

Malignant Mesothelioma Mortality in the United States, 2007 - 2016

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Received: September 09, 2019; **Published:** November 14, 2019

Abstract

Background: Malignant mesothelioma is clearly caused by asbestos. The decline in asbestos use may affect malignant mesothelioma deaths and incidence. Although asbestos use has been declined in the United States (U.S.), malignant mesothelioma deaths and incidence occurred yearly. Temporal trends in malignant mesothelioma need to be closely examined and evaluate to provide crucial information to the local, state, and Federal government for making policy and recommendation of prevention and control of malignant mesothelioma.

Objective: To describe the temporal trends in malignant mesothelioma deaths and death rates in the U.S.

Materials and Methods: Malignant mesothelioma deaths aged 25 years and older were identified using 2007 - 2016 U.S. national death certificates which are most recently available data obtained from the U.S. National Center for Health Statistics. The mesothelioma death rates were age-adjusted to the 2000 U.S. standard population and 95% confidence intervals (CI) were calculated by Poisson analysis.

Results: During 2007 - 2016, a total of 27,285 malignant mesothelioma were identified. Of these deaths, 21,567 (79.0%) were men and 25,698 (94.2%) were white. The overall age-adjusted death rate was 12.3 (95% CI: 12.2 - 12.5) per million population per year. The age-adjusted death rates decreased from 13.0 (95% CI: 12.5 - 13.5) in 2007 to 11.1 (95% CI: 10.7 - 11.5) in 2016. Rates were higher among men (23.0, 95% CI: 22.7-23.3) than women (4.6, 95% CI: 4.5 - 4.7). Among age group, the rates were highest among aged 85 years and older (79.4, 95% CI: 77.1 - 81.6). Among anatomic sites, rates were the highest in unspecified sites (9.8, 95% CI: 9.7 - 10.0).

Conclusion: Malignant mesothelioma death rates declined from 2007 to 2016. However, the number of malignant mesothelioma deaths are still occurring at a yearly average of 2,729 deaths for 2007 - 2016. These surveillance data suggest the need for more comprehensive policy and recommendation to prevent asbestos exposure and control in order to reduce malignant mesothelioma deaths in the U.S.

Keywords: *Malignant Mesothelioma; Asbestos; Erionite; Exposure; Death; Death Rate; Occupation, Prevention*

Introduction

Malignant mesothelioma is a cancer associated with asbestos fibers and other fibrous minerals (e.g. erionite). The latent period between first exposure to asbestos and development of malignant mesothelioma is generally 20 - 40 years [1].

All forms of asbestos including the serpentine form (chrysotile) and the amphibole forms (i.e. crocidolite, amosite, anthophyllite, tremolite, and actinolite) cause malignant mesothelioma [2]. Asbestos has been used in a variety of applications such as asbestos cement products (tiles, roofing, drain pipes), insulation and fireproofing textiles for heat resistance, asbestos paper, and friction materials (brake linings and gaskets). Probably the most hazardous current exposures are during repair and demolition of old buildings and ships and related on-site maintenance job. Currently in the U.S., the construction industry is the major source of asbestos exposure to workers [3]. An estimate 1.3 million construction and general industry workers potentially exposed to asbestos in the U.S. [4]. Asbestos is no longer mined in the U.S., but it is still imported, and a substantial amount of asbestos remaining in old buildings will be removed.

This report is to describe the updated trend in malignant mesothelioma mortality based on malignant mesothelioma mortality data available for the recent decade, 2007 - 2016 in the U.S. There was a previous report on malignant mesothelioma mortality in the U.S., 1999 - 2005 [5].

Materials and Methods

Malignant mesothelioma deaths during 2007 - 2016 which was currently available were identified from death certificates obtained from the U.S. National Center for Health Statistics, the Centers for Disease Control and Prevention. Malignant mesothelioma was based on the multiple cause (underlying or contributing). The respiratory mortality data have been compiled in the National Occupational Respiratory Mortality System [6] by the National Institute for Occupational Safety and Health.

For analysis of the mortality data, age was limited decedents aged 25 years and older who might be exposed to asbestos occupationally or environmentally and considering the latent period of 20 years and over. By anatomic sites according to International Classification of Disease (ICD), 10th Revision codes for malignant mesothelioma, pleura, peritoneum, other sites, and unspecified sites were included.

The death rates were age-adjusted using the 2000 U.S. standard population and 95% CIs were calculated by Poisson analysis [7].

Results

During 2007 - 2016, a total of 27,285 malignant mesothelioma were identified. Of these deaths, 21,567 (79.0%) were men and 5,718 (94.2%) were white. Total deaths among old adults, aged 55 years and older were 25,930 (95%) and deaths among young adults aged 25 - 44 years old were 1,355 (5%) (Table 1).

| | Total | | | | Men | | | | Women | | | |
|--------------------------|--------|-------|-------|-------------|--------|-------|-------|-------------|--------|-------|-------|-----------|
| | Deaths | % | Rate* | 95% CI | Deaths | % | Rate* | 95% CI | Deaths | % | Rate* | 95% CI |
| Total | 27,285 | 100.0 | 12.3 | 12.2 - 12.5 | 21,567 | 100.0 | 23.0 | 21.7 - 23.3 | 5,718 | 100.0 | 4.6 | 4.5 - 4.7 |
| Race | | | | | | | | | | | | |
| White | 25,698 | 94.2 | 13.5 | 13.4 - 13.7 | 20,345 | 94.3 | 24.9 | 24.6 - 25.3 | 5,353 | 93.6 | 5.1 | 4.9 - 5.2 |
| Black | 1,174 | 4.3 | 5.6 | 5.2 - 5.9 | 921 | 4.3 | 11.3 | 10.5 - 12.0 | 253 | 4.4 | 2.0 | 1.7 - 2.2 |
| Other | 413 | 1.5 | 3.8 | 3.4 - 4.2 | 301 | 1.4 | 6.6 | 5.8 - 7.4 | 112 | 2.0 | 1.8 | 1.4 - 2.1 |
| Age groups (yrs.) | | | | | | | | | | | | |
| 25 - 34 | 81 | 0.3 | 1.0 | 0.9 - 1.1 | 647 | 3.0 | 1.3 | 1.2 - 1.4 | 34 | 0.6 | 0.8 | 0.7 - 4.8 |
| 35 - 44 | 268 | 0.9 | 0.1 | 0.6 - 0.7 | 152 | 0.7 | 0.8 | 0.6 - 0.9 | 116 | 2.0 | 0.6 | 0.5 - 0.7 |
| 45 - 54 | 1,006 | 3.7 | 2.3 | 2.1 - 2.4 | 649 | 3.0 | 3.0 | 2.8 - 3.2 | 357 | 6.2 | 1.6 | 1.4 - 1.8 |
| 55 - 64 | 3,482 | 12.8 | 9.0 | 8.7 - 9.3 | 2,568 | 11.9 | 13.8 | 13.3 - 14.3 | 914 | 16.0 | 4.6 | 4.3 - 4.9 |

| | | | | | | | | | | | | |
|----------------------|--------|------|------|-------------|--------|------|-------|---------------|-------|------|------|-------------|
| 65 - 74 | 7,765 | 28.5 | 32.4 | 31.6 - 33.1 | 6,279 | 29.1 | 56.0 | 54.6 - 57.4 | 1,486 | 26.0 | 11.6 | 11.0 - 12.2 |
| 75 - 84 | 10,018 | 36.7 | 75.5 | 74.0 - 77.0 | 8,201 | 38.0 | 145.2 | 142.0 - 148.3 | 1,817 | 31.8 | 23.8 | 22.7 - 24.9 |
| 85+ | 4,665 | 17.1 | 79.4 | 77.1 - 81.6 | 3,071 | 14.2 | 186.6 | 180.6 - 192.7 | 994 | 17.4 | 25.4 | 23.8 - 27.0 |
| Anatomic site | | | | | | | | | | | | |
| Pleura | 1,846 | 6.7 | 0.8 | 0.7 - 0.9 | 1,473 | 6.8 | 1.6 | 1.5 - 1.6 | 373 | 6.5 | 0.3 | 0.2 - 0.3 |
| Peritoneum | 1,260 | 4.6 | 0.6 | 0.5 - 0.6 | 747 | 3.4 | 0.7 | 0.6 - 0.8 | 513 | 8.9 | 0.4 | 0.3 - 0.5 |
| Other sites | 2,648 | 9.6 | 1.2 | 1.1 - 1.3 | 2,087 | 9.6 | 2.2 | 2.1 - 2.3 | 561 | 9.7 | 0.4 | 0.4 - 0.5 |
| Unspecified | 21,725 | 79.1 | 9.8 | 9.7 - 10.0 | 17,416 | 80.2 | 18.6 | 18.3 - 18.9 | 4,309 | 74.9 | 3.4 | 3.3 - 3.5 |

Table 1: Malignant mesothelioma deaths and age-adjusted death rates among decedents aged 25 years and older by sex, anatomic site, and year in the United States, 2007 - 2016.

*Age-adjusted death rates.

The overall age-adjusted death rate was 12.3 (95% CI: 12.2 - 12.5) per million population per year. The number of deaths substantially increased from 2,603 in 2007 to 2,708 in 2016. The age-adjusted death rates decreased from 13.0 (95% CI: 12.5 - 13.5) in 2007 to 11.1 (95% CI: 10.7 - 11.5) in 2016 (Table 2).

| Year | Total | | | Men | | | Women | | |
|-------------|--------|-------|-------------|--------|-------|-------------|--------|-------|-----------|
| | Deaths | Rate* | 95% CI | Deaths | Rate* | 95% CI | Deaths | Rate* | 95% CI |
| 2007 | 2,603 | 13.0 | 12.5 - 13.5 | 2,072 | 24.8 | 23.7 - 25.9 | 531 | 4.7 | 4.3 - 5.1 |
| 2008 | 2,708 | 13.3 | 12.8 - 13.8 | 2,151 | 25.1 | 24.0 - 26.2 | 557 | 4.8 | 4.4 - 5.2 |
| 2009 | 2,752 | 13.2 | 12.7 - 13.7 | 2,193 | 25.1 | 24.1 - 26.2 | 559 | 4.7 | 4.3 - 5.1 |
| 2010 | 2,745 | 13.0 | 12.5 - 13.5 | 2,182 | 25.5 | 23.4 - 25.5 | 563 | 4.7 | 4.3 - 5.1 |
| 2011 | 2,829 | 13.1 | 12.7 - 13.7 | 2,286 | 25.2 | 24.2 - 26.3 | 543 | 4.4 | 4.0 - 4.8 |
| 2012 | 2,873 | 13.0 | 12.5 - 13.4 | 2,258 | 24.0 | 23.0 - 25.0 | 615 | 4.9 | 4.5 - 5.3 |
| 2013 | 2,686 | 11.8 | 11.3 - 12.3 | 2,065 | 21.4 | 20.5 - 22.4 | 621 | 4.9 | 4.5 - 5.3 |
| 2014 | 2,784 | 12.0 | 11.6 - 12.5 | 2,175 | 22.1 | 21.1 - 23.0 | 609 | 4.7 | 4.3 - 5.0 |
| 2015 | 2,597 | 11.0 | 10.5 - 11.4 | 2,047 | 20.2 | 19.3 - 21.1 | 550 | 4.1 | 3.8 - 4.5 |
| 2016 | 2,708 | 11.1 | 10.7 - 11.5 | 2,138 | 20.5 | 19.6 - 21.4 | 570 | 4.2 | 3.8 - 4.5 |
| 2007 - 2016 | 27,285 | 12.3 | 12.2 - 12.5 | 21,567 | 23.0 | 22.7 - 23.3 | 5,718 | 4.6 | 4.5 - 4.7 |

Table 2: Malignant mesothelioma deaths and age-adjusted death rates among decedents aged 25 years and older by sex and year in the United States, 2007 - 2016.

*Age-adjusted death rate.

Rates were higher among men (23.0, 95% CI: 21.7 - 23.3) than women (4.6, 95% CI: 4.5 - 4.7). By age group, rates began to increase with age and it increased more rapidly after 65 years and older among men and women. The rates were highest among men aged 85 years and older (186.6, 95% CI: 180.6 - 192.7) (Table 1).

By anatomic sites, rates were lowest in peritoneum ((0.6, 95% CI: 0.5-0.6) and the highest rates were in unspecified sites (9.8, 95% CI: 9.7 - 10.0) (Table 1).

Discussion

The age-adjusted death rates were decreased for the recent decade, 2007 - 2016. The decreased age-adjusted rates would be influenced by several factors. First, asbestos use in the U.S. reduced to 1,100 in 2011 from peak at 803,000 metric tons in 1973 [8]. Second, the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency limited asbestos exposure. OSHA established a permissible exposure limit (PEL) limit at 12 fibers per cubic centimeter (f/cc) of air 1971. This initial PEL was reduced to 5 f/cc in 1972, 2 f/cc in 1986, and 0.1 f/cc in 1904 [9].

This report shows that men have the higher malignant mesothelioma death rates than women, which may reflect differences in occupational exposures [10]. Men were exposed to asbestos from working in asbestos-related industries, such as construction, asbestos mining and manufacturing, and ship building.

During 2007 - 2016, the annual number of mesothelioma deaths peaked in 2012 and then decreased substantially. A study on cancer incidence data from the National Cancer Institute's Surveillance, Epidemiology, and End Results reported that cancer incidence should be declining after 2004 with an expected return to background levels by 2055 [11]. Malignant mesothelioma deaths and incidence cases are expected to decline in the future.

The majority malignant mesothelioma deaths (95%) occurred in older aged group, but 5% of the total deaths occurred in young adults aged less than 44 years old. It is not clear whether asbestos is main risk factor associated with malignant mesothelioma deaths in young adults. Nonoccupational exposure to asbestos might be a probable causative factor in the development of malignant mesothelioma in young adults. In addition, a possible genetic predisposition and radiation exposure might be associated with malignant mesothelioma in young adults [12].

The strength in this study is use of the national malignant mesothelioma mortality data available up to 2016 for recent decade, 2007 - 2016 in order to evaluate the most recent malignant mesothelioma mortality trend in the U.S. However, this study is subject to two limitations. First, death certificates do not include information on exposure to asbestos or specific work history. This limits identification of industries or occupations associated with malignant mesothelioma. Second, there are possibility of misdiagnosis of mesothelioma without confirmation by biopsy or immunohistochemistry [2]. Especially, some of peritoneum mesothelioma may have been differently diagnosed as serious papillary carcinoma of the peritoneum or ovary, resulting in an underestimate [10].

Conclusion

The finding in this study shows that the annual age-adjusted death rates of malignant mesothelioma declined for the recent decade, 2007 - 2016. The malignant mesothelioma deaths occurred at a yearly average of 2,729 death for 2007 - 2016. The Malignant mesothelioma is expected to decrease in the future. New cases might occur through occupationally or environmentally exposure to asbestos during remediation and demolitions of existing asbestos in old buildings or other mineral fibers (e.g. erionite), naturally occurring in the U.S.

Malignant mesothelioma mortality surveillance should be continued to tract temporal trend in mortality. Surveillance program can detect trends and clusters of malignant mesothelioma occurrences. Malignant mesothelioma can be prevented by eliminating exposure to asbestos occupationally and environmentally.

Conflict of Interest

I have no financial interest or no conflict of interest.

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Volume 8 Issue 12 December 2019

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