Mesothelioma Mortality in Brazil, 1980–2003

FRANCISCO PEDRA, MD, MSC, ANAMARIA TESTA TAMBELLINI, MD, PHD, BASÍLIO DE BRAGANÇA PEREIRA, STAT, PHD, ANA CAROLINA CARIOCA DA COSTA, HERMANO ALBUQUERQUE DE CASTRO, MD, PHD

Although asbestos causes asbestosis, lung cancer, and mesothelioma, it remains widely used in Brazil, mostly in cement-fiber products. We report the Brazilian mesothelioma mortality trend 1980–2003, using records of the national System of Mortality Information of DATASUS, including all deaths with IX International Disease Classification (ICD9) codes 163.n—*pleura cancer* during the period 1980-1995; and ICD10 codes c45.n—*mesotheliomas* and c38.4—*pleura cancer* for the years 1996–2003. Mesothelioma mortality rates increased over the period studied, from 0.56 to 1.10 deaths per 100,000 habitants. The total number of mesothelioma deaths nationwide in the period studied was 2,414; the majority (1,415) were in the Southeast region. Mortality was highest among males and people over age 65. Given the history of asbestos exposure in Brazil, our findings support the need for policies that limit or ban the use of this product. *Key words*: mesothelioma, mortality, asbestos, occupational epidemiology, Brazil.

INT J OCCUP ENVIRON HEALTH 2008;14:170–175

Mesothelioma, especially in the pleura, is caused by human exposure to asbestos fibers. Asbestos fibers may be inhaled by workers who deal directly with the fibers, by family members who encounter involuntary "take-home" exposures from workers' clothing, and by inhabitants of areas close to worksites where asbestos is processed or used. Environmental contamination can also occur through release of fibers from asbestos-containing products, such as tiles and pipes.

Doll[1] published the first English language epidemiologic study that demonstrated the association between asbestos exposure and lung cancer, and Wedler[2] established for the first time the relationship between asbestos and mesothelioma. The latency period for asbestos-caused mesothelioma latency is usually 20–40 years, but can range up to 60 years. However, in some individuals, the latency period may be shorter.[3]

Asbestos is considered a human carcinogen by International Agency for Research on Cancer (IARC); and many authors consider asbestos to be the predominant etiological agent of mesothelioma. Mesothelioma mortality can serve as an indicator of previous exposure to asbestos.[4]

The global production of asbestos developed throughout the 20th century, reaching a peak value around the 1970s (close to 5.10^6 tons per year), then declining to a plateau. Global asbestos consumption is currently close to 2.10^6 tons per year. In the year 2000, only six countries were responsible for almost all global asbestos production. Brazil is among these countries, and produces approximately 250,000 tons/year. Of the Brazilian production, 182,000 tons were consumed domestically, representing 1.3kg per capita/year, which ranks Brazil as the third greatest world wide asbestos consumer. From 5–10,000 tons/year in the 1960s, Brazil's consumption grew to 250,000 tons in the 1990s.[5]

There is no official information on the number of individuals exposed to asbestos in Brazil. However, it has been estimated that there are at least 240,000 workers exposed to asbestos in the fiber-cement and brick production industries alone.[6]

An increase in mesothelioma worldwide has been consistently documented, including an increase in Brazil.[7] Nevertheless, many authors point out that the number of mesothelioma deaths is underestimated, due to the long latency time, as well as difficulties in the diagnosis and identification of exposed individuals. Leigh[8] found that asbestos exposure may have caused a total of 5–10 million cancer deaths, including both lung cancer and mesothelioma. In Brazil, a recent study on pneumoconiosis, including asbestosis, showed increasing rates in several regions in the country.[9]

MATERIAL AND METHODS

The main goal of this study is to present the mortality mesothelioma data from Brazil and its macro-regions for the years 1980–2003. Mortality data was collected from the Sistema de Informação sobre Mortalidade (SIM, Mortality Information System), a database created by the Ministry of Health's DATASUS (Informa-

Received from the Center for the Study of Worker Health and Human Ecology (Centro de Estudos de Saúde do Trabalhador e Ecologia Humana), National School of Public Health, Fiocruz, Rio de Janeiro, Brazil (JFPM, HAdC); the Department of Preventive Medicine, Faculty of Medicine, Federal University of Rio de Janeiro (ATT, BdBP) and the Institute of Mathematics, Federal University of Rio de Janeiro, Brazil (ACCdC). This research was funded by CNPq, processo n° 480375/204—Universal 2004/Edital, and supported by FIOCRUZ/MS. Address correspondence to Francisco Pedra, Rua Leopoldo Bulhões 1480, Manguinhos–Rio de Janeiro, Cep: 21041-210, Brazil; email: <fpedra@ensp.fiocruz.br>.

Disclosures: The authors report no conflict of interest.

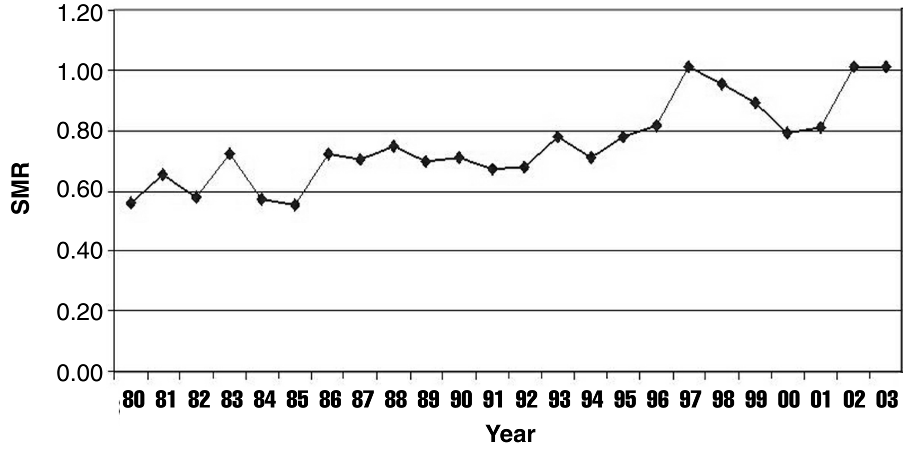

Figure 1—Mesothelioma Standardized Mortality Rate, Brazil 1980–2003 (×10^6 inhabitants)

tion Department of the Unified Health System). For the period 1980–1995, we selected records where cause of death was listed as 9th *International Classification of Diseases* (ICD9) codes 163.0—Malignant neoplasm of Parietal pleura; 163.1—Malignant neoplasm of Visceral pleura; 163.8—Malignant neoplasm other specified sites of pleura and 163.9—Malignant neoplasm of Pleura, unspecified. We assumed that all cases involving cancer coded as pleural neoplasia could be considered mesothelioma. For the period 1996–2003, we selected registered death cases coded as ICD10, codes C45.0—Mesothelioma of pleura; C45.1—Mesothelioma of peritoneum; C45.2—Mesothelioma of pericardium; C45.7—Mesothelioma of other sites; to C45.9—Mesothelioma, unspecified, as well as C38.4—Malignant neoplasm of pleura. The data was analyzed according to states, capitals and regions of the country. We used Tabwin® software to obtain the number of deaths from SIM database.

The total Brazilian population for coefficient calculations was obtained from the Brazilian Institute of Geography and Statistics (IBGE) General Census of 1980, 1991 and 2000. We estimated total populations for the intermediate years, based on IBGE data. Because mesothelioma is a rare cancer in the general population, we present the mortality rate in terms of deaths per 1,000,000 per year, based on the Brazilian population of the year 2000, to estimate the standard rates per age group. We compared state and capital (municipal) rates for the entire period studied against a standard rate for the entire nation over the same period.

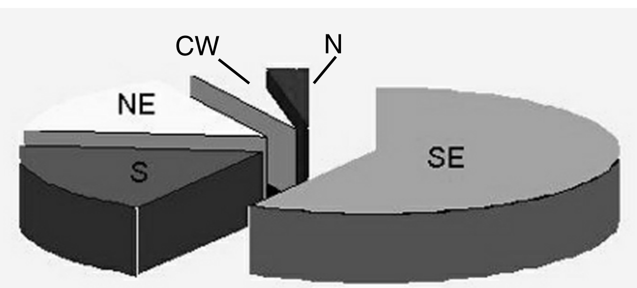

Figure 2—Deaths caused by mesothelioma in Brazil, 1980 to 2003, by region. Data from the National Mortality System, Ministry of Health, Brasil. SE = Southeast; S = South, NE = Northeast, CW = Center-west, N = North.

RESULTS

Mesothelioma mortality rates increased over the period studied, from 0.56 to 1.10 deaths per 100,000 habitants (Figure 1). There was an accumulated total of 2,414 mesothelioma deaths. Death frequency throughout the country increased from an average of 68.4 per year in the 1980s, jumping to 110 per year in the following decade, and 157 per year in 2000–2003.

Figure 2 shows the distribution of mesothelioma deaths according to Brazilian region, showing the heaviest concentration of deaths in the southeast and southern regions (58.6% and 18.1%, respectively). In Table 1, we present the standardized mortality rates (SMR) for the regions, states and capital cities having the highest average rate of mortality in the period under study. A considerable variation is observed in the rates, with the south and southeast regions having the highest rates. The 10 capitals with the highest number of cases accounted for 38.9% of the total deaths. In the southeast and south regions the figures were also high. SMRs were highest in the southern region (a high of 1.52/10^6 in 1997).

The states of São Paulo (691 deaths) and Rio de Janeiro (422 deaths) had the highest number of deaths over the entire period studied; on the other hand, Amapá (1 death) and Tocantins (2 deaths), presented the lowest total figures in the series. A sum of the deaths occurring in the capital cities amounts to 1022 (42.3% of national totals). Rio de Janeiro had the highest number of deaths (262) followed by the city of São Paulo (250 deaths), while Boa Vista and Palmas registered no deaths, and Macapá registered only one death.

TABLE 1 Mesothelioma Mortality Rates in Brazil, Regions, and Selected States and Capitals; by Year

	Mortality Mean Rate	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Brasil	0.68	0.56	0.65	0.58	0.73	0.57	0.55	0.72	0.70	0.75	0.70	0.71	0.67	0.68	0.78	0.71	0.78	0.82	1.01	0.95	0.89	0.79	0.81	1.01	1.01
Regions																									
Southeast	0.93	0.72	0.82	0.76	1.20	0.81	0.71	0.91	1.00	0.85	0.77	1.03	0.86	0.91	1.03	1.03	0.88	1.00	0.99	1.31	1.22	0.95	1.01	1.28	1.25
South	0.82	0.62	0.98	0.71	0.62	0.27	0.87	1.03	0.61	0.78	1.22	0.63	1.13	0.63	0.99	0.44	1.33	0.76	1.52	0.88	1.19	0.96	0.67	1.19	0.98
Center-west	0.45	0.00	0.26	0.67	0.55	0.60	0.12	0.54	0.35	0.93	0.58	0.28	0.14	0.35	0.38	0.54	0.93	1.37	1.12	1.16	0.65	0.46	0.77	0.90	0.42
Northeast	0.38	0.36	0.27	0.30	0.10	0.42	0.23	0.34	0.30	0.57	0.33	0.42	0.26	0.40	0.34	0.45	0.30	0.50	0.82	0.41	0.43	0.60	0.65	0.60	0.81
North	0.30	0.45	0.40	0.00	0.52	0.23	0.19	0.49	0.99	0.74	0.82	0.00	0.37	0.68	0.68	0.31	0.70	0.53	0.55	0.50	0.15	0.28	0.39	0.35	0.87
States																									
Rio de Janeiro	1.36	1.15	1.24	0.55	1.22	0.84	0.79	1.78	1.33	0.96	0.94	1.35	1.36	1.39	1.54	1.55	1.53	0.85	1.49	1.46	2.10	1.08	0.86	1.44	1.71
Rio Grande do Sul	1.19	0.55	1.33	1.19	0.90	0.42	0.78	1.21	0.62	0.81	1.81	0.82	1.72	0.60	0.83	0.72	1.87	0.87	2.33	1.33	1.36	1.00	0.72	1.77	1.18
Distrito Federal	1.04	0.00	0.72	2.23	1.45	0.00	0.00	0.00	0.78	2.89	0.00	0.00	0.00	1.58	0.00	1.55	0.89	3.13	0.74	6.87	1.92	0.52	2.61	4.28	1.40
São Paulo	0.91	0.72	0.78	1.01	1.28	0.85	0.83	0.88	1.02	0.87	0.77	1.08	0.69	0.75	0.83	0.91	0.58	1.16	0.83	1.42	1.16	1.07	1.13	1.22	1.20
Minas Gerais	0.72	0.42	0.38	0.58	1.09	0.63	0.50	0.24	0.71	0.73	0.71	0.56	0.86	0.92	0.98	0.88	1.03	0.94	0.92	0.97	0.59	0.64	0.90	1.35	0.98
Santa Catarina	0.63	0.37	1.00	0.90	0.81	0.00	0.74	0.97	0.30	0.27	0.29	0.92	0.00	0.82	1.25	0.52	1.59	0.71	0.54	0.97	1.86	1.28	0.99	0.52	0.58
Pernambuco	0.57	1.03	1.03	0.39	0.00	0.17	0.18	0.17	0.50	0.73	0.35	0.11	0.33	0.32	0.92	0.46	0.30	1.41	1.25	0.95	0.73	0.49	0.64	1.09	1.00
Paraná	0.51	0.89	0.50	0.00	0.16	0.25	1.13	0.81	0.74	1.00	0.84	0.19	0.93	0.58	1.10	0.00	0.39	0.61	0.94	0.26	0.57	0.72	0.40	0.84	0.96
Bahia	0.43	0.49	0.15	0.70	0.00	0.79	0.61	0.64	0.36	1.16	0.11	0.75	0.30	0.74	0.26	0.31	0.19	0.09	0.79	0.26	0.36	0.74	1.03	0.74	0.62
Pará	0.40	0.47	0.28	0.00	0.62	0.43	0.38	0.48	1.18	0.98	0.38	0.00	0.70	0.66	0.99	0.32	0.60	0.74	0.82	0.51	0.29	0.35	0.66	0.69	1.11
Ceará	0.31	0.00	0.26	0.00	0.00	0.48	0.00	0.23	0.19	0.57	0.56	0.71	0.00	0.20	0.33	0.60	0.32	0.67	0.29	0.30	0.47	0.80	0.40	0.22	0.39
Capitals																									
Rio de Janeiro	1.99	1.46	2.00	0.54	1.38	0.88	0.89	2.10	1.76	0.99	0.89	1.35	2.11	1.69	2.39	1.73	2.18	1.15	2.28	1.56	3.35	1.07	0.96	1.50	1.86
Porto Alegre	1.99	1.81	2.69	0.81	0.00	0.00	0.00	1.57	2.38	0.74	3.69	0.70	2.79	2.48	1.96	0.00	3.35	0.64	3.10	0.61	1.19	0.52	1.58	5.76	0.50
Recife	1.71	2.06	1.90	1.04	0.00	0.98	0.88	0.78	1.79	2.79	1.91	0.73	0.81	1.62	4.36	2.49	0.00	4.51	3.70	3.70	0.75	1.93	0.66	1.26	2.54
Salvador	1.51	3.27	0.00	1.70	0.00	3.96	2.16	2.32	0.00	3.03	0.88	4.60	2.44	3.43	1.18	1.25	0.72	0.63	4.39	1.22	1.71	3.47	2.95	2.74	0.89
Belém	1.21	1.58	0.88	0.00	2.41	0.00	1.32	1.64	4.08	1.20	1.36	0.00	1.34	2.46	1.06	0.00	1.90	2.31	3.35	2.12	1.17	0.00	2.63	1.82	3.56
Belo Horizonte	1.11	0.00	1.16	1.47	2.03	0.64	1.25	0.00	0.45	1.11	1.96	0.00	1.16	1.65	1.01	0.59	2.06	0.43	2.38	2.36	1.31	0.82	0.42	2.43	1.19
São Paulo	1.09	0.84	0.85	1.30	1.66	0.82	1.49	0.72	0.84	1.39	1.41	0.87	0.63	0.97	1.17	0.88	0.30	1.26	1.12	1.66	1.51	1.06	1.30	1.29	1.88
Brasília	1.04	0.00	0.72	2.23	1.45	0.00	0.00	0.00	0.78	2.89	0.00	0.00	0.00	1.58	0.00	1.55	0.89	3.13	0.74	6.87	1.92	0.52	2.61	4.28	1.40
Curitiba	1.00	0.00	0.00	0.00	0.00	0.00	3.42	1.10	1.06	2.79	0.79	1.17	0.00	0.64	3.41	0.00	1.46	0.62	3.47	0.86	0.84	0.61	1.09	0.60	1.88
Fortaleza	0.77	0.00	0.00	0.00	0.00	1.81	0.00	0.84	0.98	2.57	2.40	3.31	0.00	0.70	0.79	1.32	1.54	1.84	0.61	0.60	0.58	1.58	0.51	0.50	1.01

Calculated with Mortality Information System data, Ministry of Health, Brazil.

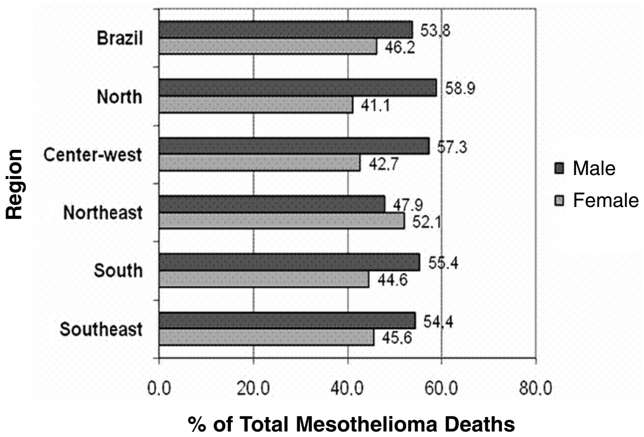

Figure 3—Mesothelioma deaths in Brazil, 1980–2003, by region and gender.

Figure 3 shows the regional distribution by sex, indicating the predominance of deaths of the male sex, accompanied by a comparable female deaths rates. Most previous reports reveal much higher ratios of male/female rate.[10,11] The northern region displayed the lowest number of mesothelioma deaths, with 73 cases total, ranging from a low of 0 in 1982 to a peak of 8 in 2003. The southeastern region had the greatest number of deaths, amounting to a total of 1,415, ranging from 30 in 1980 to 130 in 2003.

Figure 4 shows the distribution of mesothelioma deaths by age group. There is a clear increase with age; almost 50% of the deaths were of individuals over 65 years of age.

DISCUSSION

Today there is an increasing objection to the use of asbestos in all its forms, as it has been technically established that there are no safe levels of exposure to this carcinogenic agent. The companies that produce or handle asbestos have opposed the pressure brought by workers, communities and academic and sanitary institutions for a global asbestos ban. These companies have focused on their own commercial interests, despite the public health costs of asbestos and the fact that there are several optional technologies available. More than 45 countries have decided to ban asbestos, but the asbestos industry has responded by migrating its production to poorer countries, with fewer laws protecting the worker and the community health.[7,12]

According to WHO, there are 124 million people worldwide directly exposed to asbestos. Also, Goldberg et al.[13] and Lin et al.[14] conclude that 20–40% of the employees in countries that still permit the use of asbestos were, at least once, in contact with the product. WHO estimates that 100,000 people die from diseases related to asbestos annually, and that 43,000 from this group have mesothelioma and 29,000 lung cancer.[15] The number of mesothelioma cases in industrialized nations is still growing, and 100,000 deaths are expected to occur in Europe. In Western Europe, an estimated 9,000 mesothelioma deaths will take place in 2018, and 250,000 will die from mesothelioma over the next 35 years.[16] Neuman et al.,[17] showed that in Germany there was an increase in mesothelioma cases between 1987 and 1999. Our study showed similar increases in mesothelioma mortality. This increase is likely due to the latency period of mesothelioma in cases first exposed to asbestos between 1950 and 1980. It is also likely due to an improvement of diagnostic services in Brazil.

One of the limitations of this study is the quality of the DATASUS data, as well as variations in recordkeeping in the 25 years since its implementation. In this connection, Mello Jorge et al.[18] conducted an analysis of SIM and found that data quality was related to the clarity with which the death was recorded, as well as the number of deaths that occurred outside the health care system. These two factors have been improving over time. There are some Brazilian states with a high death

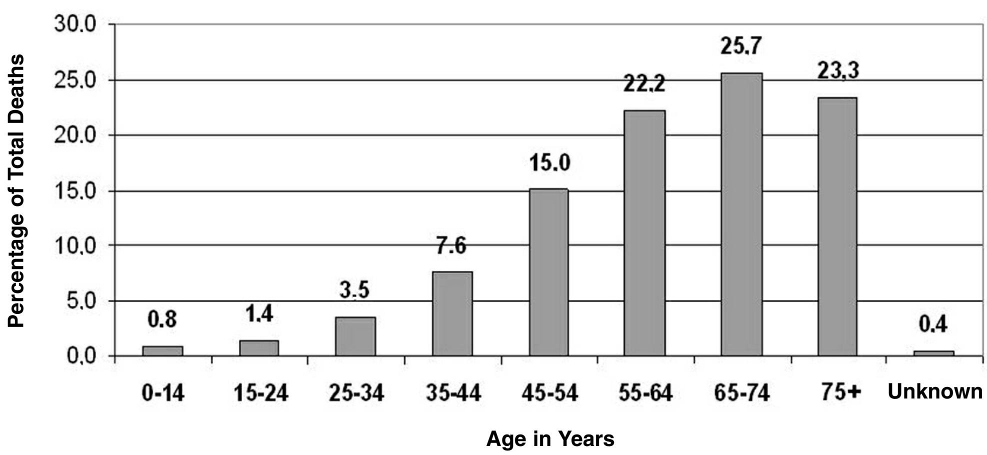

Figure 4—Mesothelioma Deaths in Brazil, 1980–2003, by age group.

rate that is classified as poorly-defined by DATASUS. This deficiency represents an important gap in the knowledge of distribution of the specific causes of death, including mesothelioma. According to Mello Jorge et al., until the middle-1980s more than 20% of the total deaths included in SIM were poorly defined. By 1990, the poorly defined group had declined to about 16% and by the 2000s the frequency of poorly defined cases dropped to around 13%. Cause of death reporting is better in the South and Southeast regions, and worse in the Middle West, Northeast and North. It is important to point out that, for the diagnosis of mesothelioma, the presence of qualified diagnostic centers is fundamental, and these are more common in the Southern and Southeastern regions.

Variation and ambiguity in ICD reporting codes may also limit our study. In considering ICD9 reporting codes in the earlier years covered by our study, we assumed a correspondence between mortality by pleura cancer and mesothelioma, labeling all deaths with the pleura cancer codification as mesothelioma deaths. Other researchers have multiplied the total ICD9 pleura cancer cases by correcting factors, either downwards 0.81, like Banaei,[19] or upwards, 1.4 for men and 1.6 for women, like Murinaga.[10] For cases coded according to the ICD10, we included deaths coded as mesothelioma as well as those coded as pleura cancer, bearing in mind that the implementation of ICD10 was not followed by a specific training of the codifiers, and at least some were likely to continue coding mesothelioma as pleura cancer. We considered the use of two corrective factors. First, we considered multiplication by a correcting factor lower than 1 to correct the ICD9 period and, secondly, multiplication by a factor higher than 1 in the period corresponding to ICD10.

After consideration, we assumed that many mesothelioma cases had pleura cancer listed as cause of death in both the ICD9 and ICD10 periods. In addition, we assumed that the lack of mesothelioma diagnostic centers equipped with immuno-histochemical diagnostic methods have likely given rise to under-diagnosis. A study conducted in the State of Rio de Janeiro by Pinheiro[21] points out a probable underestimate in the total cases diagnosed in the state. The model presented in this study is simpler and ensures a better picture of the disease in our population, while maintaining the homogeneity and coherence of the data in view of the fragility of our record system.

Further evidence that supports our assumptions regarding mesothelioma deaths is the fact that the distribution of rates and the absolute number of deaths in the period under study show a sudden decline after deaths coded as pleura cancer are excluded, suggesting a classification and coding problems. This decline appears exactly at the transition period between the two ICD classifications. We could not find any literature concerning a relationship between this hypothetical "decline" of deaths and mortality rates and a possible reduction in the in the exposure to asbestos, that would relate this "decline" to data regarding production, consumption, importation of raw material, use patterns, and technological changes into consideration. Therefore, the increased mortality rate seems to be more consistent with the natural history of the disease and the history of exposure.

In this study, concentration of mesothelioma deaths in the south and southeast, with a concentration in the capitals of the states may be explained by the fact that these are the regions with higher production and consumption of asbestos. In addition, better health care services and better quality diagnoses are available in those regions. However, a high mortality rate is also observed in the Federal Capital (Brasília), situated in the Federal District and in Goiânia, capital of the state of Goiás (Table 1). These areas are located near the only official Brazilian asbestos mine, which has been operating since 1967. It may be that the deaths occurring in both cities are related to the operation of this mine.

A fact that stands out in our findings is the similarity in SMRs between men and women. This finding differs from that in other countries, but may be due to one or more factors. It may indicate heavy exposure in predominantly female work activities, such as the use of asbestos in the textile industry,[22] or the incorporation of women's labor in other asbestos industries. High rates among women may also be due to the indirect exposure of families to asbestos fibers brought home by the workers on their clothing. This is explained by the fact that in Brazil the measures for "controlled use," for example double dressing-rooms, were taken rather late, in the early 1990s. One study on mesothelioma mortality in Holland, 1969–1998, found a gender ratio of 5:1 (male:female deaths), with an almost four-fold mesothelioma mortality ratio among men over the period studied, with no increase of the rates among women. An Italian study using a questionnaire for interviewing individuals suffering from mesothelioma showed that 83% of the men identified a possible work exposure, while only 15.7% of the women identified some labor exposure.[24] Among the women, 19.2% referred to take-home labor exposure and 6.2% to environmental exposure.

The majority of the studies indicate a higher rate of mesothelioma in men, due to their more frequent exposure in the labor environment.[25] Magnani et al., however, have shown an increase of cases among women.[26] Results from Lemesch show an equal growth tendency in male and female mesothelioma mortality rates, but with no direct work exposure in women.[27] Hillerdal found a high percentage of peritoneal mesothelioma among women.[28]

Our study found that most cases occurred in people over the age of 55, with 50% of the deaths in those over 65 years. This finding is similar to that of other studies.

Segura et al. found that in the 50-54 age group the rate was $14/10^6$ persons/year, while in the 70–74 age group the rate was $143/10^6$ persons/year.[23] Likewise, Neuman et al. indicated that the mean age found was 63.6±9.9 (range: 26–89 years), with 33.3% between 50 and 60 years, and 53.8% above 60.[17] For developing countries where the quality of life tends to improve over time, with a consequent increase of life expectancy, there will also be a potential mortality increase by mesothelioma in the higher age groups.

Our results reflect limitations due to the source of data, and from the reasons given above. We probably underestimate the total mesothelioma deaths in Brazil. Nevertheless, our findings reflect labor and environmental exposures in Brazil, and show an increase in mortality between the years 1980 and 2003. The use of asbestos in Brazil and worldwide is a public health problem of great magnitude. Our report is further evidence for the need for an immediate, global ban on asbestos use. However, and even if this is done very soon, treatment, compensation, surveillance and follow-up of the victims of asbestos expsoure will be required for at least 40 to 50 years into the future.

Our special thanks to Ines Echenique Mattos, PhD from the Department of Epidemiology and Quantitative Methods in Health at the National Public Health School, Oswaldo Cruz Foundation, for her careful reading and discussion of this manuscript.

References

1. Doll R, Mortality from lung cancer in asbestos workers. Br J Ind Med. 1955;12:81–86.
2. Cited in: Hagemeyer O, Olten H, Kraus T. Asbestos consumption, asbestos exposure and asbestos related occupational diseases in Germany. Int Arch Occup Environ Health. 2006; 79:613-620..
3. Lanphear BP, Buncher CR. Latent period for malignant mesothelioma of occupational origin. Occup Med. 1992 Jul; 34(7):718–21.
4. Tossavainen A. Asbestos, asbestosis and cancer: The Helsinki criteria for diagnosis and attribution. Consensus report. Scand J Work Environ Health. 1997; 23:211–216.
5. LaDou J. The Asbestos Cancer Epidemic. Environmental Health Perspectives. 2004;112:285–290.
6. Algranti E, Mendonça E, Freitas JBP, Silva HC, Bussacos MA. Non-malignant asbestos-related diseases in Brazilian asbestos-cement workers. Am J Ind Med. 2001; 40:240–254.
7. Giannasi F. A Construção de Contra-Poderes no Brasil na luta contra o Amianto: A Globalização por Baixo [The construction of counter-powers in Brazil in the fight against asbestos]. In: Mendes R. Patologia do Trabalho [Pathology of Work]. Rio de Janeiro: Ed. Atheneu; 2002. 2 Volumes, 2° edição.
8. Leigh J. Asbestos-related diseases: international estimates of future liability. In: Working Safely in a Changing World. Proceedings of the 5th International Congress on Work Injuries Prevention, Rehabilitation, and Compensation and 2nd Australian National Workers Compensation Symposium (Workcongress 5), 2001 March 18–21; Adelaide Australia. Adelaide; Workcover Corporation South Australia, 102.
9. Castro, HA, Vicentin, G, Pereira KCX. Mortality due to pneumoconioses in macro-regions of Brazil from 1979 to 1998; J Bras Pneumol. 2003; 29(2):82–8.
10. Murinaga K, Kishimoto T, Sakatani M, Akira M, Yokoyama K, and Sera Y. Asbestos-Related Lung Cancer and Mesothelioma in Japan. Industrial Health 2001; 39, 65–74.
11. Enterline PE, Henderson VL. Geographic patterns for pleural mesothelioma deaths in the United States, 1968–1981. JNCI. 1987; 79:31-37.
12. Castleman B. Global Corporate Policies and international “double standards” in occupational and environmental health. Int J Occup.Environ. Health. 1999; 5:61–64.
13. Goldberg M, Banaei A, Goldberg S, Auvert B, Luce D, Gueguen A. Past occupational exposure to asbestos among men in France. Scand J Work Environ Health. 2000; 26:52–61.
14. Lin RT, Takahashi K, Karjalainen A, Hoshuyama T, Wilson D, Kameda T, Chan CC, Wen CP, Furuya S, Higashi T, Chien LC, Ohtaki M. Ecological association between asbestos-related diseases and historical asbestos consumption: an international analysis. Lancet. 2007;369:844–49
15. World Health Organization. Asbestos, 2d ed. Air Quality Guideline. Copenhagen;WHO Regional Office for Europe; 2000.
16. Peto J, Decarli A, La Vecchia C, Levi F, Negri E. The European mesothelioma epidemic. Br J Cancer. 1999;79:566–572.
17. Neumann V, Günther S, Müller KM, Fischer M. Malignant Mesothelioma—German Mesothelioma Register 1987–1999. Int Arch Occup Environ Health. 2001; 74:383–395.
18. Mello Jorge MHP, Laurenti R, Gotlieb SLD, Análise da qualidade das estatísticas vitais brasileiras: a experiência de implantação do SIM e do SINASC [Analysis of the quality of Brazilian vital statistics: The experience of the establishment of SIM and SINASC]. Cien Saude Colet 2007; 12(3):643–654.
19. Banaei A, Auvert B, Goldberg M, Gueguen A, Luce D, Goldberg S. Future trends in mortality of French men from Mesothelioma. Occup Environ Med. 2000; 57:488–494.
21. Pinheiro GA, Antão VCS, Monteiro MMT, Capelozzi VL, Terra-Filho M. Mortality from pleural mesothelioma in Rio de Janeiro, Brazil, 1979–2000. Int J Occup Environ Health. 2003; 9:147–152.
22. Castro HA, Mendonça ICT. Perfil Respiratório de 121 Trabalhadores em Indústria Têxtil com Exposição ao Amianto no Estado do Rio de Janeiro [Respiratory profile of 121 textile industry Workers with exposure to asbestos in the state of Rio de Janeiro]. Rev. Bras. Med. Trab.. 2003; 1(2):119–123.
23. Segura O, Burdorf A, Looman C. Update of predictions of mortality from pleural mesothelioma in the Netherlands. Occup Environ Med. 2003; 60:50–55.
24. Gennaro V, Ugolini D, Viarengo P, Benfatto L, Bianchelli M, Lazzarotto A, et al.. Incidence of pleural mesothelioma in Liguria Region, Italy (1996–2002). Eur J Cancer. 2005; Nov;41(17): 2709–14.
25. Roggli VL, Oury TD, Moffatt EJ. Malignant mesothelioma in women. Anat Pathol.; 1997; 2:147–63.
26. Magnani C, Agudo A, González CA, Andrion A, Calleja A, Chellini E, et al. Multicentric study on malignant pleural mesothelioma and non-occupational exposure to asbestos. Br J Cancer 2000; 83(1), 104–111.
27. Lemesch C, Katz L, Steinitz R. Mesothelioma in Israel (1973–1982). R Soc Health. 1986; 106(4):141–2.
28. Hillerdal G. Malignant mesothelioma 1982: review of 4710 published cases. Br J Dis Chest. 1983; 77(4):321–43.