Change in Prevalence of Asbestos-Related Disease Among Sheet Metal Workers 1986 to 2004*

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In 1985, the Sheet Metal Workers International Association and the Sheet Metal and Air Conditioning National Association formed The Sheet Metal Occupational Health Institute Trust to examine the health hazards of the sheet metal industry in the United States and Canada. Between 1986 and 2004, 18,211 individuals were examined. The mean age of this cohort was 57.9 years, and the participants had worked for a mean (± SD) duration of 32.9 ± 6 years in the sheet metal trade. Twenty-three percent of participants were current smokers, 49% were former smokers, and 28% were never-smokers. A total of 9.6% of participants (1,745 participants) had findings that were consistent with parenchymal disease (International Labor Organization [ILO] score, ≥ 1/0); 60% of those with an ILO score ≥ 1/0 were classified as 1/0, 34% as 1/1 to 1/2, and 6% as ≥ 2/1. A total of 21% of participants (3,827 participants) had pleural scarring. There was a lower prevalence of nonmalignant asbestos-related disease among those who began to work after 1970, when compared to workers who began to work before 1949; those who began to work between 1950 and 1969 had a prevalence between the other two groups. The strongest predictor of both parenchymal and pleural disease on a chest radiograph was the calendar year in which the worker began sheet metal work; work in a shipyard was also an important risk. The results of this study suggest that the efforts to reduce asbestos exposure in the 1980s through strengthened Occupational Safety and Health Administration regulation have had a positive public health impact. ***(CHEST 2007; 131:863–869)***

Key words: asbestos; asbestosis; prevalence

Abbreviations: CI = confidence interval; f/cc = fibers per cubic centimeter of air; ILO = International Labor Organization; NIOSH = National Institute for Occupational Safety and Health; OR = odds ratio; OSHA = Occupational Safety and Health Administration

Numerous studies[1–5] have documented the health effects of occupational exposure to asbestos. The federal government placed a moratorium on the production of many asbestos products in the early 1970s, and consequently experts have predicted a reduction in asbestos-related disease for cohorts beginning work after 1970.

Sheet metal work is one of the construction trades with recognized exposure to asbestos.[6,7] In 1985, the Sheet Metal Workers International Association and the Sheet Metal and Air Conditioning National Association formed the Sheet Metal Occupational Health Institute Trust to examine the health impact of asbestos exposure in the sheet metal industry in the United States and Canada. In a prior report[8] on this program, 32% of the participants examined

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between 1986 and 1990 were found to have either pleural or parenchymal radiographic abnormalities consistent with pneumoconiosis. Here, we present an updated analysis of this cohort, with results for 18,211 sheet metal workers examined between 1986 and 2004, and look at change in the prevalence of radiographic abnormalities for different decades of work in the trade.

Materials and Methods

Starting in 1986, the Sheet Metal Occupational Health Institute Trust contracted with facilities in the United States and Canada to offer a standardized screening program for sheet metal workers who had first been employed in the industry at least 20 years earlier. The physicians agreed to complete standardized reporting forms, to classify the chest radiographs using the International Labor Organization (ILO) classification,[9] and to follow the American Thoracic Society standards for conducting pulmonary function testing.[10] A more detailed description of the methods of the examination program can be found in prior reports.[8,11] The study was conducted in accord with the recommendations of the Helsinki Declaration[12] and was approved by the Institutional Review Board of the Center to Protect Workers Rights.

For the sheet metal program, each chest radiograph was classified by one reader who was an A reader, a B reader, or a physician with proficiency in the use of the ILO classification but who was neither an A or B reader; this last group was combined with the A readers for this analysis. National Institute for Occupational Safety and Health (NIOSH) B reader approval is granted to physicians who demonstrate proficiency in the classification of chest radiographs for pneumoconioses using the ILO classification through testing; an A reader has attended the American College of Radiology Symposium on Radiology of the Pneumoconioses.[13,14]

Parenchymal abnormalities were considered to be present if the radiograph was classified with a profusion of $\geq 1/0$. A participant was considered to have pleural abnormalities if there were any notations on the NIOSH/ILO coding form in sections 3A to 3D.

There were a total of 21, 865 examinations performed in the program. Approximately 12% of participants were examined more than once; this analysis includes only the last examination for those workers who have had more than one examination. After excluding the second examination and workers with missing ILO sheets, missing or illogical dates, and missing pertinent variables such as FVC and gender, our final sample consisted of 18,211 workers.

Statistical Analysis

Descriptive data are presented as number (%) or the mean ± SD. Continuous variables were compared using the Student *t* test, dichotomous variables were compared with the χ^2 test of general association, and ordinal categoric data were compared with the Cochran-Armitage test for trends or the Spearman correlation test for variables compared with two or more categories. Logistic regression models were constructed to determine predictors for the presence or absence of parenchymal or pleural disease, and results are reported as prevalence odds ratios (ORs) and 95% confidence intervals (CIs). The risk factors incorporated in the models included the total number of years the participant had worked in the sheet metal industry, the calendar year during which the participant had entered the sheet metal industry, age, smoking history (in pack-years), type of radiograph reader (*ie*, A reader or B reader), and a dichotomous variable for any history of shipyard work. The presence of multi-collinearity among the independent variables was checked using diagnostics such as the variation inflation factor and tolerance. Due to the small number of women in these data, logistic models were restricted to men. All statistical analyses were performed with a statistical software package (SAS for Windows, version 9.1; SAS Institute; Cary, NC).[15] Tests of significance are presented only for the adjusted analyses.

Results

Among these 18,211 individuals, the mean age was 57.9 years, and the median age was 57 years. The participants had worked for a mean duration of 32.9 ± 6 years in the sheet metal trade. About 50% of participants were working at the time of the examination, 38% were retired, 8% were unemployed, and 3.6% were disabled. Only 17 participants were women. Twenty-three percent of participants were current smokers, 49% were former smokers, and 28% were never-smokers. The mean number of pack-years smoked among current smokers was 40.7 ± 21.5, and among former smokers it was 27.6 ± 21.4. Among the entire group screened, 1,745 (9.6%) had findings that were consistent with parenchymal disease (ILO classification score, $\geq 1/0$); 60% of those with an ILO classification score of $\geq 1/0$ were classified as 1/0, 34% as 1/1 to 1/2, and 6% as $\geq 2/1$. A total of 21% of participants (3,827 participants) had pleural scarring.

Eighty four percent of the chest radiographs were read by B readers, 11.8% by A readers, and no reader classification was recorded for 4% of the readings. A readers were more likely than B readers to report parenchymal abnormalities (16.4% vs 7.8%, respectively) and pleural abnormalities (32.3% vs 20.0%, respectively). Chest radiographs read in the earlier years of the screening were more likely to have been read by A readers; as a result, A reading was correlated with shipyard work and with the calendar year the participant had entered the trade. A previous analysis[11] of a subset of the B readers found excellent specificity for abnormal radiograph findings and good agreement in a κ analysis.

Table 1[16] presents an overview of the characteristics of the population, divided into the following three groups: those examined between 1986 and 1990; those examined from 1991 to 2000; and those examined from 2001 to 2004. The participants in the second and third rounds were slightly older than the ones examined in the first round, had worked for a slightly long time (in years) in the trade, and were more likely to be retired. The participants after 1991 were on the whole more likely to have normal lung