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Pneumoconiosis mortality and morbidity trends in the United States, 1968–2004

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Abstract

Objective: To describe trends in pneumoconiosis in the United States during 1968–2004.

Methods: The National Center for Health Statistics multiple cause-of-death records were used to derive numbers of deaths and death rates for asbestosis, coal workers' pneumoconiosis (CWP), and silicosis. Morbidity data on CWP from a large national worker monitoring program were used to derive CWP prevalence defined as presence on the chest radiograph of small opacities category 1/0 or greater or large opacities, as determined by at least two National Institute for Occupational Safety and Health (NIOSH) readers.

Results: Overall, annual asbestosis deaths increased over 19-fold from 78 in 1968 to 1,493 in 2000 and then declined to 1,470 in 2004, due mostly to a drop in asbestosis deaths among those aged ≤74; deaths continue to increase among individuals aged ≥75. Silicosis deaths decreased nearly 6-fold from 1,065 in 1968 to 178 in 1998; no substantial change was observed thereafter in all age groups (mean 166 deaths/yea for 1999–2004 overall, with a mean of 4 deaths/year among individuals aged 15–44 years). CWP deaths peaked in 1972 (n=2,910), and then declined more than 4-fold to 703 in 2004. After 1998, the number of CWP deaths continued to decline among those aged ≥65, but appeared to increase among younger individuals (15–44 years old). CWP prevalence in working coal miners with ≥20 years of tenure increased nearly 3-fold from 3.2% in 1995–1999 to 8.3% in 2005–2006.

Conclusions: The slight decline from 2000 through 2004 in asbestosis deaths suggests that asbestosis mortality has peaked in the U.S. Mortality data for silicosis indicate a continuing occupational risk, even in younger workers. The increase in both CWP mortality and CWP morbidity suggests that past gains in disease prevention are being compromised.

Introduction

This report concerns pneumoconiosis in the U.S. over the last 40 years. It focuses on the three major pneumoconioses: asbestosis, silicosis, and coal workers' pneumoconiosis (CWP), which are all fibrotic diseases of the lung, caused by the inhalation of asbestos fibers, silica, and coal dust, respectively. In general, each has a long latency period (10 years or longer) and can lead to impairment, disability, and premature death. Federal limits on the level of workplace exposure were implemented in the 1970s for the prevention of these diseases, although immediate benefits were not expected because of the legacy of overexposure and the long latency of the diseases. To protect coal miners' health, including the prevention of CWP, the U.S. National Coal Workers' X-ray Surveillance Program (CWXSP) was established under the

Federal Coal Mine Health and Safety Act of 1969.[1] The National Institute for Occupational Safety and Health (NIOSH) administers this voluntary medical screening program for underground miners, from which national estimates of CWP prevalence were obtained.

The objectives of this study are: 1) to describe trends in the pneumoconioses in the U.S. during 1968–2004 using mortality data for asbestosis, silicosis, and CWP, and morbidity data on CWP; and 2) to examine trends by age group to better understand patterns of change over time.

Materials and Methods

National multiple cause-of-death data from the National Center for Health Statistics were used to generate statistics on pneumoconiosis deaths for 1968–2004. These include deaths from asbestosis, silicosis, CWP, and other/unspecified pneumoconiosis reported as either the underlying or contributing cause. Data on CWP prevalence were obtained from the CWXSP for the period 1970–2006. CWP was defined as the presence of small opacities category 1/0 or greater, or of large opacities, on the chest radiograph as determined by at least two NIOSH readers.

Results

Overall pneumoconiosis mortality in the U.S. has been gradually declining, from a peak of more than 5,000 deaths in 1972 to 2,500 deaths in 2004 (Figure 1). There have been long-term declines in deaths with silicosis and CWP, but an increase in deaths with asbestosis. Deaths from other/unspecified pneumoconioses are included in Figure 1 for completeness and show similar declines to those for silicosis and CWP. Further details on the trends in asbestosis, silicosis, and CWP deaths follow.

Asbestosis: Deaths with asbestosis increased from 78 (0.5 per million) in 1968 to 1,470 (6.3 per million) in 2004 (Figure 1). Examination by age group indicated that deaths are rising only in older individuals (age ≥75 years), leveling off in individuals age 45–74, and appear to be declining in individuals age 15–44 (see Figure 2 for youngest age group).

Silicosis: Silicosis deaths declined from 1,065 (8.2 per million) in 1968 to 166 (0.7 per million) in 2004 (Figure 1). Mortality in all age groups has declined but seems to be leveling off; Figure 2 shows the numbers of deaths for individuals age 15–44.

CWP: Deaths with CWP decreased from 1,849 (14.2 per million) in 1968 to 703 (3.0 per million) in 2004 (Figure 1), particularly in older individuals. However, examination of deaths in individuals age 15–44 (Figure 2) indicates that deaths have stopped falling and may have been rising since 1995. The mortality findings are confirmed by the trend in disease prevalence. CWP prevalence in working coal miners declined from 1970 until 1995 but now appears to be rising among miners with 20 or more years of work in mining (Figure 3).

Discussion

There are three primary factors impacting temporal changes in pneumoconioses mortality: a) the general extent of exposure, as measured, for example, by the amount of material used or the number of workers

exposed; b) the intensity or level of exposure, which is impacted by factors such as voluntary dust control and compliance with standards (e.g., federal exposure limits); c) the latency of disease, impacting when disease incidence occurs.

Asbestosis: Asbestos use in the U.S. increased from approximately 1,000 metric tons in the early 1900s to a peak of 803,000 tons in 1973. Increased awareness of the health consequences of asbestos exposure led to voluntary and regulatory actions that resulted in subsequent decline in asbestos use to less than 4,000 metric tons in 2004.[2] OSHA established a permissible exposure limit (PEL) for asbestos in 1971.This initial PEL of 12 fibers per cubic centimeter (f/cc) has subsequently been reduced to 5 f/cc in 1972, 2 f/cc in 1976, 0.2 f/cc in 1986, and 0.1 f/cc in 1994.[3] Reduced use and lower asbestos exposure levels may have contributed to reductions in asbestosis deaths since 2000, particularly as observed in younger individuals. However, because of the legacy of past exposures and long latency of asbestosis, the full impact of these reductions in asbestos usage and exposures on disease occurrence is still a decade away in the future. Efforts to ban all uses of asbestos in the U.S. continue, including a proposed "Ban Asbestos in America Act" currently under consideration by the U.S. Congress.[4]

Silicosis: Silicosis mortality declined between 1968 and 2004. This trend is probably due to a reduction in both the extent and intensity of exposure. Exact data are not available for changes in extent of exposure, but employment in heavy industries such as steel workers in foundries, where silica exposure was prevalent, has substantially decreased in the U.S. Regarding intensity, national compliance limits on silica dust were applied in the early 1970s throughout all industries. The PEL methodology differed across industries and time.[5] For general industry before March 1, 1989 and after March 22, 1993 the PEL was and currently is [(10 mg/m^3)/(%quartz+2)] for respirable dust containing at least 1% quartz, and was 0.1 mg/m^3 in the intervening period. For metal and non-metal mining the PEL is [(10 mg/m^3)/(%quartz+2)] for respirable dust containing at least 1% quartz, while for coal mining the level of respirable dust is progressively reduced as the %quartz increases using the formula: respirable dust PEL = [(10 mg/m^3 MRE[a])/(%quartz)]. As shown on Figure 2, the data indicate that deaths among younger individuals have leveled off. This underscores the critical need to educate younger workers and institute preventive measures in the workplace. Because of the continuing risk of disease at the current U.S. exposure limit, NIOSH recommended a reduction in the PEL for crystalline silica to 0.05 mg/m^3 in 1974.[6]

CWP: The reduction in deaths with CWP reflects the effect of a greatly reduced workforce in combination with the results of the imposition of the 2 mg/m^3 federal respirable dust limit set in 1969. Radiographic monitoring provided by the CWXSP also likely contributed to the reduction in prevalence through providing secondary prevention opportunities. The effectiveness of the prevention measures in the early years is evidenced by the substantial decline in disease prevalence. However, since 1995, the CWP prevalence rate appears to be increasing, suggesting the need for better dust control. To address this, NIOSH recommended that the coal mine dust PEL be reduced to 1 mg/m^3.[7] In addition, NIOSH research has indicated "hot spot" areas of high CWP prevalence that need to be investigated further.[8]

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[a] MRE denotes a dust concentration equivalent to that obtained using a dust sampler developed by the U.K. Mining Research Establishment.

There are several limitations in this study. First, cause of death can be misclassified. Second, temporal trends in diagnosis could impact findings (e.g., willingness to assign an occupational cause). Third, patterns relating to legal claims for compensation may have distorted findings, particularly for asbestosis, but also for silicosis. Finally, the morbidity data may have been impacted by selective participation in the worker monitoring program.

Conclusions

During 1968–2004 deaths with pneumoconiosis declined in the US. The recent declines for asbestosis suggest that asbestosis mortality has peaked in the U.S. The mortality data for silicosis suggest that, although there has been a distinct reduction in extent and intensity of exposure, there is a continuing occupational risk. In particular, there should be a focus on disease prevention in younger workers. The increase in both CWP mortality and CWP morbidity suggests that the past gains in disease prevention are being compromised.

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Figure 1. Numbers of U.S. pneumoconiosis deaths, 1968–2004

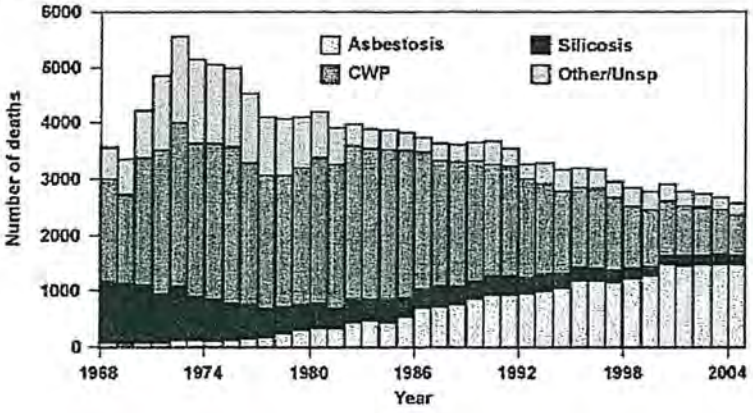


Figure 2. U.S. pneumoconiosis deaths at ages 15–44, averaged over each successive 2-year period, 1986–2004

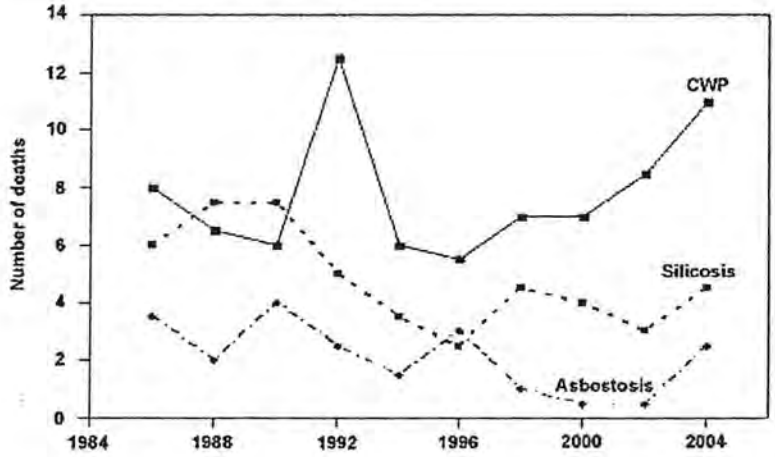
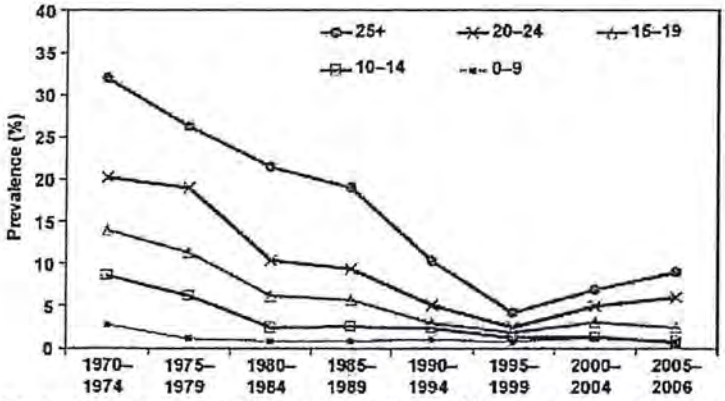


Figure 3. Prevalence of CWP in working U.S. underground coal miners by tenure, 1970–2006



The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.