Estimating the incidence of malignant mesothelioma in Vietnam: a pilot descriptive cancer registration study

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Introduction: Global asbestos consumption has shifted toward lower income countries, particularly in the Asian region including Vietnam where asbestos and asbestos-containing products have been imported since the late 1960s.

Methods: This pilot descriptive epidemiological study aimed to provide contemporary estimates of malignant mesothelioma incidence (histological subtype M9050/3; ICD-O-3) by gender and age group as recorded across nine cancer registries in Vietnam.

Results: We identified 148 incident cases of malignant mesothelioma during 1987–2013. The majority of cases were recorded in the Hanoi region ($n = 93$) and were aged 55 years or older ($n = 96$).

Discussion: By carefully reviewing existing cancer registry records in Vietnam, we identified a larger number of malignant mesothelioma cases than previously estimated. We recommend the use of cancer registry data in tracking future asbestos-related disease in Vietnam.

Keywords: Malignant mesothelioma, Vietnam, Cancer registration, Asbestos-related diseases, Incidence

Introduction

Despite the well-established evidence for its role as a human carcinogenic agent, asbestos continues to be used around the world with approximately 2 million metric tonnes consumed globally each year.^{1,2} The majority of this asbestos consumption occurs in Asia.³ Asbestos-related disease includes both malignant and non-malignant disease.⁴ Malignant mesothelioma is an aggressive tumor originating in the serosal membranes that line the thoracic and abdominal cavities and is causally linked to asbestos fiber exposure.^{5,6} The link between historic asbestos consumption and the incidence and mortality of asbestos-related disease at the global level is well established. For instance, Lin and colleagues presented an ecological analysis that demonstrated that historical asbestos consumption was a significant predictor of malignant mesothelioma mortality, regardless of gender.⁷ There is also evidence for an increase over time in the global burden of asbestos-related disease. Lim and colleagues analyzed the

global burden of disease attributable to a range of different risk factors including analyses of the number of deaths due to occupational exposure to asbestos in 1990 and 2010.⁸ These analyses show that there was a 46% increase in the number of deaths due to occupational asbestos exposure between 1990 and 2010. The investigators estimated that 23,057 people died from occupational asbestos exposure in 1990, and that this rose to 33,610 in 2010, with men making up approximately 75% of all estimated deaths. Delgermaa and colleagues have also published data that show an increase over time in global malignant mesothelioma mortality rates between 1994 and 2008.⁹

At the individual country level, there is a strong body of evidence of the occurrence of malignant mesothelioma in high-income Asian countries such as the Hong Kong Special Administrative Region of China, Republic of Korea, and Taiwan Province of China.^{10–12} There is also a group of middle- and low-income countries where the evidence is mounting for the presence of malignant asbestos-related disease through occupational asbestos fiber exposure at the population level such as Argentina, Brazil, and China as well as for environmental exposure

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to erionite fibers in Mexico and Turkey.^{13–21} Individual case studies of malignant asbestos-related diseases in Asian region countries such as India and Thailand have also been reported.^{22,23} However, there are few contemporary reports on the incidence or mortality of malignant mesothelioma in Vietnam, a country where asbestos has been consumed since the late 1960s. Asbestos consumption in Vietnam is primarily from the importation of raw asbestos fibers as well as, to a lesser extent, the mining of naturally occurring asbestos.^{24,25} The total volume of raw asbestos fibers consumed annually in Vietnam increased from 15,000 metric tonnes in 1995 to 67,7000 metric tons in 2000, with a levelling off in the last 5–10 years.²⁵ Using average volumes of asbestos consumption published by the Vietnam National Institute of Labour Protection, the average annual volume of raw asbestos imported into Vietnam during 2007–2011 was 67,854 tons.²⁶ There is currently no asbestos ban in Vietnam.²⁷

The aim of this pilot study was to assess the feasibility of using up-to-date data from nine active cancer registries in Vietnam to provide contemporary estimates of malignant mesothelioma incidence.

Methods

The case-series in this study included people newly diagnosed with malignant mesothelioma in Vietnam between 1 January 1987 and 31 December 2013 whose information was recorded in any of the nine active cancer registries in Vietnam. These registries cover approximately a third of Vietnam's population. Each of the nine cancer registries utilize the International Classification of Diseases for Oncology, 3rd edition (ICD-O-3). More specifically, it was not possible to extract data on incident malignant mesothelioma cases using the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) as this variable was not readily available in the nine cancer registries. Following consultation with senior staff at the Hanoi Cancer Registry, it was agreed that incident malignant mesothelioma cases would be identified using morphology codes as defined in ICD-O-3. Specifically, the ICD-O-3 code M9050/3 (malignant mesothelioma, not otherwise specified) was used to identify cases to be included in the case-series. It

was not considered relevant to extract other potentially relevant morphology codes such as M9051/3–M9053/3 (epithelioid, sarcomatoid and biphasic histological subtypes) as it was highly unlikely for any cases to be recorded using these codes due to the limited ability in Vietnam to identify malignant mesothelioma histological subtypes.

Demographic and tumor characteristic variables were collected for each case including full name, date of birth, gender, and contact details. Tumor characteristics included date of diagnosis and type of information used to determine diagnosis such as clinical symptoms, chest X-ray, and pathological (immunohistochemical) confirmation. Of the 148 cases included in this case-series, 142 had pathology report data from the primary tumor with the remaining six cases confirmed through computer topography scans (Supplementary Table 1). Data for each case was sent to the central investigation team at the Vietnam Health Environmental Management Agency (HEMA) in hard copy or as an electronic file format and all data were merged into a single data file. Senior personnel from HEMA reviewed the merged data file for overall quality and calculated descriptive data. Aggregate demographic data (age group and sex) were then reported to the lead investigators at the Asbestos Diseases Research Institute, Sydney, Australia.

We also collected information about the calendar years for which data are available as well as the total number of incident cancer cases reported in each cancer registry, allowing for a preliminary assessment of how representative the malignant mesothelioma data may be. It was difficult to ascertain the precise coverage for each cancer registry in terms of its underlying population and whether the registries were truly population-based as determined in assessment of cancer registry data quality such as published by the International Agency for Research on Cancer (IARC).²⁸ We aimed to calculate incidence as a count measure but also as an age-standardized incidence rate. We also attempted to collect general population data for each of the nine cancer registry regions for each calendar year for the cancer diagnosis periods included. However, these data were not readily available for this study. We considered estimating a

Table 1 Number of incident malignant mesothelioma cases identified in each population-based cancer registry, Vietnam, 1987–2013

Cancer registry characteristics		Number of incident malignant mesothelioma cases (M9050/3; ICD-O-3)		
Name of cancer registry	Period of incident cases	Males	Females	Total
Can Tho/Hau Giang	2002–2013	4	2	6
Da Nang	2012–2013	0	0	0
Hanoi	1987–2013	49	44	93
Hai Phong	2010–2013	0	0	0
Ho Chi Minh	2000–2013	18	22	40
Kien Giang	2009–2013	0	0	0
Thai Nguyen	2001–2013	3	2	5
Thanh Hoa	2009–2013	1	0	1
Thura Thien Hue	2001–2013	3	0	3
All registries combined	1987–2013	78	70	148

crude and age-adjusted incidence rate for this study by using general population data for Vietnam. However, this would have introduced numerator-denominator bias due to the data from the nine cancer registries covering only a third of the Vietnam population. Therefore, we did not consider it valid to estimate crude or age-standardized incidence rates.

Approval to undertake this study was obtained from the Vietnam Ministry of Health (Decision No. 751/QD-BYT; 5 March 2014) and from HEMA (Decision No. 85/QD-MT; 6 June 2014). Data were held and analyzed at HEMA using SPSS statistical software, version 16.0.

Results

We identified 148 cases of malignant mesothelioma across the nine cancer registries (Table 1). The majority of malignant mesothelioma cases identified in this study were diagnosed in Hanoi with 93 cases of malignant mesothelioma recorded in the Hanoi cancer registry, making up 63% of all cases identified. The Hanoi cancer registry includes data on approximately 390,000 people with incident cancer over a 26-year period. The second largest group of malignant mesothelioma cases identified was from the Ho Chi Minh region with 40 cases reported from this cancer registry (27% of all cases). This cancer registry was established in 2000 and includes data on 130,000 incident cancer cases. A small number of malignant mesothelioma cases ($n = 15$) were reported in the Can Tho, Hau Giang, Thai Nguyen, Thanh Hoa and Thua Thien Hue cancer registries. These cancer registries were established much more recently. No malignant mesothelioma cases were identified in the Da Nang, Hai Phong, and Kien Giang cancer registries. Across all cancer registries, the male-to-female ratio of 1.11 suggests that there was little difference between the numbers of cases by gender. More female than male cases were reported in the Ho Chi Minh cancer registry (22 females, 18 males).

For both genders, 66% of people were aged 55 years and above at the time of their malignant mesothelioma diagnosis ($n = 96$) with the remaining cases ($n = 50$) aged 54 years or under (Figs. 1(a) and (b)). Two reported cases did not have age at diagnosis recorded. There were apparent differences by gender in the age distribution of the malignant mesothelioma cases reported. Approximately, a quarter of male cases were diagnosed before they were 45 years of age. For men, 56% of all cases reported were aged 55 years and over ($n = 43$). A substantially higher proportion of women were older at the time of their malignant mesothelioma diagnosis with 77% of female cases being 55 years of age or older ($n = 53$).

Discussion

We identified 148 cases of malignant mesothelioma, primarily diagnosed through pathology of the primary tumor, most of whom were recorded as being diagnosed in the

Hanoi region. Just over half the record cases were men and 65% of cases were aged 55 years or older at the time of diagnosis. No information was available on mortality or asbestos exposure histories in this study. This is one of the first contemporary studies to estimate malignant mesothelioma incidence in Vietnam using cancer registration records and one of the first studies to bring together data across all nine cancer registries in Vietnam. However, there are a number of obvious limitations in the present study. Firstly, we were not able to obtain region-specific general population estimates enabling the accurate calculation of crude and age-standardized incidence rates of malignant mesothelioma in Vietnam. This has substantially limited the ability to compare our data with similar jurisdictions in the South-East Asian region or with other low- and middle-income countries that are currently using asbestos such as data presented by IARC.²⁹ Secondly, the data extracted from the nine cancer registries were defined using ICD-O-3 histology codes. We recognize that the use of the commonly used ICD-10 C45 diagnostic codes (used for example by Park and colleagues) would have been more ideal.³⁰ However, we were restrained by availability of diagnostic codes currently available on the Vietnam cancer registration data. Third, an independent case ascertainment process was not undertaken. It is recognized that comparing cancer registration data with an independently compiled case-series is a useful approach to evaluating completeness and accuracy of the cancer registration series.^{31,32} This is an area where further research is warranted. An independent case-ascertainment process may also be informative to examine the potential for the under-diagnosis of malignant mesothelioma. In a study published by Park and colleagues who estimated the global magnitude of malignant mesothelioma accounting for reported and unreported cases, it has been suggested that one malignant mesothelioma case may be overlooked for every four to five recorded.³⁰ If this assumption held true in our case-series, the total number of incident malignant mesothelioma cases would be closer to 200.

Cancer incidence data is more easily ascertained in Vietnam compared to mortality data due to substantial limitations in the collection of fact of death and cause of death data at the local, regional, and national levels.^{33–35} For global cancer incidence data to be reported by IARC in their global cancer incidence reports, a high threshold of data quality needs to be met such as those described by Bray and Parkin.^{31,32} For countries like Vietnam, this threshold is difficult to meet and as a result cancer incidence data from these countries is less frequently reported compared to countries with greater health system resourcing. In 2002, IARC reported that during 1993–1997, a total of 17 cases of incident malignant mesothelioma occurred in Vietnam.³⁶ Fifteen of these cases were diagnosed in Hanoi (nine males and six females) and two cases in men were diagnosed in Ho Chi Minh. In our study, the high number of cases in Hanoi and Ho Chi Minh most likely

Figure 1 (a) Distribution (number) of male and female incident malignant mesothelioma cases identified in Vietnam, 1987-2013, by 5-year age group. (b) Distribution (percent) of male and female incident malignant mesothelioma cases identified in Vietnam, 1987-2013, by 5-year age group.

reflects a number of key factors including: the geographic distribution of the population; the geographic distribution of occupations where workers may be exposed to asbestos; differences in the level of expertise and technology to accurately diagnose malignant mesothelioma cases in major cities compared to less populated geographic areas; differences in the level of expertise and experience in the collection of cancer cases into regional cancer data-sets between those cancer registries that have been established for a longer period of time compared to those more recently established; and patient or family preference for having diagnostic tests and health care performed in larger cities compared to smaller cities thereby creating an artifactual concentration of malignant mesothelioma cases in one region. In this study however, we were not able to directly measure or test whether those assumptions hold true.

Contemporary data on the overall quality of all the nine cancer registries has not, to our knowledge, been formally assessed including the comparability, validity, timeliness, completeness, and overall data quality of malignant mesothelioma data. However, we are able to draw upon work published in 2002 on Vietnam's cancer control response where it was reported that the quality of cancer registration data in Hanoi and Ho Chi Minh City were compatible with those of developing countries.³⁷ In this evaluation, the investigators reported that around 60% of all registered cancer cases in Hanoi had microscopic verification, with a corresponding figure of 70% for Ho Chi Minh City cancer data. It was also suggested that the patterns across all cancers as recorded in both these cities were reflective of the cancer incidence patterns common in developing countries. Based on these findings, we expect that there is a higher malignant mesothelioma data quality

and completeness available through the Hanoi and Ho Chi Minh cancer registries compared to the more recently established cancer registries in Vietnam.

We consider that describing the number of incident cases of malignant mesothelioma cases as recorded in the Vietnam cancer registries is valid in its own right. However, we also recognize that information about the type of environment or occupational in which a person or sub-population is exposed to airborne asbestos fibers has the potential to provide important information about the prevention of future asbestos-related disease. In this study, it was not possible to determine with any certainty how a person was exposed to asbestos. Nevertheless, a description of the types of occupational environments where asbestos exposure is likely is informative. The key characteristics of the workforce potentially exposed to asbestos in Vietnam have been well described.²⁵ These authors state that in Vietnam, chrysotile asbestos (the main fiber type used) is mostly used in the manufacturing of asbestos-containing roof sheets as well as in the manufacturing of car brakes and thermal insulation. There are approximately 35 asbestos-containing roof sheet factories operating in Vietnam with variation in their production capacity. The majority of these roof sheet factories are located in northern Vietnam. The investigators also quantified the number of people working in industries where asbestos-containing products are used. These authors estimated that approximately 4,350 people work in asbestos-cement roof sheet factories, 923 people work in the production of molten phosphate fertilizer, 406 people work in shipbuilding and boiler maintenance, and 21 people work in industries where asbestos exposure is possible through maintenance of asbestos-containing car brakes. Furthermore, Vietnam has naturally occurring asbestos-rock mines. Importantly though, the quality of the natural occurring asbestos in Vietnam is considered poor with around 1% of asbestos making up the rock content (the standard for industrial use of asbestos is around 5%). The largest of Vietnam's asbestos mines is located in the Thanh Hoa province. The majority of asbestos consumed in Vietnam is imported either as raw product or through asbestos-containing products. We do note industrial histories of countries in Eastern Asia point toward shipbuilding and port activities as reported by Bianchi and Bianchi.³⁸ To our knowledge, shipbuilding and port activities are not considered the highest type of industrial activity in Vietnam for occupational asbestos exposure. Nevertheless, these industrial activities should be monitored over time.

We have also reported a higher number of cases among females compared to males in the Ho Chi Minh region ($n = 22$ and $n = 18$ respectively). The incidence of malignant mesothelioma is generally higher among males compared to females due to factors such as gender differences in occupational asbestos exposure.² However, a recent study has suggested that the male-to-female incidence

ratio will be closer to unity in communities where non-occupational asbestos exposure plays a larger role than occupational asbestos exposure.³⁹ The differences in gender reported in our study for Ho Chi Minh may be an artifact of the data but may also reflect actual differences in asbestos exposure settings; further research is warranted in this area. Emerging data from China may also be informative. In particular, a report from Gao and colleagues showed that all of the 43 patients with a confirmed malignant mesothelioma diagnosis from Yuyao People's Hospital were females who had a recorded asbestos exposure history involving domestic or occupational exposure to chrysotile fibers.²⁰ Wang and colleagues also reported a significant increase in malignant mesothelioma and ovarian cancer for women in a cohort of Chinese asbestos textile factory workers.²¹

In conclusion, Vietnam is one of a number of countries in the South-East Asian region where asbestos is being imported primarily for use in the construction of asbestos-containing roof tiles. Despite the use of asbestos in Vietnam since the 1960s, there are few contemporary reports of malignant asbestos-related disease incidence and mortality. We have carefully reviewed data on newly diagnosed malignant mesothelioma cases collected from nine active cancer registration data-sets in Vietnam, representing around a third of the country's population. We have identified 148 cases of malignant mesothelioma that have been reported to the cancer registration data system from 1987 through to 2013. While there are obvious limitations with this pilot descriptive study, we have identified a substantially larger number of incidence malignant mesothelioma cases than previously estimated. This pilot study has demonstrated the feasibility of using active cancer registries to collect data about malignant mesothelioma in Vietnam.

Author contribution statement

MS and NvZ designed the study. All named investigators from Vietnam provided oversight and scientific leadership of the collection of the data from the cancer registries. Thanks to the staff in each of the nine cancer registries who identified and extracted the relevant data. All authors revised the manuscript for intellectual content.

Supplementary material

Supplemental data for this article can be accessed <http://dx.doi.org/10.1080/10773525.2016.1151604>.

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