalists bidding for and winning jobs that involved the removal of friable asbestos, for which a Class B licence holder is not licensed.

"B Class doing A Class work … There's a B Class company who won an A class removalist job. That's some dodgy practice," (Class A, Tasmania).

Poor, or limited, training was thought to be the cause of incorrect procedure and practice.

Additionally, several removalists suggested that increases in inspections, and more enforcement of regulations, would assist in improving the safety of work undertaken.

"I've been doing this job for ten years, and I've never had a work site inspector at any of my sites. I've never even seen one … They haven't got the manpower to police it," (Class A, Western Australia).

Indigenous communities and land

Indigenous communities, in particular communities in Western Australia, New South Wales, and Northern Territory were identified in the literature review and interviews as having a large amount of *in situ* asbestos, mostly in poor condition, though the exact amount is unknown. These communities are located in areas subjected to extreme weather conditions, including flooding, cyclones, and bushfires, with the potential to further damage or deteriorate the *in situ* asbestos.

"That's my fear, is that we go do good work [removing asbestos] in communities and it [the asbestos] could be deemed in 'good' condition and then a cyclone comes through and just rips it apart and it's now more dangerous … It's a long-term problem," (Remote Program Officer, Northern Territory).

Asbestos maintenance and removal in Indigenous communities is frequently delayed due to confusion over what entity (local, state or federal) is responsible for it.[24]

Future work

Most removalists felt there was still considerable amounts of asbestos product to be removed, and that they would have secure employment for the next 10 years. Two removalists considered that most ACMs would be removed within 20 years, but the majority thought that *in situ* asbestos would be an ongoing issue in Australia.

"Asbestos infrastructure remediation is in its infancy in Australia. Our grandchildren will inherit this business." (Class A, Queensland).

"We haven't scratched the surface of asbestos yet." (Class A, Western Australia).

Removalists commented on the small amount of work that has been currently undertaken.

"We knock out buildings from around the 50s and 60s here … So the 80s, it's about another 25 years until we start knocking those ones down. There's going to be enough work to keep us busy for our lifetimes," (Class B, South Australia).

Discussion

Knowledge of the risks of asbestos exposure to human health has been well understood for decades.[2,7,25] Yet this literature review and interviews with removalists and EHOs have shown that considerable amounts of ACM remain in the Australian-built environment. Most remaining asbestos products are non-friable with similar amounts spread across residential, industrial, and public premises. Remaining friable asbestos was mostly reported in industrial or commercial buildings in the form of asbestos insulation. Asbestos in large amounts remained in government buildings, including schools, hospitals, and prisons. The majority of removalists interviewed considered that the quantities of residual asbestos ensure that there will be decades of removal work in the future.

Although there was a general consensus among interviewees that most of Australia's remaining *in situ* asbestos was presently in a reasonably stable condition, asbestos in poor condition where release of fiber was likely was seen fairly frequently. Most removalists saw asbestos in poor condition weekly and most EHOs saw it on a monthly basis. *In situ* asbestos in poor condition was reported as having either deteriorated due to weathering (external ACMs) or due to age (internal ACMs) or had been damaged from fire, a weather event such as a cyclone or a storm or through homeowners undertaking do-it-yourself renovations. These products will continue to age and weather over time, increasing their risk of becoming friable and releasing fibers. Both illegally dumped asbestos and contaminated soil could continue to pose a future exposure risk, although the risk for exposure from contaminated soil is considered to be low.[26]

We found that Indigenous communities and lands, particularly those located in remote areas subject to extreme weather events, had considerable amounts of *in situ* asbestos that was in poor condition and subjected to weathering. In addition, there is confusion over what entity (local, state or federal) is responsible for the maintenance and upkeep of these buildings, resulting in poor maintenance and subsequent exposure risk to the community.

In our study, the management of fire-damaged asbestos was criticized by many participants. In particular, participants stated that asbestos contamination was not consistently recognized, and that fire-damaged structures were frequently handled by the public, volunteers, and firefighters without any asbestos decontamination occurring. This was often due to asbestos contamination from fire-damaged buildings being the responsibility of the house owner. Firefighters have an increased risk of mesothelioma, likely due to asbestos exposure from burning buildings, or during cleanup.[27,28] Bushfire intensity and frequency are anticipated to increase in Australia because of changing climatic conditions.[29] Regulation and their proper enforcement must ensure that exposure to asbestos does not occur during bushfires and their subsequent cleanup.

Our interviews highlighted a concern among participants that incorrect or incomplete removals and assessments were being undertaken, posing an exposure risk to those working or living in the premise where the work was undertaken, as well as to the removalist undertaking the work. A national campaign conducted by the Heads of Workplace Safety Authorities in Australia in 2006 targeting 15 issues in the construction industry, such as signage, traffic control, and dust control found that asbestos removal had the lowest rate of compliance. Of the 292 sites inspected during asbestos removal, only 214 (73.3%) were compliant in following the requirements set out by the Australian Standards.[30] Similarly, SafeWork South Australia and the South Australian Environmental Protection Authority audited 71 licenced asbestos removalists between 2012 and 2014. Three hundred ten Statutory Notices, 416 compliance plans and 4 prohibition notices were issued. Compliance problems occurred in the areas of: safe storage and transport of waste, asbestos removal control plan compliance, respirator fit-testing, respirator use, maintenance of asbestos vacuum cleaners, procedures of asbestos vacuum cleaner, and health monitoring program. It was concluded that further work was needed to ensure that licensees use appropriate procedures to minimise the release of asbestos fibers.[31]

The association between asbestos-related disease and non-occupational exposure has been clearly demonstrated.[7,22,32–38] Non occupational exposure tends to be lower than occupational exposure,[32,37,39] and the latency period between exposure and disease incidence longer.[35,40] A review of studies from South Africa, France, and Italy suggested that up to 20% of mesotheliomas in those countries may be attributed to non-occupational exposure to asbestos.[32] An epidemiological national surveillance system in Italy documented 10% of malignant mesotheliomas as being due to non-occupational exposure.[41] Similarly, Antao et al. suggested that exposure to asbestos through maintenance and demolition is likely to see asbestos-related mortality continue in the United States of America.[42] Exposure from do-it-yourself home renovations in Western Australia accounted for 8.5% and 35.7% of all mesotheliomas diagnosed between 2005 and 2008 for men and women, respectively.[22] Future cases of asbestos-related disease and mortality can only be prevented by stringent regulation and careful maintenance and removal of existing *in situ* asbestos across the country.[43]

Strengths and limitations

This research used qualitative interviews in conjunction with a literature review to identify where current and future risk of asbestos exposure may occur in Australia. The qualitative data permitted an exploration of the current practice and experience of removalists and EHOs, and their thoughts about future risks. A strength of this study was that it involved removalists and EHOs who were active, and who had considerable experience in their field. Participants from every state and territory were interviewed, and consistent themes were identified across Australia. The study also included a mix of Class A and Class B removalists, who commonly had different experiences. For example, Class A removalists were more likely to see friable asbestos due to their licence permitting them to remove it. Asbestos assessors provided an additional viewpoint, with their work mostly occurring in industrial premises or public buildings. The study also involved EHOs from both urban and rural areas, to better understand issues with asbestos management, remediation, and waste disposal.

The study is limited in that it may not give an accurate representation of removalists and EHOs across Australia, for the reasons highlighted above as strengths. Several EHOs contacted declined to be interviewed for this study because they were unable to identify asbestos or because they had limited knowledge about it. Those who participated were more likely to be experienced EHOs and several had an interest in asbestos. We interviewed more Class A than Class B removalists, although data from all states and territories show that there are more Class B removalists than Class A. However, Class A removalists were able to provide more in-depth responses compared to Class B, had greater knowledge about asbestos, and were able to talk about friable and non-friable *in situ* asbestos.

Conclusion

Australia was a large producer and consumer of raw asbestos and manufactured asbestos products and has been left with a legacy of considerable amounts of *in situ* asbestos in the built environment. This may present a risk for future exposure to asbestos fibers through damage and deterioration of ACM. The management, regulation, and removal of asbestos are likely to be a determining factor in the risks of exposure to the public to asbestos fibers. Identifying possible sources of asbestos exposure, both currently and in the future, will allow for the prevention of asbestos-related diseases and deaths. This research has highlighted a need for consistent approaches in the regulation and enforcement of safe practices for the management and removal of asbestos, to ensure that *in situ* asbestos is managed appropriately.

Supplementary material

Supplemental data for this article can be accessed at http://dx.doi.org/10.1080/10773525.2016.1227037

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