

Lung Cancer in Shipbuilding and Related Industries in Louisiana

MARISE S. GOTTLIEB, MD, MPH, and ROBIN B. STEDMAN, MPH,[†] New Orleans, La

ABSTRACT: The relationship between shipbuilding and related industries and risk of fatal lung cancer (1960-1975) is described for selected Louisiana parishes. Deaths from lung cancer were matched to deaths not caused by cancer. Shipbuilders had a significantly increased risk (greater than twofold) of dying of lung cancer as compared with other causes. The risk of dying of lung cancer in related occupations (seamen and longshoremen) was also increased. Information on laterality of lung cancer was not supportive of particulate substances contributing to causality due to the large number of unspecified cases. The preponderance of deaths appears to be occurring in men with a greater number of years of exposure to this industry and in those aged 20 to 34 years in 1940. These common occupations in Louisiana could contribute to the high rate of lung cancer.

LOUISIANA has one of the highest mortality rates for cancer of the lung (1950-1969) in the United States,¹ and the incidence rates (1974-1976) for New Orleans are similarly elevated.² The distribution of contiguous parishes with high lung cancer mortality rates follows the course of the Mississippi River to its runoff in southern Louisiana in the Atchafalaya Basin and the Gulf of Mexico. This region is unique in its cultural patterns, the ethnicity of the population, and the presence of the Mississippi River with its associated industries and use as a drinking water source.

Rates of employment in the chemical and petroleum industries were reported to be correlated with a high cancer mortality by county in the South and Gulf areas of the United States.³ Increased risk of lung cancer associated with the shipbuilding industries has been reported in other areas,^{4,6} and exposure to asbestos in building and repairing ships has been implicated as an etiologic agent in lung cancer. Asbestos exposure also occurs in related industries and occupations. The shipbuilding industry is significant in Louisiana, currently employing 1.8% of the population, and considerably more than that in the 20- to 30-year age group.^{7,8}

This report examines the relationship between shipbuilding and related industries (longshoremen and seamen) and lung cancer mortality in 19 Louisiana parishes. To determine factors contributing to these rates, lung cancer death certificates from 19 selected

parishes from 1960 to 1975 were reviewed for recorded usual industries and occupations, and compared with matched noncancer deaths.⁹ Subsequent reports on other industries will describe additional associations with lung cancer.

METHODS

Parishes selected for study included those with 1% or more of the work force employed in petrochemical, paper, or chemical industries, or having a high lung cancer mortality. Many of the parishes in Louisiana with the greatest number of workers employed in shipbuilding (eg, Orleans) were not selected for this study as there were likely to be other confounding risks in these parishes. The parishes included were Acadia, Allen, Ascension, Calcasieu, Concordia, Iberville, Jackson, Morehouse, Plaquemines, St. Bernard, St. Charles, St. James, St. John, St. Martin, Tensas, Terrebonne, Washington, Webster, and West Feliciana.

The 1970 census for these parishes included 346,041 men. Lung cancer deaths were identified from a data tape of deaths compiled by the Louisiana Division of Vital Statistics (1960 to 1975). A computer program matched an equal number of lung cancer and noncancer deaths by sex, race, age ($\pm$ two years), year of death, and parish of residence at death (to control for water source and ethnic variability). Industry and occupation were coded by the three-digit classification of the US Census Bureau.¹⁰

The relative risk of death from lung cancer was estimated by the odds ratio. Approximate 95% confidence limits were calculated using the logit method.¹¹

RESULTS

A total of 2,803 lung cancer deaths in men were

[†]From the Department of Medicine, Tulane University School of Medicine, and the Division of Health and Environmental Quality, Louisiana Health and Human Resources Administration, New Orleans.

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Reprint requests to Tulane University School of Medicine, 1430 Tulane Ave, Box D-55, New Orleans, La 70112 (Dr. Gottlieb).

TABLE 1. Relative Risk for Lung Cancer Associated With Shipbuilding and Related Industries

Industry	Occupation	Cases	Controls	Odds Ratio	95% Confidence Intervals
Shipbuilding (228*)	Shipfitters**	12	3	2.21	(1.04-4.82)
	Other†	12	8		
Shipping (419*)	Seamen‡	46	29	1.61	(0.99-2.64)
	Longshoremen (760)	20	10	2.03	(0.90-4.65)
Total		90	50	1.83	(1.27-2.63)
Other industries		2,713	2,753		

*US Census Classification Codes of Industry and Occupation. (See Appendix for further description of codes.)

**Shipfitter codes: 404, 522, 540, 575, 642, 651, 680

†Other shipbuilding occupations: 245, 415, 424, 441, 461, 510, 690, 695, 785, 962

‡Sailors and deckhands: 221, 661, 701

Appendix

Shipfitters:

404 = Boilermakers
522 = Plumbers and pipefitters
540 = Shipfitters
575 = Riggers
642 = Oilers and greasers
651 = Grinding machine operatives
680 = Welders and flamecutters

Other Occupations in Shipbuilding:

245 = Managers and administrators
415 = Carpenters
424 = Crane operatives and derrickmen
441 = Foremen
461 = Machinists
510 = Painters, construction, maintenance
690 = Machine operatives, misc.
695 = Not specified operatives
785 = Laborers
962 = Guards and watchmen

Sailors and Deckhands:

221 = Officers, pilots, pursers; ship
661 = Sailors and deckhands
701 = Boatmen and canalmen

matched to 2,803 noncancer deaths. Of the total 5,606 cases and controls, 35 (0.6%) were categorized as usually working in the shipbuilding industry.

Related occupations included sailors and deckhands (N = 75) and longshoremen (N = 30). Thus, these categories of shipbuilding-related occupations represent 2.5% of the study population. As noted in Table 1, the odds ratio is significantly elevated above 1.0 for shipbuilders, sailors, and deckhands. For the 24 lung cancer deaths and 11 noncancer deaths classified in the shipbuilding industry (category number 228), the resulting odds ratio was 2.21 (95% confidence limits, 1.04-4.82), indicating an approximate twofold risk in lung cancer in this industry. For cases and controls working in shipbuilding and related occupations, the odds ratio was 1.83, which is significantly elevated (95% confidence limits, 1.27-2.63).

The association between chronic obstructive pulmonary disease (COPD) and shipbuilding-related occupations was also examined. To measure this associa-

TABLE 2. Chronic Obstructive Pulmonary Disease (COPD) in Shipbuilding Workers and Matched Nonshipbuilding Controls

Occupational Group	Cause of Death	
	COPD No. (%)	Non-COPD No. (%)
Shipbuilding and related occupations	6 (12.0)	44
Relative odds (95% confidence interval)		0.98 (0.28, 3.13)
Non-shipbuilding-related occupations	11 (12.2)	79

tion, the matched controls (noncancer) of the subjects working in an industrial category, who were not working in shipbuilding, were compared with all controls who were reported to have worked in the industry. The resulting proportion of COPD deaths for shipbuilding plus related occupations and occupations not related to shipbuilding was 12.0% and 12.2%, respectively (Table 2). This would indicate the accuracy and similarity of diagnostic reporting in the two groups, as well as the security that all cases of lung cancer were likely identified and reported.

The laterality of lung cancer was also investigated among occupational groups, since particulate substances (eg, asbestos) tend to be trapped preferentially in the right lung because of the configuration of the right bronchus.

To measure this association, the subjects not working in shipbuilding-related occupations, who were matched to the 50 controls working in these occupations, were compared with subjects working in shipbuilding and related occupations. The resulting proportion of cancer of the right lung in shipbuilding and related occupations was not increased above that of lung cancer cases in the non-shipbuilding-related occupations. However, in only 31% of cases was laterality specified (Table 3).

The total 2,803 cases were matched to controls by age ($\pm$ two years). Interestingly, those in the shipbuilding industry were younger in 1940 than the controls working in that industry; 70.8% of cases were less than 35 years of age, while the corresponding figure for controls was 45.5% (Table 4). This may indicate that subjects had worked longer in the industry than their corresponding controls. In an attempt to control for this differential, a shipbuilder was redefined to include only those workers in shipbuilding who had died after age 52. Assuming continuous exposure since

TABLE 3. Laterality of Lung Cancer in Selected Occupational Groups

Occupation	Laterality		Unspecified
	Specified	Unspecified	
	No. Right (%)	No. Left (%)	
Shipbuilding	7 (87.5)	1 (12.5)	16
Seamen	9 (60.0)	6 (40.0)	31
Longshoremen	3 (37.5)	5 (62.5)	12
Nonshipbuilding, seamen or longshoremen	11 (84.6)	2 (15.4)	37

TABLE 4. Age in 1940 of Workers* in Shipbuilding-Related Occupations for Lung Cancer and Non-Lung-Cancer Deaths

Occupation	Age in 1940	Cause of Death	
		Lung Cancer No. (%)	Noncancer No. (%)
Shipbuilders	0 - 19	2 (8.3)	2 (18.2)
	20 - 34	15 (62.5)	3 (27.3)
	35 +	7 (29.2)	6 (54.5)
Longshoremen	0 - 19	4 (20.0)	1 (11.1)
	20 - 34	9 (45.0)	4 (44.4)
	35 +	7 (35.0)	4 (44.4)
Seamen	0 - 19	7 (15.6)	6 (20.7)
	20 - 34	20 (44.4)	12 (41.4)
	35 +	18 (40.0)	11 (37.9)

*Excludes one longshoreman control and one seaman with cancer for whom age at death was not recorded.

1940, this would allow for inclusion into this industry only persons who, on the average, worked for 25 years or more. This new definition of a shipbuilder results in a 50% increase in the original relative risk estimate to 3.04 (21 cases, seven controls). Redefining seamen and longshoremen in the analogous way did not change the relative risk.

DISCUSSION

We have shown that, as in other areas in the United States, Louisiana shipyard workers do have an increased risk of lung cancer which is approximately two to three times greater than that of nonshipbuilding workers. A 50% to 100% increase in risk was also noted for seamen and longshoremen. Whether the risk is lower in these latter two groups merely because they may have been exposed to lower concentrations of asbestos than shipbuilders is unknown.

The finding that COPD was not more prevalent in deaths among controls who were and were not in shipbuilding-related occupations indicates that (1) noncancer deaths categorized to shipbuilding are not likely to include missed cases, and (2) COPD is not associated with shipbuilding occupations.

Although a preponderance of right-sided lung cancer in shipbuilding-related versus nonshipbuilding-related occupations would support the theory that a particulate substance such as asbestos fibers contributes to lung cancer among shipbuilders, this could not be demonstrated because of the large number of cases with unspecified laterality (69%).

The age distribution at death caused by lung cancer compared to noncancer deaths among shipbuilders is consistent with an exposure reflecting the temporal pattern of these industries in Louisiana.

As this study was based on death certificates, the

limitations are (1) the inability to measure lifetime occupational patterns and (2) the inability to measure such factors as cigarette smoking and to assess competing causes of death which may confound the estimates of risk. As the occupational and industrial experiences are known to be underreported in death certificates, the reported estimates of risk are likely to be conservative. Matching on parish of residence is also likely to produce conservative estimates.

Since shipbuilding is a significant industry in Louisiana, a high rate of lung cancer in this industry could account for a substantial amount of the high lung cancer mortality in Louisiana. Of 993,362 men older than 20 years (1970 census), 15,902 (1.6%) worked in shipbuilding, and an additional 29,849 (3.0%) worked in water transportation (which includes seamen and longshoremen).⁷ The relative risk of lung cancer in these industries of 1.8 is, as stated previously, a conservative estimate. The resulting proportion of cases of lung cancer attributable to these industries is 3.5%. Although the shipbuilding industry cannot totally account for the substantially excessive lung cancer mortality in Louisiana and other coastal states, it can provide an explanation for a significant part of environmental lung cancer.

More complete information from death certificates would lead to greater usefulness of this type of data, since death certificates are very useful when effects on large populations have to be studied.

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