



Mesothelioma mortality in Argentina, 1980-2013

Mortalidad por mesotelioma en Argentina, 1980-2013

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ABSTRACT Mesothelioma mortality and its socio-demographic and temporal patterns in Argentina from 1980 to 2013 were estimated using data from death certificates obtained from the Vital Statistics System of Argentina's National Ministry of Health. There were 3,259 mesothelioma deaths corresponding to an age-standardized mortality of 3.1 per 1,000,000 in 1980 and 5.7 per 1,000,000 in 2013, an average increase of 84.1% in 34 years. This raising trend became clearer after 1997. Males had higher mortality estimates compared with women in every year of the series; these findings suggest past exposure to asbestos. It is plausible that the asbestos exposure was mostly occupational, which is more common among men. Actions related to reinforcing the asbestos ban already in place and strengthening health surveillance directed at workplaces, previously exposed workers, and the population in general are recommended.

KEY WORDS Neoplasms; Mesothelioma; Mortality; Time Series Studies; Argentina.

RESUMEN Se estimó la tasa de mortalidad por mesotelioma y su distribución sociodemográfica y temporal en Argentina para el período 1980-2013 con datos del Sistema de Estadísticas Vitales del Ministerio de Salud de la Nación. Se encontraron 3.259 defunciones por mesotelioma, lo que resulta en una tasa de mortalidad estandarizada por edad de 3,1/1.000.000 en 1980 y de 5,7/1.000.000 en 2013, con un aumento promedio del 84,1% en 34 años. El incremento de la tendencia fue más claro a partir de 1997. En todos los años, la tasa de mortalidad fue mayor en hombres que en mujeres. Los resultados sugieren antecedentes de exposición al asbesto en el pasado. Aparentemente, la exposición predominante fue la ocupacional, más común entre los hombres que concentraron los casos. Se recomiendan acciones dirigidas a hacer más efectiva la prohibición ya en vigor y la vigilancia en salud orientada a los ambientes de trabajo, trabajadores previamente expuestos y la población en general.

PALABRAS CLAVES Mesotelioma; Mortalidad; Estudios de Series Temporales; Argentina.

INTRODUCTION

Mesothelioma is a malignant tumor associated with asbestos, a fibrous mineral used worldwide, and classified as a Group I carcinogen by the International Agency for Research on Cancer (IARC).⁽¹⁾ This cancer of occupational and/or environmental origins is avoidable. Therefore, the World Health Organization (WHO) has recommended norms and laws regarding the total or partial prohibition of extraction, production and use of all forms of asbestos. The asbestos ban was implemented in 54 countries⁽²⁾ including Argentina. In this country, the Ministry of Health proposed a carcinogen surveillance program, including the epidemiological monitoring of asbestos-related disease mortality.⁽³⁾ Regarding asbestos, mesothelioma mortality is the most common and relevant statistic used to monitor the effects of asbestos in health or the impact of preventive actions,⁽⁴⁾ in spite of its long latency period.

Estimates of mesothelioma mortality vary widely among countries and world regions. In a study with data from 83 countries for the 1994-2008 time period, 92,253 deaths were identified and a 4.2 per 1,000,000 age-standardized mesothelioma mortality for the total population was estimated. The highest mesothelioma mortality was estimated for the United Kingdom (17.8 per 1,000,000), followed by Australia (16.5 per 1,000,000) and Italy (10.3 per 1,000,000).⁽⁵⁾ From 36 European countries, there were 71,686 deaths of mesothelioma identified between 1994 and 2010, an average death risk of 7.7 per 1,000,000 for the general population.⁽⁶⁾ In Great Britain and Northern Ireland, 13,517 deaths were reported between 1994 and 2008, a crude mesothelioma mortality rate of 17.8 per 1,000,000,⁽⁷⁾ much higher than the age-standardized mortality of 9.6 per 1,000,000 estimated for Belgium during the same time.⁽⁸⁾

In less developed areas such as South America, mesothelioma data are scarce and low mortality estimates suggest underreporting of cases.⁽⁹⁾ For instance, although Brazil is the third largest world asbestos producer, the average age-standardized

mortality was estimated as low as 0.77 per 1,000,000 between 1980 and 2010.⁽¹⁰⁾ From 2000-2012 among individuals 30 years of age or older, mesothelioma mortality was 2.1 per 1,000,000.⁽¹¹⁾ In five South American countries, the highest mesothelioma mortality estimates among males were from Chile (3.1 per 1,000,000), Argentina (2.5 per 1,000,000) and Uruguay (2.3 per 1,000,000), while Ecuador and Brazil showed similar estimates (0.5 per 1,000,000).⁽¹²⁾ These results clearly indicate underestimation of rates as compared to those from industrialized countries. These differences may be a result of poor quality and coverage of health information systems, in addition to differences in the production and consumption patterns and effectiveness of protective programs, among other factors, which reduced the magnitude and intensity of environmental or occupational exposure to asbestos.

Males have greater mesothelioma mortality than women. In the Delgermaa *et al.*⁽⁵⁾ study, the annual age-standardized mortality rate for all ages from 1994-2008 was 9.0 per 1,000,000 among men and 1.9 per 1,000,000 for females, a male/female ratio of 4.7:1. Similarly, in Belgium, the estimated mortality in men (9.0 per 1,000,000) was greater than in women (1.9 per 1,000,000).⁽⁸⁾ These general population findings are close to the estimates for individuals over 40 years of age in Germany: 39.0 per 1,000,000 in men and 8.0 per 1,000,000 in women, with a male/female ratio of 4.8:1.⁽¹³⁾ However, a smaller sex difference was observed in Spain, where a ratio of 2.5:1 was estimated in 2010, claimed to be resulting from a smaller asbestos industry where male workers predominate⁽¹⁴⁾ as could be seen in Belgium.⁽⁸⁾ These findings show the relevance of occupational exposure among men compared to environmental or domestic exposure experienced by both sexes.⁽¹⁵⁾ It is worth noting that women and children can also be indirectly exposed through the contact with tools or clothing of asbestos-exposed workers.⁽⁸⁾

According to studies carried out in the United Kingdom⁽¹⁶⁾ and the US,⁽¹⁷⁾ mesothelioma mortality has grown since the 1950s.

In several countries⁽⁵⁾ a mesothelioma mortality increase over time has been reported, from 4.0 per 1,000,000 in 1994-2000 to 5.6 per 1,000,000 in 2001/2008, a 32.5% rise, corresponding to an average annual growth of 5.0%.⁽⁵⁾ This increase was greater in Spain (39.9%), where mesothelioma mortality went from 2.8 per 1,000,000 in 1976-1980 to 3.9 per 1,000,000 in 2006-2010.⁽¹⁴⁾ However, in Austria from 1970 to 2001, Neuberger and Vutuc⁽¹⁸⁾ reported a mesothelioma mortality of 11.0 per 1,000,000 in 1970-1974, which fell to 8.4 per 1,000,000 in 2000-2001, a 24.0% decline. Brazil is the only Latin American country with historical data on mesothelioma mortality. The rate increased 46.9%, varying from 0.6 per 1,000,000 in 1980 to 0.9 per 1,000,000 in 2010.⁽¹⁰⁾ In contrast, in Great Britain, mesothelioma mortality grew from 3.3 per 1,000,000 in 1969-1971 to 39.9 per 1,000,000 in 2011-2013, an increase of more than 1,000% over this period of time.⁽⁷⁾

These time trends reflect a rise in the exposure of asbestos as prevalence as well as characteristics such as the frequency, intensity and duration of exposure, particularly in workplaces. However, there is evidence that prevalence of the exposed has decreased between 1970 and 2000,^(6,19) although the impact of this decrease will only be seen in mesothelioma mortality after 30 or 40 years, given the long latency period of the cancer. On the one hand, it is expected that the increase in mortality will continue for several more years, which could be determined by the presence of asbestos in the environment,⁽¹²⁾ the aging of the population,⁽¹⁵⁾ greater access to diagnostic resources⁽¹³⁾ or even improvements in mortality information systems and in the International Classification of Disease (ICD).^(8,13,19) Indeed, in developed countries, improvements in the quality of records might explain the increase in mortality over time, especially when the initial mortality estimates were low.⁽¹²⁾ This increase in mortality has been described for both men and women, although it is greater in the former, which could be associated with gender differentials unfavorable to men in terms of the occupations related to asbestos exposure.⁽¹³⁾

In Argentina, from 1994-2008 1,065 mesothelioma deaths were reported, 97 per year on average.⁽²⁰⁾ From 1996-2007, the age-standardized mortality rate for mesothelioma of 2.7 per 1,000,000 among men, with an 8.9% increase over the period.⁽¹²⁾ From 2007-2011, 297 women and 428 men died from mesothelioma, an estimated mortality rate of 2 per 1,000,000 and 4 per 1,000,000, respectively.⁽²¹⁾ In this study, annual mesothelioma mortality is estimated in Argentina over the 1980-2013 time period according to sex.

METHODS

This is a mortality study of mesothelioma in Argentina among individuals aged 15 years or older. Mesothelioma cases were from the Vital Statistics System of the Department of Statistics and Health Information (DEIS) [*Dirección de Estadística e Información en Salud*] of the National Ministry of Health, based on death certificates. Population data was gathered from the National Institute of Statistics and Censuses (INDEC) [*Instituto Nacional de Estadística y Censos*]. Mesothelioma corresponds to the following International Classification of Diseases (ICD) codes:

- ICD-9th Revision (1980-1996): 163.0 Malignant neoplasm of parietal pleura, 163.1 Malignant neoplasm of visceral pleura, 163.8 Malignant neoplasm of other specified sites of pleura and 163.9 Malignant neoplasm of pleura, unspecified.
- ICD-10th Revision (1997-2013): C45.0 Mesothelioma of pleura, C45.1 Mesothelioma of peritoneum, C45.2 Mesothelioma of pericardium, C45.7 Mesothelioma of other specified sites and C45.9 Mesothelioma, site unspecified.

The underlying cause of death was the only one considered. Descriptive variables were sex (male/female), age and year of death.

The annual mortality was calculated by dividing the number of deaths due to mesothelioma by the total population of 15 years

of age or older. Age-standardized estimates based on the direct method used the World Health Organization reference population.⁽²²⁾ For the intercensus years the population was projected based on geometric interpolation.

The study data are from public vital statistics sources which are under the protection of the Law of Statistical Secrecy in Argentina [*Ley 17622 de Secreto Estadístico*]. This research project was reviewed and approved by the Research Ethics Committee of the Instituto de Saúde Coletiva at the Universidade Federal da Bahia (CAAE 28218914.3.0000.5030).

RESULTS

From 1980 to 2013, there were 3,259 mesothelioma deaths in Argentina. During the first years, 1980-1996, 1,279 cases were recorded, the majority (98.3%) classified as ICD-9 163.9 code, of unspecified malignant

neoplasm of pleura. After that time, when ICD-10 was used, 1,980 deaths were found, mostly under the C45.9 code of mesothelioma of unspecified site, corresponding to 69.8% of all cases. However, over this later time period there was a decrease in the proportion of nonspecific diagnoses compared to the previous time when ICD-9 was used. Under ICD-10, 22.1% of mesothelioma cases had C45.0 mesothelioma of pleura as the underlying cause of death. This pattern did not differ for males and females (Table 1).

In 1980, 64 deaths were recorded, while in 2013 the number tripled to 177. From 1980 to 1997, the number of mesothelioma deaths did not show a clear pattern but after this, a clear linear increasing trend was observed (Figure 1) for both sexes, although for females this rise begins later, in 2004. A total increase of 176.6% in the number of mesothelioma deaths was shown, greater for male (189.7%) than for female cases (156.0%). In Figure 2 the crude and age-standardized

Table 1. Distribution of mesothelioma deaths in the population over 15 years of age, by International Classification of Disease (ICD) codes and sex. Argentina, 1980-2013.

ICD codes	Males		Females		Total	
	n	%	n	%	n	%
	1,919	59.8	1,340	41.1	3,259	100.0
ICD-9th (1980-1996)						
163.0 Malignant neoplasm of parietal pleura	6	0.8	2	0.4	8	0.6
163.1 Malignant neoplasm of visceral pleura	4	0.6	2	0.4	6	0.5
163.8 Malignant neoplasm of other specified sites of pleura	2	0.3	6	1.1	8	0.6
163.9 Malignant neoplasm of pleura, unspecified	702	98.3	555	98.2	1,257	98.3
Subtotal	714	100.0	565	100.0	1,279	100.0
ICD-10th (1997-2013)						
C45.0 Mesothelioma of pleura	264	21.9	171	22.1	435	22.0
C45.1 Mesothelioma of peritoneum	23	1.9	17	2.2	40	2.0
C45.2 Mesothelioma of pericardium	26	2.2	15	1.9	41	2.1
C45.7 Mesothelioma of other specified sites	38	3.2	44	5.7	82	4.1
C45.9 Mesothelioma, site unspecified	854	70.9	528	68.1	1,382	69.8
Subtotal	1,205	100.0	775	100.0	1,980	100.0

Source: Own elaboration based on data from the Statistics and Health Information Office [*Dirección de Estadísticas e Información en Salud*] (DEIS), Ministry of Health, Argentina. ICD = International Classification of Diseases.

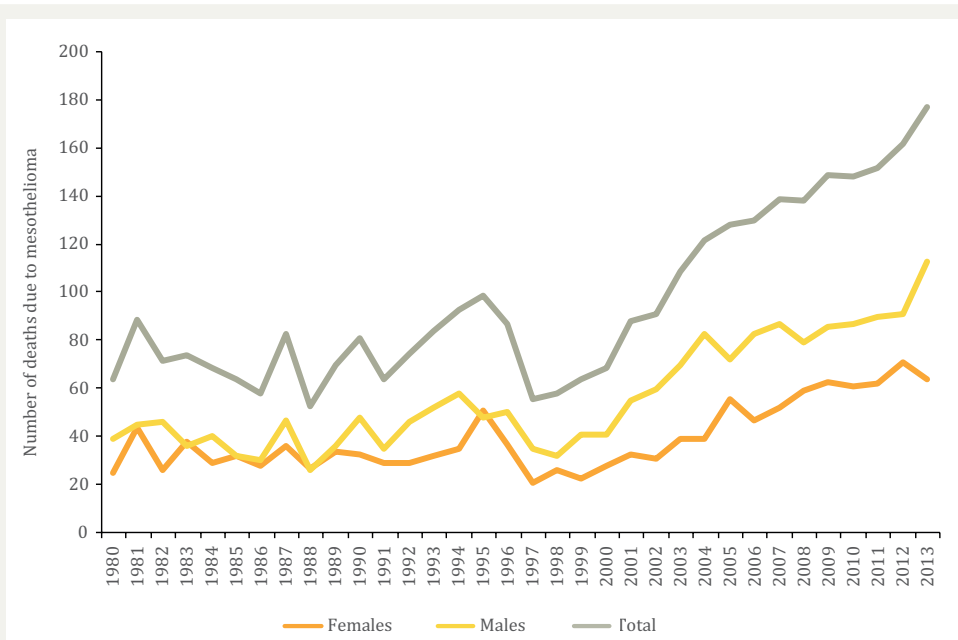


Figura 1. Annual mesothelioma mortality in the population over 15 years of age, by sex. Argentina, 1980-2013.

Source: Own elaboration based on data from the Statistics and Health Information [Dirección de Estadísticas e Información en Salud] (DEIS), Ministry of Health, Argentina.

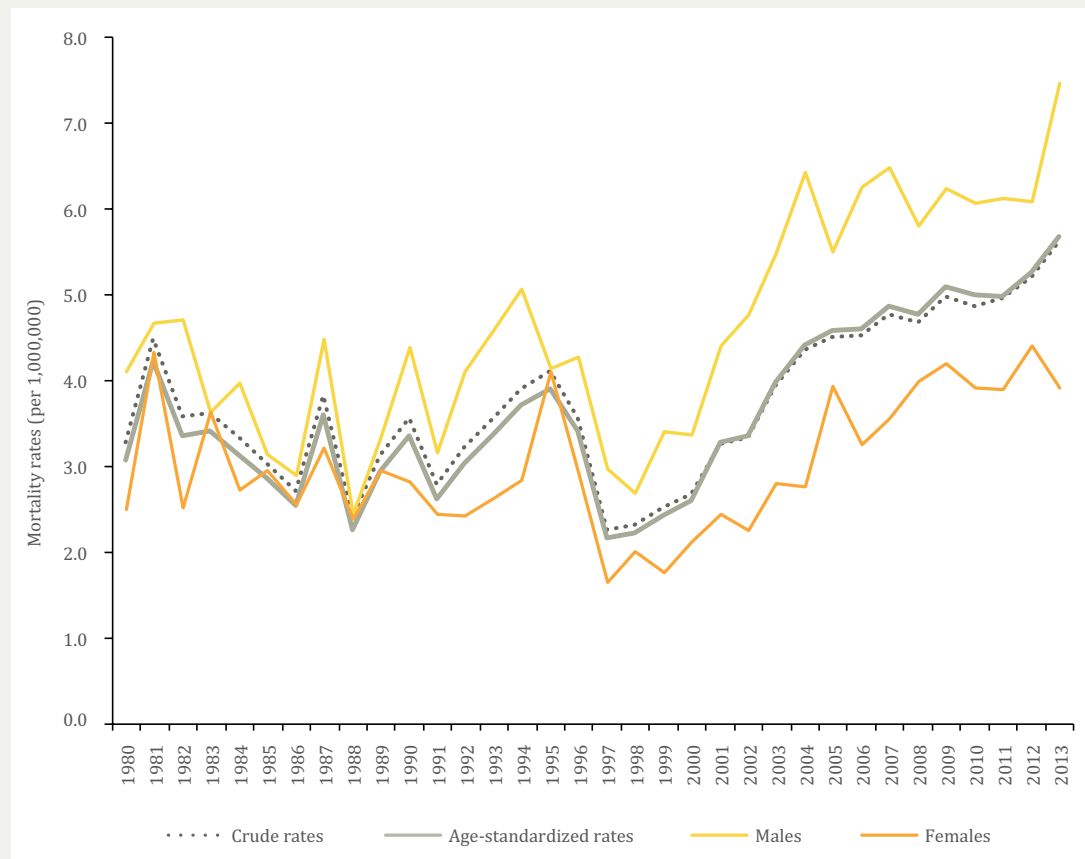


Figure 2. Annual crude and age-standardized mesothelioma mortality rates, by sex. Argentina, 1980-2013.

Source: Own elaboration based on data from the National Institute of Statistics and Censuses [Instituto Nacional de Estadística y Censos] (INDEC), Office of Statistics and Health Information [Dirección de Estadísticas e Información en Salud] (DEIS), Ministry of Health, Argentina.

mesothelioma mortality estimates are much closer throughout the study period. The age-standardized mesothelioma mortality fell from 3.3 per 1,000,000 in 1980 to 2.3 per 1,000,000 in 1997, showing fluctuations over time. The linear growth trend becomes clear after 1998 and continues until the end of the study period. Similar results were observed in the standardized mesothelioma mortality rates for each sex. Among males it dropped from 4.1 per 1,000,000 in 1980 to 2.8 per 1,000,000 in 1998, reaching 7.5 per 1,000,000, the highest estimate in 2013. For women a 2.5 per 1,000,000 estimate was obtained in 1980, which fell to 1.7 per 1,000,000 in 1997; until 2004 there was a steady growth to the peak of 3.9 per 1,000,000 in 2013.

DISCUSSION

The results of this study show that in Argentina between 1980 and 2013, in the population aged 15 years of age or older, mesothelioma was the underlying cause of death for 3,259 people, with cases recorded every year. The highest mortality rate was seen in 2013, 5.7 per 1,000,000, and the lowest in 1998, 2.3 per 1,000,000. In the study period an increase in the number of deaths by more than 170% and in the mortality rate by over 80% was observed. The percentage increase in the mortality rate was greater in males (81.9%) than in females (57.1%). The majority of diagnoses were classified with "non-specific" codes.

The mesothelioma cases indicate that asbestos exposure continued to occur in the country, considering that for this cancer the fraction attributable to asbestos exposure is estimated at between 80% and 90%.⁽¹⁹⁾ In Argentina, asbestos was extracted from 1869 to 1970⁽²³⁾ and records confirm the importation of 21,206 tons in 1970, descending to a single ton in 2002. Nevertheless, the apparent consumption measured via the difference between the volume produced and the volume imported increased from 1995 to 2010, reaching 341 tons. After 2010, consumption

dropped to reach 100 tons in 2013, the last year with recorded data.⁽²⁴⁾ No data regarding the prevalence of asbestos exposure, either individual occupational or environmental exposure, was found. The number of deaths caused by mesothelioma which were attributable to occupational asbestos exposure was 735 in 2009.⁽⁹⁾

In this study, the mesothelioma mortality rates were estimated for the general population of 15 years of age or older, in contrast to other studies that considered the total population^(5,7,10) or the population over 30 years of age.⁽¹¹⁾ Although this limits comparability, it makes it possible to calculate more appropriate estimates given the small number of cases in younger age groups and the long latency period of 25 to 40 years. With this age limit our estimates of the mesothelioma mortality rate were higher, although they were still below those offered for countries using as a reference the total population.⁽²⁰⁾

These smaller mesothelioma mortality rates in Argentina may be the result of low exposure levels: there are few natural sources of asbestos and the volume of production and importation has been small in comparison to other countries. Another possible explanation stems from the technical complexity and the cost implied in an adequate diagnosis of mesothelioma, which requires that doctors receive specific medical training. This problem was identified and discussed during the 6th Annual Argentina Health and Workplace Safety Week [*IV Semana Argentina de la Salud y la Seguridad en el Trabajo*] in 2007.⁽²⁵⁾ Our findings were above the available estimates for other countries in the region like Brazil,⁽¹⁰⁾ a result at odds with the greater production, use and consumption of asbestos in that country.⁽²⁶⁾ The WHO classifies Argentina's death records as of good quality for health surveillance.⁽²⁷⁾

Men showed a greater mesothelioma death risk than women in all the years studied, a result similar to those found in other countries.^(5,8,13,18,28) This difference appears to stem from the greater occupational exposure men face, as they more frequently work in extraction, product manufacturing,

construction and other similar industries.⁽⁸⁾ The studies show that the death risk for mesothelioma is greater when exposure is occupational, as such exposure is often of a greater intensity than environmental exposure.⁽²⁹⁾ In Argentina, data on the production profile confirms a greater predominance of males in occupations usually associated with asbestos contact.⁽³⁰⁾

In this study, the mesothelioma mortality rate increased between 1980 and 2013, in general and for both males and females separately. This tendency suggests a historical increase in the frequency, intensity and/or duration of exposure, as well as in the prevalence of people exposed to asbestos. Nevertheless, the cancer's latency period is quite long. The fluctuation in mortality between 1980 and 1997 could be due to the difficulties in carrying out the diagnosis and properly classifying it, given that the ICD-9, which was used during that period, only includes neoplasm of pleura without specifying mesothelioma.⁽⁸⁾ It is common for mortality estimates of rare diseases to fluctuate given the small numbers upon which they are based. The growing trend observed starting in 1998 could also be the result of the incorporation of the specific "mesothelioma" diagnosis in the ICD-10 and the quality and coverage of the system of mortality records in Argentina.⁽³¹⁾ In countries with low mesothelioma mortality rates like Argentina, increases over the course of time series may be due to these improvements,⁽⁵⁾ although the possibility of a true increase in the death risk should not be discarded, considering that other similar patterns have been seen in other countries⁽⁵⁾ with more recent prohibitions of asbestos. Data on the production, importation and consumption of asbestos in Argentina is incomplete,⁽²⁴⁾ which limits understanding of the role of these factors in explaining the trends. No data regarding asbestos exposure in workers was found; this type of exposure is considered to be the greatest contributor to mesothelioma.

The greater increase in mesothelioma mortality in men as compared to women over time appears to reflect differences in the

growth of economic activities associated with asbestos, in which male workers tend to participate to a greater extent. This also suggests a larger growth in occupational exposure, characterized by greater frequency, intensity and duration within the workplace as compared to environmental exposure, which affects both sexes equally.

The findings of this study could be affected by some methodological limitations, for example, the previously mentioned problems in diagnosis and recording due to the complexity and cost of the implied procedures.⁽³²⁾ The diagnosis of mesothelioma, according to the protocol proposed by the Finnish Institute of Occupational Health,⁽³³⁾ requires training and knowledge on the part of health professionals regarding the importance of this diagnosis, not only for treatment, but also for prevention, given that this is an avoidable disease.⁽³⁴⁾ It is possible that companies may have exerted pressure to impede the recording of cases amongst their workers because of economic interests, as has been seen in other countries.⁽³⁵⁾ One study estimated an underrecording of 20-25% in mesothelioma mortality around the world.⁽²¹⁾

In Argentina, no estimates of underrecording in mesothelioma deaths exist, although the mortality information system has been classified as being of "good" quality.⁽²⁵⁾ Even so, the majority of diagnoses using both the ICD-9 and the ICD-10 were unspecified, which could indicate the difficulty in establishing whether the tumor origin is primary or metastatic. The male/female ratios of the mesothelioma mortality rates in this study were smaller than those found in other countries, which could be due to a differential underrecording between the sexes. This could be possible given the high burden of occupational exposure to asbestos in mesothelioma among males.⁽²⁹⁾

It is necessary to carry out studies on the distribution of mesothelioma mortality among occupational groups and economic sectors, as well as to map sources of occupational and environmental exposure for preventive measures. This is one of the first national studies of mesothelioma in Argentina using

a mortality time series, which could prompt other studies on occupational cancer surveillance. These results provide evidence of interest to administrators and decision-makers, especially in the effective implementation of health surveillance focused on asbestos and its health effects. Prohibition itself does not ensure the elimination of exposure; it is necessary to accompany the implementation of prohibitions in use, extraction and importation with the safe removal of products and the adequate disposal of waste. In addition, policies that facilitate the availability of

materials alternative to asbestos for industrial use can favor the prevention of exposure.

The wide circulation of such information can contribute to greater visibility of this collective health problem, especially among health professionals and organizations of workers and other social actors committed to the fight against this carcinogen. In addition, access to this type of information on the part of workers can be used as a base to prioritize and emphasize the right to information and reaffirm demands for better safety conditions in the workplace.

ACKNOWLEDGEMENTS

The first author received a doctoral fellowship from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) in 2012 and 2013 and from the Coordenação de Aperfeiçoamento de Profissionais do Ensino Superior (CAPES) in 2013-2015. The second author is a fellow in the productivity category IC of CNPq. This work was developed as a part of the collaborative agreement between the Programa de Pós-Graduação em Saúde Coletiva, Universidade Federal da Bahia (ISC-UFBA), and the Instituto de Salud Colectiva at the Universidad Nacional de Lanús (ISCo-UNLa).

REFERENCES

1. International Agency for Research on Cancer. Arsenic, metals, fibres, and dusts: Volume 100 C, A review of human carcinogens [Internet]. Lyon: IARC, WHO; 2012 [cited 15 Jun 2016]. Available from: <http://tinyurl.com/az5hd48>.
2. World Health Organization. Chrysotile asbestos. [Internet]. 2014 [cited 1 Sep 2016]. Available from: <http://tinyurl.com/z9f5u55>.
3. Secretaría de Ambiente y Desarrollo Sustentable de la Nación. Primer compendio de estadísticas ambientales: República Argentina. Buenos Aires: Secretaría de Ambiente y Desarrollo Sustentable de la Nación; 2008.
4. Weill H, Hughes J, Churg A. Changing trends in US mesothelioma incidence. *Occupational and Environmental Medicine*. 2004;61(5):438-441.
5. Delgermaa V, Takahashi K, Park E, Vinh G, Toshiyuki H, Sorahan T. Global mesothelioma deaths reported to the World Health Organization between 1994 and 2008. *Bulletin of the World Health Organization*. 2011;89(10):716-724.
6. Kameda T, Takahashi K, Kim R, Jiang Y, Movahed M, Park E, Rantanen J. Asbestos: use, bans and disease burden in Europe. *Bulletin of the World Health Organization*. 2014;92:790-797.
7. Health and Safety Executive. Mesothelioma in Great Britain: Mesothelioma mortality in Great Britain 1968-2013 [Internet]. London: HSE; 2014 [cited 7 Jun 2016]. Available from: <http://tinyurl.com/d5fa93z>.
8. Van den Borre L, Deboosere P. Asbestos in Belgium: an underestimated health risk: The

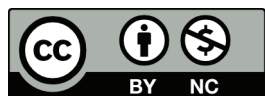
- evolution of mesothelioma mortality rates (1969-2009). *International Journal of Occupational and Environmental Health*. 2014;20(2):134-140.
9. Pasetto R, Terracini B, Marsili D, Comba P. Occupational burden of asbestos-related: Cancer in Argentina, Brazil, Colombia, and Mexico. *Annals of Global Health*. 2014;80:263-268.
10. Pedra F, Oliveira da Silva P, Mattos I, Castro H. Mesothelioma mortality rate in Brazil, 1980 to 2010. *Revista Brasileira de Cancerologia*. 2014;60(3):199-206.
11. Algranti E, Saito C, Carneiro A, Moreira B, Mendoça E, Bussacos M. The next mesothelioma wave: Mortality trends and forecast to 2030 in Brazil. *Cancer Epidemiology*. 2015;39(5):687-692.
12. Nishikawa K, Takahashi K, Karjalainen A, Wen C, Furuya S, Hoshuyama T, Todoroki M, Kiyomoto Y, Wilson D, Higashi T, Ohtaki M, Pan G, Wagner G. Recent mortality from pleural mesothelioma, historical patterns of asbestos use, and adoption of bans: a global assessment. *Environmental Health Perspectives*. 2008;116(12):1675-1680.
13. Schonfeld SJ, McCormack V, Rutherford MJ, Schuz J. Regional variations in German mesothelioma mortality rates: 2000-2010. *Cancer Causes and Control*. 2014;25(5):615-624.
14. López-Abente G, García-Gómez M, Menéndez-Navarro A, Fernández-Navarro P, Ramis R, García-Pérez J, Cervantes M, Ferreras E, Jiménez-Muñoz M, Pastor-Barriuso R. Pleural cancer mortality in Spain: time-trends and updating of predictions up to 2020. *BMC Cancer*. 2013;13:528.
15. Pitarque S, Clèries R, Martínez JM, López-Abente G, Kogevinas M, Benavides FG. Mesothelioma mortality in men: trends during 1977-2001 and projections for 2002-2016 in Spain. *Occupational and Environmental Medicine*. 2008;65(4):279-282.
16. Peto J, Hodgson JT, Matthews FE, Jones JR. Continuing increase in mesothelioma mortality in Britain. *Lancet*. 1995;345(8949):535-539.
17. Price B, Wave A. Mesothelioma trends in the United States: an update based on surveillance, epidemiology, and end results program data for 1973 through 2003. *American Journal of Epidemiology*. 2004;159(2):107-112.
18. Neuberger M, Vutuc C. Three decades of pleural cancer and mesothelioma registration. *International Archives of Occupational and Environmental Health*. 2003;76:161-166.
19. Stayner L, Welch LS, Lemen R. The worldwide pandemic of asbestos-related diseases. *Annual Review of Public Health*. 2013;34:205-216.
20. Park EK, Takahashi K, Hoshuyama T, Cheng TJ, Delgermaa V, Le GV, Sorahan T. Global magnitude of reported and unreported mesothelioma. *Environmental Health Perspectives*. 2011;119(4):514-518.
21. Instituto Nacional del Cáncer, Ministerio de Salud de la Nación. Atlas de mortalidad por cáncer en Argentina, 2007-2011. Buenos Aires: Ministerio de Salud de la Nación; 2013.
22. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJL, Lozano R, Inoue M. Age standardization of rates: a new WHO standard (GPE Discussion Paper Series: No. 31) [Internet]. WHO; 2001 [cited 15 Jun 2016]. Available from: <http://tinyurl.com/jl9vak9>.
23. Rodriguez E. Asbestos Banned in Argentina. *International Journal of Occupational and Environmental Health*. 2004;10(2):202-208.
24. Virta RL. Worldwide asbestos supply and consumption trends from 1900 through 2003: Circular 1298. Reston, Virginia: U.S. Geological Survey; 2006.
25. McCulloch J, Geoffrey-Tweedale G. Defending the indefensible: The global asbestos industry and its fight for survival. New York: Oxford University Press; 2008.
26. Capone L, Consiglio E, Fulgenci AE, Jarés E, Labbate A, Poropat A. Patología respiratoria de origen ocupacional: Ateneo SRT-AAMR. Buenos Aires: Superintendencia de Riesgos del Trabajo; 2007.
27. Marsili D, Terracini B, Santana VS, Ramos-Bonilla JP, Pasetto R, Mazzeo A, Loomis D, Comba P, Algranti E. Prevention of asbestos-related disease in countries currently using asbestos. *International Journal of Environmental Research and Public Health*. 2016;13(5): E494.
28. McElveny DM, Darnton AJ, Price MJ, Hodgson JT. Mesothelioma mortality in Great Britain from 1968 to 2001. *Occupational Medicine*. 2005;55:79-87.
29. Lacourt A, Gramond C, Rolland P, Ducamp S, Audignon S, Astoul P, Chamming's S, Gilg-Soitllg A, Rinaldo M, Raheison C, Galateau-Salle F, Imbernon E, Pairon JC, Goldberg M, Brochard P. Occupational and non-occupational attributable risk of asbestos exposure for malignant pleural mesothelioma. *Thorax* 2014;69(6):532-539.

30. Superintendencia de Riesgos del Trabajo. Informe sobre indicadores de accidentabilidad por provincia y sector económico: Procesamiento especial-año 2006. Buenos Aires: Instituto de Estudios Estratégicos y Estadísticas, Área de Estadísticas Superintendencia de Riesgos del Trabajo; 2006.
31. Alazraqui M, Spinelli H, Zunino MG, Souza ER. Calidad de los sistemas de información de mortalidad por violencias en Argentina y Brasil - 1990-2010. *Ciência e Saúde Coletiva*. 2012;17(12):3279-3288.
32. Addis B, Roche H. Problems in mesothelioma diagnosis. *Histopathology*. 2009;54(1):55-68.
33. Finnish Institute of Occupational Health. Asbestos, asbestosis, and cancer Helsinki criteria for diagnosis and attribution 2014. Helsinki: Finnish Institute of Occupational Health; 2014.
34. Collegium Ramazzini. Asbestos is still with us: repeat call for a universal ban. *New Solut*. 2010;20(2):257-66.
35. Pan American Health Organization. Health information and analysis: Health situation in the Americas: Basic indicators 2008. Washington DC: PAHO; 2008.

CITATION

Trotta A, Santana VS, Alazraqui M. Mesothelioma mortality in Argentina, 1980-2013. *Salud Colectiva*. 2017;13(1):35-44. doi: 10.18294/sc.2017.1027.

Received: 18 Jun 2016 | Modified: 2 Nov 2016 | Approved: 16 Dec 2016



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<https://doi.org/10.18294/sc.2017.1027>

This article was translated by Vanessa Di Cecco.