Asbestosis in Louisiana: A Descriptive Review and Demographic Analysis of Hospitalizations for Asbestosis, 1999-2009

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Asbestosis is a debilitating, chronic, lung disease with no known treatment and most commonly occurs among workers in certain occupational settings. As a condition highly associated with occupational exposure, its incidence has been affected by changes in industry standards. In particular, the bans on both production and new uses of asbestos fibers put in place during the past 20 to 30 years have significantly reduced occupational exposures. Despite these restrictions, asbestos can still be found in many products. Louisiana has more facilities that produce, process, or use asbestos than any other state in the US. Health outcomes associated with asbestos exposure include asbestosis, mesothelioma, and lung cancer. To evaluate the impact of asbestos exposure on Louisiana residents, Louisiana Hospital Inpatient Discharge Data (LAHIDD) from 1999-2009 was analyzed. Results indicate that asbestosis hospitalizations have remained steady over the 11-year period with approximately 295 cases per year. White males have the highest rates, and cases are clustered geographically. Overall, Louisiana's rate is significantly greater than the US rate ($p<0.0001$).

INTRODUCTION

Pneumoconiosis is a term for a class of non-malignant chronic lung diseases caused by the inhalation of mineral dust, such as asbestos, silica, and coal dust, nearly always in an occupational setting. As a result of its low cost and desirable properties, asbestos has been used in a large number of industrial applications and types of manufactured products.[1] In Louisiana, asbestosis accounts for nearly 90% of all pneumoconiosis cases. Inhaled asbestos fibers cause fibrotic lung tissue to lose its elasticity and limit its ability to normally expand and contract, resulting in shortness of breath – asbestosis's most tell-tale sign.

Modern industrial use of asbestos began in the 1880s and peaked in the late 1960s and the early 1970s when asbestos was used in more than 3,000 industrial applications or products.[2] Over the past 20 years, however, asbestos use has decreased dramatically largely due to its severe health impacts on workers exposed to asbestos fibers. In 1999, asbestos consumption was 4% of what it was in 1980. In Louisiana, the use of asbestos has changed over the years from shipbuilding to use in railroad and construction materials.[1] The 1999 domestic consumption pattern was 61% for roofing products, 13% for friction products (automobile clutch, brake, and transmission components), and 19% for packing and gaskets.[1]

Despite a decrease in asbestos use, asbestosis remains an important occupational health issue because of latent onset of illness due to past exposures and the ongoing potential for new exposures. The objective of this paper is to provide a descriptive analysis of hospitalizations with an asbestosis diagnosis in order to better understand the impact of asbestos exposure on Louisiana's workers.

BACKGROUND

Asbestosis

Asbestos has been linked to a variety of different diseases including asbestosis, pleural plaques, pleural effusions, lung cancer, and mesothelioma. All of these diseases have similar physical manifestations such as dyspnea (shortness of breath), cough with sputum production, and chest pain. These manifestations rarely appear within the first 10 years after exposure and are more common after 20 years or more. The disease may remain static or progress to respiratory failure, cor pulmonale (enlargement of the right side of the heart due to pulmonary hypertension from progressive fibrosis), cancer, and death.[3] Increasing doses are associated with a higher incidence of all asbestos-related diseases.

Drugs are not effective in the treatment of asbestosis.

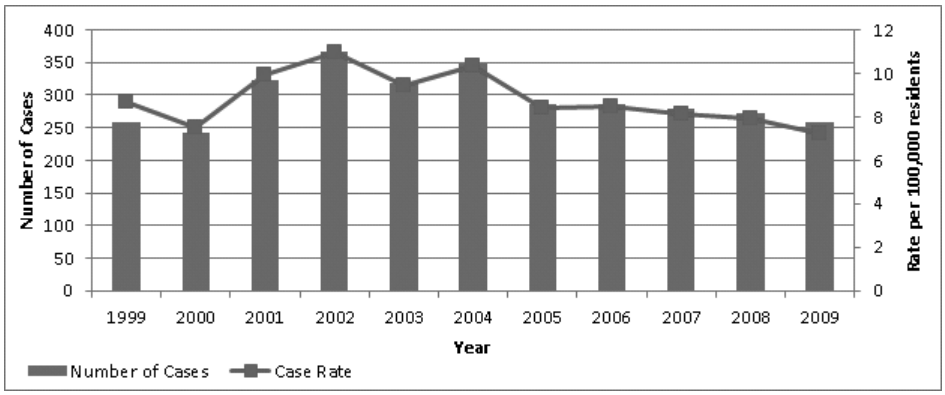

Figure 1: Annual Case Count and Age-Standardized Case Rate of Abestosis Hospitalizations in Louisiana; 1999-2009.

Control of exposure to asbestos is the most effective method of preventing asbestosis. Prompt attention to pulmonary infections will ensure fewer complications, and cessation of smoking will significantly decrease the risk of developing lung cancer in asbestos-exposed individuals.[3]

Smoking and Carcinomas

Occupational exposure to asbestos has been associated with an increased risk of bronchogenic carcinomas. Concomitant cigarette smoking significantly increases the risk of bronchogenic carcinoma. When a cigarette smoker is exposed to asbestos, the risk of lung cancer increases 50 to 84 times.[4] According to a study of asbestos workers in Great Britain, 26% of lung cancer deaths were attributable to the synergistic interaction of asbestos and smoking, and the risk of lung cancer mortality increased with packs smoked per day, smoking duration, and total smoke exposure.[5] Interestingly, smoking has not been linked to an increase risk of developing mesothelioma.[3]

Exposure Sources

For centuries, asbestos fibers have been mined and processed for use because of their high tensile strength, resistance to heat, durability in acids and other chemicals, and light weight. Because of asbestos's unique properties, it has a variety of applications in many different industries. Examples include: fire-resistant textiles, friction materials used in brake linings in the automotive and railroad industries, thermal and electrical insulation for pipes and boilers in shipbuilding and power plants, and for the strengthening of cement and plastics, and fireproofing and sound absorption of ceiling and floor tiles in the construction industries.[6]

In the past, occupational exposure occurred primarily during the mining and milling of asbestos, the manufacture of asbestos products, and in the shipbuilding and construction industries. According to the Occupational Safety and Health Administration (OSHA), the heaviest exposure currently occurs in the construction industry and among workers in occupations such as asbestos insulation, brake repair and maintenance, building demolition, and asbestos abatement.[3] Work related tasks in these occupations expel large amounts of asbestos fibers into the air that can then be inhaled by workers. To protect workers from asbestos exposure, OSHA has established limits on the amount of airborne asbestos fibers to which workers can be exposed. In the 1970s, the federal government banned any new uses of asbestos and mining for asbestos in the United States.[7,8]

Although exposure to asbestos occurs primarily in occupational settings, non-occupational exposures can also occur. Family members may be exposed if workers carry home asbestos fibers on their clothes, and the general public may be exposed from the use of asbestos-containing products or living in proximity to facilities that process asbestos-containing materials. The most important source of asbestos in a home is from damaged or deteriorating asbestos-containing insulation, ceiling, or floor tiles.[1]

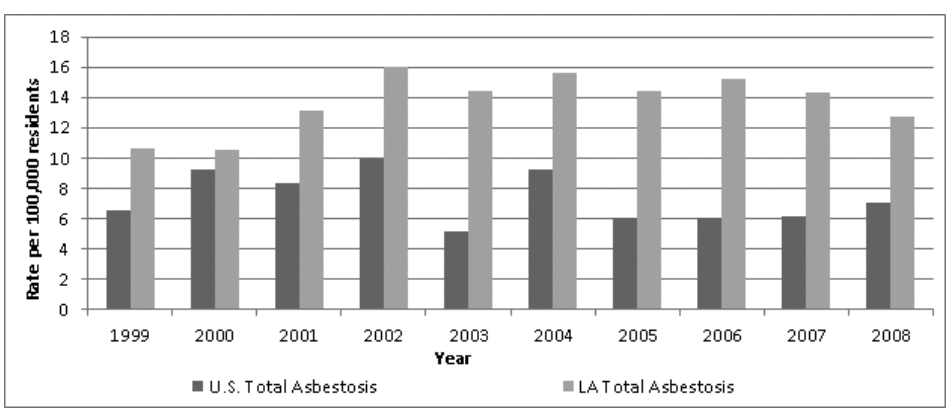

Figure 2: Comparison of U.S. and Louisiana Age-Standardized Rates of Total Abestosis Hospitalizations; 1999-2009.

METHODS

A retrospective review of asbestosis hospitalizations using Louisiana Hospital Inpatient Discharge Data (LAHIDD) from 1999-2009 was conducted. LAHIDD is a comprehensive collection of inpatient data for all non-federal, Louisiana hospitals. Louisiana law mandates the reporting of hospital discharge data to the Louisiana Department of Health & Hospitals. LAHIDD contains detailed information on all hospital admissions: age, sex, race, marital status, date of birth, patient

address, admission and discharge date, principal diagnosis, and at least eight different secondary diagnosis, procedure codes, discharge status (expired, discharged to home, discharge to hospice care, etc), admit type (urgent, emergency, physician referral, etc), total charges, payment source, and length of stay. Records were selected if they had an ICD-9 diagnostic code of 501 (asbestosis) as either a primary or secondary diagnosis and were at least 16 years of age. Repeat admissions and patients who were not residents of Louisiana were excluded.

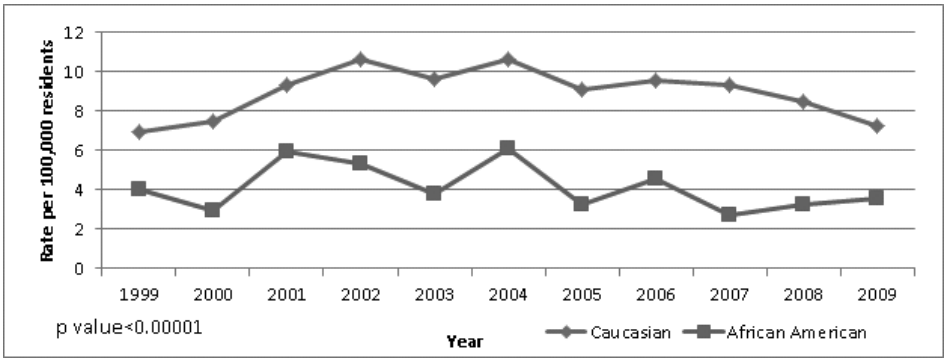

Figure 3: Annual Age-Standardized Case Rates of Asbestosis Hospitalizations by Race in Louisiana; 1999-2009

Annual, age standardized rates were calculated by dividing the total number of identified asbestosis hospitalizations by Louisiana's population age 16 years and older for the same calendar year and standardized using the US 2000 population. Population data was obtained from the US Census Bureau of Population Estimates for the years 2000-2009 and the Current Population Survey for 1999. [9,10] US asbestosis hospitalization rates were obtained from the Centers of Disease Control and Prevention.[11] The mean case count by age group was calculated by dividing the total number of cases for each age group 11. SAS 9.1 software was used to perform linear regression analyses to determine trends of age-standardized rates of asbestosis hospitalizations. Analyses of variance (ANOVA), two- tailed t-tests, and Tukey tests were performed to compare hospitalization rates stratified by sex, age, race, and parish of residence. Statistical significance was defined as p-values less than 0.05.

RESULTS

During the 11-year study period, there were a total of 4,968 hospitalizations of individuals with an asbestosis diagnosis; after eliminating repeat admissions, there were 3,240 unique individuals hospitalized for asbestosis resulting in approximately 294.5 cases per year (Figure 1). The age-standardized incidence rate had minimal variation over the 11-year period ranging from a low of 7.23 per 100,000 residents in 2009 to a high of 10.95 in 2002. The mean annual rate was 8.8 per 100,000 residents. The decrease in annual rates was not statistically significant (t=-0.43 p=0.68).

Figure 2 compares Louisiana's total asbestosis hospitalization rate with the US rate. Many individuals are hospitalized more than once for asbestosis. These secondary hospitalizations cannot be excluded from the National Hospital Discharge Dataset. Because of this limitation, Figure 2 is a measure of hospitalizations for asbestosis, not persons with asbestosis. Louisiana's mean asbestosis rate for the 10-year period 1999-2008 is approximately twice the US rate (13.7 per 100,000 residents vs. 7.3 per 100,000 residents respectively; p<0.0001). U.S. hospitalization rates were unavailable for 2009.

Information on race was available for 92% of cases. The 11-year mean age standardized rates were significantly higher among whites than blacks with a mean of 8.93 hospitalizations per 100,000 residents compared to 4.13 hospitalizations per 100,000 residents, respectively. This difference was statistically significant (t=9.20 p<0.00001) (Figure 3).

Males had significantly higher age standardized rates than females with a mean hospitalization rate of 20.56 per 100,000 residents for males compared to 0.69 per 100,000 residents for females (t=23.51 p<0.00001) (Figure 4).

The mean age of asbestosis cases was 72 (SD=9.65 range 35-99) years. Seventy-nine percent of asbestosis cases occurred among individuals between 65 and 84 years. The mean rate of hospitalizations increased with each age group, except 85 and older. The mean rate of hospitalizations among individuals 75 to 84 years was significantly different from the other age groups. However, there was no significant difference in rates among age groups 35-44 and 45-54 (Figure 5).

Parish rates were calculated for 2000-2009 using the patient's parish of residence at the time of hospitalization. Parish level data was not available for 1999. In general,

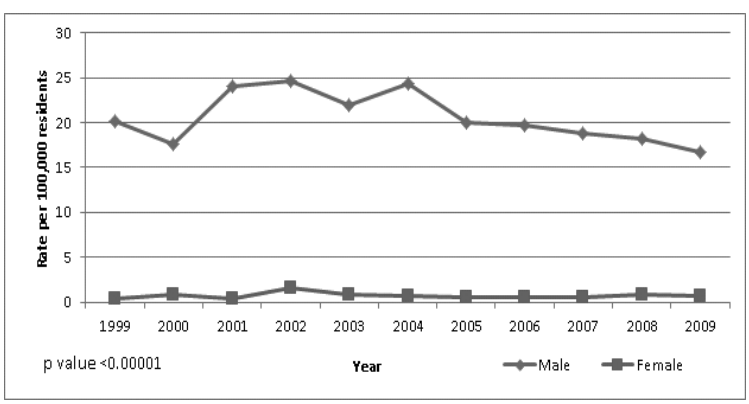

Figure 4: Annual Age-Standardized Case Rates of Asbestosis Hospitalizations by Gender in Louisiana; 1999-2009.

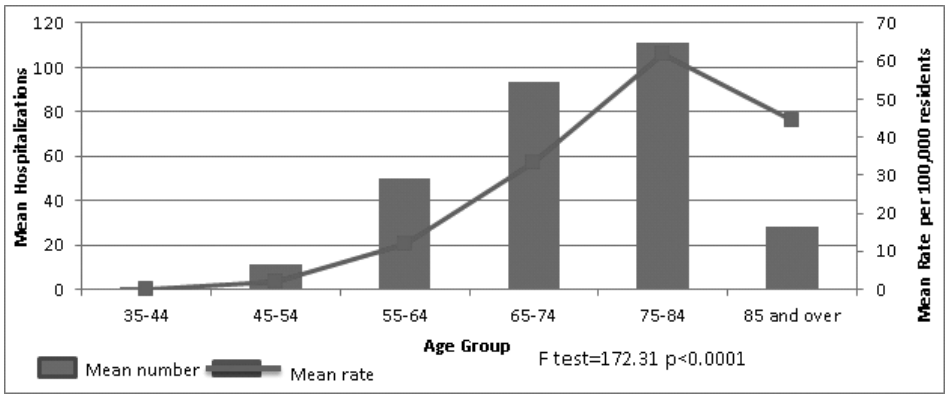

Figure 5: Annual Mean Number of Cases and Case Rate of Asbestosis Hospitalizations in Louisiana by Age Group; 1999-2009.

parishes with the highest hospitalization rates (> 10.51 per 100,000 residents) were clustered in the northeast and within the industrial corridor (river parishes between New Orleans and Baton Rouge). Calcasieu, also an industrial area and port, had the highest rate: 21.43 per 100,000 residents (Figures 6).

The mean length of stay was 4.16 days (SD=4.37 range=0-54). Sixty percent of cases were hospitalized for four days or less, while 32.2% stayed between 5 and 10 days, 6.3% stayed between 11 and 17 days and 2% stayed 18 days or more (Figure 8). The major payment source for most hospitalizations was Medicare insurance (67.6%), followed by private pay and Medicaid insurance, with less than 1% by Workers' Compensation insurance programs.

DISCUSSION

This is the first population-based analysis of asbestosis in Louisiana.[12] Results indicate that Louisianans have consistently elevated rates of asbestosis hospitalizations in comparison with national rates. As asbestosis is primarily an occupational exposure, these findings highlight an important occupational health condition affecting Louisiana workers. The data shows that during the 11-year study period, rates of asbestosis remained steady. According to the US Department of Health and Human Services' Agency for Toxic Substances and Disease Registry, Louisiana has more facilities that produce, process, or use asbestos than any other state in the US.[1] Louisiana industries that use asbestos include construction, shipbuilding, railroad, automotive, and textile.

The elevated case rate among males compared with females reflects gender differences in occupational patterns. Women's share of labor occupations has remained unchanged between 1975 and 1995 at approximately 24%. This indicates that men dominate in industries with the highest risk of asbestos exposure.[13] Data from the Current Population Survey (1999-2009) indicates that males comprise about 88% of the jobs in the construction and automotive industries compared to 12% by females. These work patterns and resulting health outcomes are not unique to asbestos workers. Overall, males have much greater work-related mortality and hospitalization rates than females. Recent studies of Louisiana workers found that males represent more than 90% of work-related mortalities and 75% of work-related hospitalizations.[14,15]

The racial differences in hospitalization case rates were unanticipated and may reflect differences in employment patterns. Historically, due to racial inequality, Caucasians were more likely than African-Americans to obtain employment in high paying labor occupations, such as shipbuilding and textile manufacturing. Several studies have shown that blacks faced rigid racial employment patterns in the south, and these discriminatory practices prevented blacks from obtaining employment in many southern industries.[16,17]

Older residents had more asbestosis hospitalizations than younger ones. This is consistent with other studies as asbestosis has a long latency period of approximately 20 years.[18] The development of the disease requires heavy exposure to asbestos, and the latency period is inversely proportional to exposure level. Therefore, the lower the exposure level, the longer it takes to reach this threshold. [18] Although asbestosis is strongly associated with work, very few hospitalizations were paid for by Workers' Compensation, suggesting that most individuals do not seek occupational compensation for the disease or are no longer employed in the industry when symptoms begin to appear. An increase in asbestos- related and other chronic disease mortality among patients in their 60s and 70s likely results in the decline in hospitalization rates among residents 85 years and older.

The parishes that had incidence rates two to three times greater than the state average are parishes located in regions where shipyards, power plants, oil refineries, and railroad industries are most abundant. Shipyards along the southern coast (including southeast Louisiana) extensively used asbestos as insulator for pipes and within the walls in the construction of ships and oil rigs.[19] Exposure to asbestos occurs during the construction and demolition of ships and oil rigs.[19] Power plants in east and south Louisiana contain pipes and boilers that are covered with asbestos fibers for thermal insulation purposes.[20] These asbestos fibers are disrupted and released into the air during routine checking and maintenance of pipes and/or boilers.[20] Other sources of asbestos exposure are railroads in north Louisiana, oil rigs and refineries in the Gulf of Mexico and along the southern coast of Louisiana, and construction industries throughout the state. Asbestos is released in these industries through various mechanisms: erosion of the lining of brakes on trains; the gripping of rings associated with brake systems in drilling equipment on oil rigs; the building and demoli-

tion of walls enclosing oil rig platforms; and the installation, removal, grinding, and sanding of cement pipe, cement sheet, ceiling, and floor tiles in homes and other buildings.[21,22,23,24,25] Louisiana also had six facilities that processed vermiculite contaminated with asbestos; vermiculite is a mineral that was used in numerous products, particularly insulation for attics and walls.[26]

Lastly, hospitalizations resulting from asbestosis are an important economic and social burden for workers, their families, and the health caresystem. Many of the 3,240 patients were hospitalized multiple times as asbestosis is a chronic, debilitating condition that requires ongoing medical treatment and is frequently complicated by chronic comorbidities including COPD, asthma, and cardiovascular disease.

LIMITATIONS

There are several limitations to this study. First, hospital discharge records may underestimate the actual burden of asbestosis in Louisiana for several reasons: patients in the early stage of disease are less likely to be hospitalized; Louisiana residents who are hospitalized in another state are not reported to LAHIDD, and LAHIDD only includes reports from non federal, acute care hospitals. Therefore, cases hospitalized through the Veterans Affairs (VA) Hospital are not included. An over-reporting of asbestosis is also possible as case selection using an ICD-9 code does not provide any indication as to the process or method of diagnosis; an asbestosis diagnosis based solely on patient reporting or clinical tests may be inaccurate.[27,28] Secondly, it is difficult to link the disease with a particular industry or occupation because occupational history is not recorded on hospital discharge records. Thirdly, patient's parish information denotes the patient's residence at the time of hospitalization, which may not reflect where the person worked or where the exposure occurred. Lastly, the comparison of Louisiana's total hospitalization rates with the National Hospital Discharge Survey includes all hospitalizations, both initial and repeats. Louisiana's rate may be artificially inflated if it has more repeat hospitalizations than the national data.

CONCLUSIONS

Our review has revealed important information about asbestosis and its impact on Louisiana residents. Historic asbestos uses in Louisiana, as in ship-building, may have resulted in increased asbestos exposure to Louisiana workers in comparison to other states as reflected by Louisiana's significantly elevated asbestosis rate. Hospitalization rates for asbestosis will likely remain high nationwide due to asbestosis's long latency period and the relatively recent ban on new uses. Despite stricter regulations, there is still a risk of exposure due to the continued use of many asbestos-containing products, such as construction mastics (ceiling and floor tiles), boiler and pipe insulation, and thermal products. Monitoring the impact of these products on workers will require ongoing tracking of asbestosis cases in order to better identify high risk work practices and settings. This information could result in a strengthening of exposure regulations, if warranted. Healthcare providers can assist public health officials in this pursuit by collecting and recording patients' occupational and smoking history.

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