Silicosis Deaths Among Young Adults—United States, 1968-1994

MMWR. 1998;47:331-335
2 figures omitted

Silicosis is a potentially fatal and typically chronic fibrotic lung disease caused by occupational exposure to respirable crystalline silica dust.[1] In the United States, most silicosis-associated deaths occur among persons aged ≥65 years,[2] often following many years of silica dust exposure. However, the continuing occurrence of silicosis deaths in young adults reflects relatively recent overexposures, some of sufficient magnitude to cause severe disease and death after relatively short periods of exposure. This report describes deaths among two young adults with silicosis and underscores the risk for deaths from silicosis at relatively young ages.

Case Reports

Two sandblasters died from progressive massive fibrosis (PMF), an advanced form of silicosis, following intensive dust exposure during abrasive sandblasting of oil field pipes and tanks in western Texas.[3] The first death occurred in a 36-year-old man who had worked as a sandblaster for 36 months from 1984 to 1988, when PMF was diagnosed. He died from respiratory failure in 1995, 11 years after his initial exposure. The second death occurred in a 30-year-old man who had worked as a sandblaster for 48 months during 1986-1990. He died from respiratory failure in 1996, 10 years after initial exposure.

At diagnosis, each worker had radiographic evidence of severe silicosis; one underwent a lung biopsy that revealed silicotic nodules and fibrosis. Autopsies for both revealed grey and hard upper and middle lobes of the lungs, with multiple small nodules palpable in the lower lobes. Microscopic examination revealed widespread interstitial inflammation and fibrosis, and mineralogic analysis revealed extremely high silica particle content.

Mortality Surveillance Trends

Using CDC's National Center for Health Statistics (NCHS) multiple cause-of-death data files for all U.S. deaths from 1968 through 1994, presumptive silicosis deaths were identified using *International Classification of Diseases* (ICD) codes* listed as either an underlying or contributing cause of death among persons aged ≥15 years. Descriptive analyses were conducted using three age groups (15-44 years, 45-64 years, and ≥65 years). Usual industry and occupation, coded in accordance with Bureau of Census industry and occupation codes, were examined in the NCHS data files.

During 1968-1994, a total of 14,824 silicosis-associated deaths were recorded; 11,250 (75.9%) occurred among persons aged ≥65 years, 3367 (22.7%) among persons aged 45-64 years, and 207 (1.4%) among persons aged 15-44 years. Overall, silicosis deaths declined substantially from 1157 in 1968 to <400 annually after 1980. Among young persons (i.e., aged 15-44 years), deaths from silicosis declined less during 1968-1994. Young silicosis decedents resided in 38 states and the District of Columbia; 17 (8.2%) were aged 15-24 years; 40 (19.3%), aged 25-34 years; and 150 (72.5%), aged 35-44 years.

Among young silicosis decedents, 57.0% were white, and 90.8% were male. Among silicosis decedents aged ≥65 years, 90.0% were white, and 98.1% were male. The proportion of decedents of races other than white generally increased during 1968-1994 in both the 45-64 and ≥65 age groups, but remained relatively stable among young decedents. In all three age groups, the proportion of female decedents generally increased. Of the nine silicosis deaths that occurred among young women during 1985-1994, six were of races other than white.

Reporting to NCHS of the "usual" industry and occupation of decedents began in 1985, with varying numbers of states (range: 16-22 states) providing this information in that and subsequent years. Of the 59 young silicosis decedents during 1985-1994, a total of 25 (42.4%) died in a year for which their state of residence provided decedents' employment information to NCHS. Construction and manufacturing were coded most frequently as the usual industry (28.0% each); no deaths were attributed to mining. In comparison, among 897 silicosis decedents aged ≥65 years, manufacturing accounted for 46.2%, mining for 21.1%, and construction for 9.5% of deaths. Usual occupations for the 25 young silicosis decedents included operators of various machines used to crush, grind, mix, and blend materials (six [24.0%]); painters/paint spray operators (five [20.0%]); construction trades (four [16.0%]); and laborers, except construction (four [16.0%]).

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CDC Editorial Note: Primary prevention of silicosis through exposure control is important because no effective medical treatment exists for this disease, which continues to progress even after a worker is removed from further exposure.[4] Despite the existence of legally enforceable limits on worker exposure to respirable crystalline silica dust, overexposures of sufficient magnitude to cause premature deaths continue to occur in the United States. Silicosis latency and rate of progression correlate with intensity of exposure[5]; extremely high exposures are associated with much shorter latency and more rapid disease progression. Consequently, silicosis-associated deaths in young persons generally result from more recent and intense exposure to silica dust.

The sex, racial, and employment differences between young and older silicosis decedents presented in this report may reflect changes in both workforce

demographics and industrial activity over recent decades, especially given the increasing proportion of females among young silicosis decedents. The high, but temporally constant, proportion of minorities among young silicosis decedents may reflect the generally higher levels of dust to which minority workers have been exposed.[6,7] For example, in the foundry industry, higher levels of silica dust exposure accounted for apparently higher risk for silicosis among black workers than among white workers.[7]

Extreme overexposures to respirable silica have been documented during sandblasting[5] and in the construction industry.[8] Abrasive blasting with silica sand, often used to prepare surfaces for painting, has been associated with exposures up to 200 times the CDC's National Institute for Occupational Safety and Health (NIOSH)-recommended exposure limit for respirable crystalline silica dust (0.05 mg/m^3).[5] NIOSH has recommended that silica sand be prohibited as an abrasive blasting agent.[5]

The findings in this report are subject to several limitations. The ICD code used to identify presumptive silicosis is not entirely specific for silicosis, and cause-of-death coding errors can occur. However, a review of a sample of death certificates of 10 young decedents in whom silicosis was presumptively diagnosed found that only two were not attributable to silicosis. In addition, many states do not provide decedents' employment data to NCHS, and the Census employment codes lack substantial detail. Even when recorded accurately and coded appropriately, silicosis decedents' usual employment does not always represent employment relevant to silica exposure. Finally, the NCHS data lack personal identifiers necessary for follow-back to confirm silicosis as cause of death, to ascertain details about occupational exposure to silica dust, and to investigate specific workplaces for potential ongoing hazardous exposure.

The Sentinel Event Notification System for Occupational Risks (SENSOR) program† and a preexisting surveillance program in New Jersey have demonstrated that identifying silicosis deaths from state mortality data files is one of several useful case-ascertainment methods for state-based silicosis surveillance and related preventive intervention.[9] Although implementation of all silicosis case ascertainment methods and case follow-up activities field-tested through SENSOR may be optimal, state health departments often do not have sufficient resources for a comprehensive approach.

In 1997, the Council of State and Territorial Epidemiologists adopted a resolution recommending that silicosis be made a reportable condition. Regardless of reporting requirement status, state health departments can initiate active efforts in silicosis prevention by identifying silicosis deaths through annual review of state mortality data and giving priority to investigation of circumstances surrounding those that occur at younger ages. Additional information about silicosis prevention activities and technical assistance for worksite investigations and other follow-back activities are available from NIOSH, telephone (304) 285-6115.

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*The Eighth Revision (ICD-8) codes 010 and 515.0 were used for 1968-1978, and the Ninth Revision (ICD-9) code 502 was used for 1979-1994.

† The SENSOR program, involving cooperative agreements between NIOSH and state health departments, is designed to develop and field test surveillance and intervention strategies for selected occupational conditions.

Population-Based Survey for Drug Resistance of Tuberculosis—Mexico, 1997

MMWR. 1998;47:371-375
2 tables, 1 figure omitted

The WORLD Health Organization (WHO) estimates that 90 million cases of tuberculosis (TB), resulting in 30 million deaths, will occur during the 1990s.[1] To address this problem, WHO has recommended a comprehensive strategy of directly observed treatment, short-course (DOTS)*.[2] Although DOTS results in cure rates of ≥80%,[3] the worldwide emergence of strains of *Mycobacterium tuberculosis* (MTB) resistant to antimycobacterial agents threatens this strategy for TB control.[2] In 1994, WHO and the International Union Against Tuberculosis and Lung Disease (IUATLD) proposed the establishment of a global surveillance program to monitor drug resistance.[2] In 1997, the Secretary of Health of Mexico, in collaboration with CDC, developed and implemented a national survey of drug resistance for TB as part of the global project on TB drug resistance. This report describes study results for three states in Mexico (Baja California, Oaxaca, and Sinaloa) and presents the first population-based TB drug-resistance data available for that country.

For this study, the 31 states and Federal District of Mexico were categorized by reported TB incidence in 1994 into three strata (high, medium, and low incidence). Nine of these 32 areas were randomly chosen in proportion to the number of cases reported in each strata. Baja California (high), Sinaloa (high), and Oaxaca (medium) were selected as the first of the nine to participate in the survey. Cases were enrolled from two of the country's five major public-sector health-care agencies, the Secretaria de Salud Administracion (Secretary of Health) (SSA) and the Instituto Mexicano de Seguro Social (Mexican Institute of Social Security) (IMSS); these two agencies together provide health-care service to approximately 80% of the population and diagnose and manage 90% of reported TB cases. During January-April 1997, physicians, epidemiologists, and laboratory workers from these agencies in all three states received extensive training from SSA in conducting the survey. During April 1- October 31, physicians completed patient enrollment forms for all patients submitting at least one sputum sample for evaluation for pulmonary TB. All acid-fast bacilli (AFB) smear-positive samples were sent to the state laboratories for inoculation onto Lowenstein-Jensen media and were forwarded to the Instituto Nacional de Diagnostico y Referencia Epidemiologicos (National Diagnostic and Epidemiologic Reference Institute)

(INDRE) in Mexico City for species identification and testing for drug susceptibility to isoniazid, rifampin, pyrazinamide, streptomycin, and ethambutol using the radiometric method.[4] The reference institute and CDC exchanged and tested 20 MTB isolates on two separate occasions for quality-control monitoring; there was a discrepancy in one drug for one isolate, for an accuracy rate of 97.5%.

In this analysis, resistance to one or more drugs was defined as resistance to isoniazid, rifampin, or pyrazinamide—the three drugs that constitute first-line treatment in Mexico. Resistance to one or more drugs was defined as primary for patients who had never taken anti-TB drugs and as acquired for patients reporting previous treatment with anti-TB drugs. Multidrug-resistant (MDR) TB was defined as resistance to at least isoniazid and rifampin.[2] Primary resistance was considered to reflect infection with a resistant organism, and acquired resistance was considered to reflect the development of resistance during the course of previous therapy.

During the study period, 816 patients were officially reported with AFB smear-positive pulmonary TB: 351 from Baja California, 110 from Oaxaca, and 355 from Sinaloa. Of these, 602 (74%) were enrolled in the study; MTB isolates were available for drug-susceptibility testing from 440 (73%) patients. Of the remaining specimens, 22% had no growth, 4% were contaminated, and 1% had nontuberculous mycobacteria. Of patients with MTB isolates, 24% had a history of prior TB treatment. The median age of patients was 36 years (range: 10-99 years); 69% were male. No difference was observed between patients with culture-positive and culture-negative isolates by age or prior history of TB.

Primary resistance to one or more of the three current first-line drugs used in Mexico was 12%; acquired resistance was 50%. Levels for both primary and acquired drug resistance did not differ significantly by state or by patient age or sex. Levels of combined resistance (primary and acquired), which represent an approximation of the overall level of drug resistance to isoniazid, rifampin, pyrazinamide, ethambutol, or streptomycin the community, were 26% (113 of 440) for one or more of the five drugs, 18% (79 of 440) for isoniazid resistance, and 6% (28 of 440) for MDR TB.

Patients with acquired resistance were significantly more likely than patients with primary resistance to have resistance to one or more of the three first-line drugs (prevalence rate ratio [PRR] = 4.0; 95% confidence interval [CI] = 2.8-5.7), to have isoniazid resistance (PRR = 3.6; 95% CI = 2.5-5.4), and to have MDR TB (PRR = 12.4; 95% CI = 4.8-32.3).

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CDC Editorial Note: This is the first population-based study of TB drug resistance from Mexico. Compared with results from 35 countries participating in the WHO/IUATLD global project on TB drug-resistance surveillance during 1994-1997, Mexico would have had the ninth highest level for primary resistance to at least one of the four first-line drugs (isoniazid, rifampin, ethambutol, and/or streptomycin) at 18% (pyrazinamide resistance was not evaluated). The United States ranked 14th with a level of 12%.[2]

In 1996, 8% of TB cases in the United States occurred in persons born in Mexico.[5] The 1993-1996 U.S. surveillance data about persons with TB who were born in Mexico and the findings from the survey of persons born in Mexico described in this report indicate similar rates among patients for primary isoniazid resistance (9% and 11%, respectively) and primary MDR TB (2% and 2%, respectively).[6]

The findings in this report are subject to at least three limitations. First, although surveillance for TB improved in the three surveyed states during the study period, the ability to assess data representativeness is limited by underreporting and notification delays. For example, the study in Oaxaca enrolled more patients than the number of persons officially reported as having smear-positive pulmonary TB. Second, 26% of the persons reported to the SSA with AFB smear-positive TB were not enrolled in the study, and 27% of the samples submitted could not be cultured. However, patients with positive cultures did not differ significantly from those with negative cultures by age or prior treatment history. Third, findings presented here are from only three of 31 states in Mexico and the Federal District; although the states are geographically dispersed, they may not be representative of the nation.

The findings of this survey have lead to improved TB control in Baja California, Oaxaca, and Sinaloa. All three state laboratories now have implemented the capacity to culture for MTB. Although smears rather than cultures are recommended by WHO as the basis of initial TB diagnosis in countries with limited resources, the newly developed culture capacity in the three states will be useful in surveillance efforts and in the management of cases not responding to routinely recommended treatment regimens.

In part as a result of this survey, the Secretary of Health of Mexico, in an effort to limit increases in drug resistance, is planning to initiate a four-drug treatment regimen by adding ethambutol to the current three-drug regimen. Four-drug regimens are recommended by CDC and the American Thoracic Society for communities with primary isoniazid resistance of ≥4%.[7] A second action to limit drug resistance that is being implemented by the Secretary of Health is to expand the DOTS program to the entire country. In addition to preventing the development of drug resistance, national strategies that are feasible in Mexico are needed to treat patients with MDR TB. As changes are made in the TB program, trends in MTB drug resistance will need to be monitored by implementing ongoing surveillance or performing periodic surveys. Further collaborative international efforts will be needed to improve TB control in the United States and Mexico.

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*DOTS consists of (1) committing to a sustainable national TB program; (2) detecting cases among symptomatic patients self-reporting to health services, using smear microscopy; (3) administering standardized short-course chemotherapy with direct observation of treatment; (4) establishing a regular drug supply of essential anti-TB drugs; and (5) establishing and maintaining a standardized recording and reporting system that allows assessment of treatment results.