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Environmental Household Exposures to Asbestos and Occurrence of Pleural Mesothelioma

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We reviewed the certificates of 39,650 deaths which occurred in the period 1975-1988 in Leghorn and of 45,900 in La Spezia (Italy) in the period 1958-1988.

In total 262 cases have been recorded as pleural mesothelioma. The main occupational exposures occurred in the shipbuilding industry.

Regarding non-occupational exposures to asbestos, 13 cases of mesothelioma were found in women who had washed the work clothes of their relatives at home; we also found other domestic uses of asbestos which were rarely or never discussed previously in the literature: six cases might be explained by the installation of fireproof or non-conductive materials in the domestic environment.

These exposures probably are more frequent than realized until now.

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Key words: asbestos household exposures, pleural mesothelioma in women, non-occupational asbestos exposures, death certificate study

INTRODUCTION

Numerous investigations, particularly case reports and case series, have studied the occurrence of mesothelioma as a consequence of non-occupational asbestos exposure. An exhaustive review has recently been presented by Gardner and Saracci [1989]. A number of reports have addressed the health effects of asbestos exposure for those who live around asbestos mines and factories [Arul and Holt, 1977; Greenberg and Lloyd Davies, 1974; Lieben and Pistawka, 1967; Newhouse and Thompson, 1965; Wagner et al., 1960].

Several reports look at domestic exposure due to asbestos carried into the house by the work clothes of subjects exposed in the workplace. Concentration of fibers in these situations may have been higher than that occurring for residential exposures [Nicholson et al., 1980].

Newhouse and Thompson [1965] found 9 patients who had a relative working

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with asbestos, versus 1 control. Three cases of mesothelioma who had a relative employed in the asbestos industry were described by Lieben and Pistawka [1967].

Four cases of pleural mesothelioma were detected by Anderson et al. [1976] among the relatives of workers active in a plant where amosite products were manufactured; one of the cases was the daughter of a worker who also died of mesothelioma. Two cases of mesothelioma in the same family, described by Li et al. [1987], involved the wife and the daughter of an insulator who was affected by asbestosis and died of lung cancer.

Vianna and Polan [1978] examined occupational and environmental exposure to asbestos of female cases of mesothelioma deceased in New York State (excluding New York City) between 1967 and 1977, and a matched sample of controls. A significantly higher number of cases than controls had husbands and/or fathers active in asbestos related occupations, mainly insulation (relative risk: 10, 95% confidence interval: 1.42-37.40).

The role of household exposure to asbestos in the development of mesothelioma in young adults has been recently reassessed by Kane et al. [1990], who suggested that mesothelioma in the first four decades of life might be more common than ordinarily believed. According to the authors, a detailed occupational and non-occupational interview may detect unsuspected modes of exposure.

As far as Italy is concerned, a survey on hyaline pleural plaques occurrence, examining 343 necropsies performed on females in the years 1979-1984, was conducted in Monfalcone (northeastern Italy). The prevalence of pleural plaques was 21.6%. In most cases, domestic exposure to asbestos was detected, mostly linked to contaminated work clothes of relatives active in a shipyard. Two of these women were affected by pleural mesothelioma [Bianchi et al., 1987].

The present paper describes a cluster of cases of pleural mesothelioma attributable to non-occupational exposure to asbestos in the towns of La Spezia and Leghorn. These towns, located on the western coast of Italy, have been selected because their mortality rates from pleural neoplasms are among the highest in Italy. In 1980-1983 the province of La Spezia had a mortality rate of 7.13×10^{-5} in males and 1.59×10^{-5} in females; Leghorn, in the same years, had rates of 4.92×10^{-5} and 1.96×10^{-5} , respectively [Bruno et al., 1988]. Both towns are important centers of the shipbuilding industry. In contrast, rates for the whole of Italy are 1.35×10^{-5} in males and 0.75×10^{-5} in females.

MATERIALS AND METHODS

This work is concerned with non-occupational exposures to asbestos among 16 cases of mesothelioma that occurred in the towns of Leghorn (1975-1988) and La Spezia (1958-1988).

In all, the causes of death were examined for 39,650 subjects deceased in Leghorn and 45,650 in La Spezia.

There were 88 deaths (60 men, 28 women) in Leghorn and 174 (146 men, 28 women) in La Spezia recorded as pleural mesothelioma in the quoted periods, for a total of 262 cases (206 men, 56 women). It was not possible to collect any information on 60 subjects (43 males, 17 females) that we considered "lost cases" (Table I). We took under consideration the diagnosis of death of the mortality registries of general population.

TABLE I. Asbestos Exposure of Subjects Deceased From Pleural Mesothelioma in Leghorn (1975-1988) and La Spezia (1958-1988)

Exposure	Men	Women	Total
Sure, occupational	114	3	117
Probable, occupational	24	2	26
(Indirect), non-occupational	3	13 (+3) ^a	19
Non-definite	22	18	40
Total interviews	163	39	202
"Lost cases"	43	17	60
Total cases recorded on mortality registries	206	56	262

^aDomestic asbestos exposure, very probably, but not sure.

It was possible, through direct or telephone interviews with close relatives of the deceased, to obtain information on 202 persons (77% of total cases): 163 men (79%) and 39 women (70%).

Among 202 cases on whom we collected satisfactory information, we can classify 143 subjects (138 males and 5 females) as occupationally exposed ("surely" or "probably" exposed). The exposures of cases were classified by three hygienists with intimate knowledge of the industrial processes of the area. People "surely" exposed were mainly shipyard and insulating workers. For 16 cases, as mentioned, we found non-occupational exposures, usually domestic, to asbestos ("indirect" exposure); for 40 subjects we have not been able to assess any definite exposure to asbestos. For these female cases (in brackets in Table I) we considered domestic exposure to asbestos very probable, but not sure.

Table I briefly summarizes these findings; the most frequent occupational exposures occurred in shipyard industry.

The non-occupational exposures in our review are noteworthy because they have not been reported previously and awareness of new sources can contribute to prevention.

Because of the long latency, we were not able to achieve technically reliable information about the insulating materials installed in the houses of the subjects deceased of mesothelioma. Nevertheless, we analyzed 5 panels and a cord still used as fireproofing in houses in Leghorn and La Spezia.

We collected these specimens in the dwellings of low social class individuals and submitted them to inspection of a geologist and to scanning electron microscopy.

RESULTS

In Table II, the cases of mesothelioma with non-occupational exposure to asbestos are described (13 women and 3 men), by year of death and by occupation.

The average age of death was 63 years (range 60-65) for men and 76 (range 66-87) for women.

Among the thirteen women, ten (Cases 1-10) lived with workers who were exposed to asbestos for occupational reasons: 8 of them were the wives and one was

TABLE II. Cases of Mesothelioma With Non-Occupational Exposure to Asbestos (Leghorn, 1975-1988; La Spezia, 1958-1988)

No.	Year of death	City ^a	Sex	Age	Occupation
1	1967	SP	F	73	Housewife
2	1979	LI	F	70	Housewife
3	1980	LI	F	73	Housewife
4	1981	SP	F	87	Housewife
5	1982	LI	F	75	Housewife
6	1985	LI	F	74	Housewife
7	1985	LI	F	66	Housewife
8	1987	LI	F	79	Housewife
9	1988	LI	F	82	Housewife
10	1988	SP	F	74	Housewife
11	1980	SP	F	83	Housewife
12	1984	SP	F	74	Housewife
13	1988	SP	F	79	Housewife
14	1967	SP	M	60	Musician, wine dealer ^b
15	1970	SP	M	64	Oyster cultivator
16	1988	SP	M	65	Shipyard employee ^b

^aSP = La Spezia, LI = Leghorn.

^bBoth non-occupational and occupational exposure (see text).

the sister of shipyard workers; another was the wife of an oil refinery worker.¹ By interviewing relatives, it was learned that the ten women used to wash the work clothes of their relatives at home. Two of these cases also used asbestos boards for ironing clothes.

In the kitchen of the Case 11, the exposed insulation of hot water pipes was asbestos.

The last two women (Cases 12 and 13) were exposed to asbestos panels that had been installed behind radiators to limit heat dispersion.

In a similar manner, the three men (Cases 14-16) lived in houses where asbestos panels were employed to limit heat dispersion. However, two of these males also experienced occupational exposures: one (Case 14) prepared filters to improve the quality of the wine he sold² and another (Case 16) worked as warehousemen at the military shipyard in La Spezia. It is remarkable that the occupational exposures of these two cases occurred so near the date of death (six and two years before, respectively) that a causal relation to occupational asbestos exposure cannot be estimated as sufficient. It seems likely that there is sufficient latency with regard to the non-occupational exposure to permit a causal relation.

All of the interviewees recalled the duration of domestic exposures to be a long, not well-specified, period ("the whole life," "many years," etc.). Table III summarizes the quoted form of non-occupational exposures to asbestos.

In addition to the case-series described, there are also three female cases (not

¹The man who worked in the oil refinery was exposed to asbestos fibers while repairing insulated pipes and boilers there.

²Filters were made and periodically replaced by inserting asbestos powder in a suitable net, placed along the wine passing.

TABLE III. Non-Occupational Exposure to Asbestos of 16 Subjects Deceased From Pleural Mesothelioma in Leghorn (1975-1988) and La Spezia (1958-1988)

	Men	Women
Work clothes wash	0	10
Domestic use of fireproof panels	3 ^a	2
Domestic insulation for hot water pipes	0	1

^aBoth non-occupational and occupational exposure (see text).

reported in the tables) for whom exposure to asbestos has to be considered very probable, but not sure.

One of the women could have inhaled asbestos fibers that were brought into the domestic environment by her son, who was an employee in a firm that sold non-conductive material used as substitute for asbestos (i.e., ceramic fibers). As a consequence, this man worked daily in environments where asbestos was present and where he went to propose the alternative products. We have no confidence about the exposure of this case to asbestos and/or to ceramic fibers, but it is clear that the son also kept some samples of ceramic material in his house.

Two other women had been married to men occupationally exposed to asbestos (a ship engineer and a locomotive engineer in the port), but their interviewed relatives did not remember if the deceased women had washed their husbands' work clothes at home. No other supplementary information about asbestos fibers inhalation was available.

Table IV summarizes the results of the mineralogic examination of 5 fireproof panels and a cord still used in houses in the area of Leghorn and La Spezia.

Crocidolite was found in none of the examined specimens; we stress, however, that these results can be referred only in hypothetic terms to the aetiology of the cases of mesothelioma above reported.

DISCUSSION

Our findings are consistent with previous reports in the literature [Gardner et al., 1989] and have also been described earlier by some of us [Neri et al., 1989]. However, the present series deals with more numerous findings.

Our study is based on death certificates, which have the advantage of systematic coverage of the population, even if it is well known that pleural mesothelioma is underreported as a cause of death [Delendi et al., 1991].

It is well known that the diagnosis of mesothelioma requires pathologic evidence, and death certificates are affected by a margin of error [Nelson and Farebrother, 1987].

Pleural mesothelioma, nevertheless, is included among the sentinel health events described by Rutstein et al. [1983], and an example of surveillance of mesothelioma by use of death certificates is provided by Schwartz [1986]. Previous studies by us show that only about 70% of patients affected by pleural mesothelioma are correctly registered as malignant neoplasms of pleura at death [Bruno et al., 1990]. A general discussion of the issue can be found in the paper by Dubrow et al. [1987].

For the cases we report, a diagnostic bias for compensation payment matters

TABLE IV. Mineralogic Examination of Fireproof Materials Still Used in the Area of Leghorn and La Spezia

Macroscopic features	SEM* investigation fiber types	SEM investigation fiber average sizes	Non-fibrous particles
A: Flexible, 4 mm thick panel. Slightly breakable; friability and maximum fiber dispersion mostly along rims and angles.	Chrysotile	Length = up to 1 mm, diameter = 1-5 μ	Chrysotile ^a
B: Poorly flexible, 2 mm thick panel. Poorly breakable; friability and maximum fiber dispersion mostly along rims and angles.	Chrysotile	Length = up to 1.5 mm, diameter = 1-5 μ	Chrysotile ^a
C: Flexible, 6 mm thick panel. Highly breakable; spread friability and maximum fiber dispersion along rims, angles, and flaking planes.	Glass fibers, chrysotile	Length = up to 1 mm, diameter = 5-15 μ	Quartz, barite, chrysotile ^a
D: Stiff, 1 cm thick panel. Slightly breakable; friability and maximum fiber dispersion mostly along rims and angles.	Chrysotile	Length = up to 1.5 mm, diameter = 1-10 μ	Chrysotile ^a
E: Poorly flexible, 2 mm thick panel. Poorly breakable; friability and maximum fiber dispersion mostly along rims and angles.	Chrysotile	Length = up to 1 mm, diameter = 1-10 μ	Chrysotile ^a
F: Totally moldable, 1 mm thick cloth (cord). Poorly breakable; very low friability and fiber dispersion.	Chrysotile	Length = up to 1.5 mm, diameter = 1-5 μ	Chrysotile ^a

*SEM = scanning electron microscopy.

^aNon-fibrous phase.

cannot be suspected. Furthermore, items about exposure were collected without informing the interviewed persons about the aims of the study and information can therefore be deemed fairly reliable.

Briefly, in thirty-nine women with a pleural mesothelioma diagnosis on their death certificate and for whom it has been possible to collect medical records and interview information, thirteen were definitely exposed to asbestos in the domestic environment; three more cases were probably exposed and 5 were exposed at work.

In addition, the number of "lost cases" plus the cases without definite exposure could obscure some additional cases with non-occupational exposure. It is very difficult, in fact, through the interviews of the decedents' relatives to identify domestic or "free-time" activities that occasion the inhalation of asbestos fibers. Domestic washing of work clothes seems especially to constitute an important non-occupational exposure. According to Huncharek et al. [1989], the total amount of inhaled fibers in this operation may be comparable to that inhaled by workers occupationally exposed to asbestos.

Although work clothes have been no longer washed at home in Italy for many years, we have observed that a questionable domestic use of asbestos still exists—

namely as non-conductive material to limit heat dispersion, often without any regard to friability and fiber dispersion. We found only chrysotile in the specimens examined; but, in our opinion, the unnecessary domestic use of all types of asbestos, even that overlooked in the past, should now be banned. Health education is also required.

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