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Asbestos hazard in the Swedish construction industry—recent trends in mesothelioma incidence

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Objectives The aim of this study was to analyze the incidence of pleural tumors among various categories of Swedish construction workers and to determine to what extent its change over time differs from that of the general male population.

Methods Traditional methods have been used to study cancer incidence through 1998 in a cohort comprising 370 165 male workers examined in 1971–1992 by Bygghälsan, an organization at the time providing nationwide occupational health service. Incidence was assessed by linkage to the national cancer register.

Results Swedish construction workers, particularly those heavily exposed to asbestos, had an excess incidence of pleural tumors in 1975–1998 [standardized incidence ratio (SIR) 3.16, 95% confidence interval (95% CI) 2.55–3.88]. The excess declined with subsequent follow-up periods and birth cohorts with the exception of the most recent period (SIR 3.83, 95% CI 2.64–5.38) and those borne in the 1930s.

Conclusions A possible decline in pleural tumors among men following the cessation of asbestos use 25 years earlier in the population at large may not be applicable to an end-user sector like construction work. In occupations charged with repairing and refurbishing work, there may even have been an increase lately.

Key terms asbestos use; end-user; lung; pleura; third wave.

Many studies describing the health effects of exposure to asbestos have been published in the past 50 years. Most of them have concerned asbestos mining and the manufacturing of asbestos-containing products, including asbestos cement. However, already in a study in the 1960s, Selikoff et al (1) first reported elevated mesothelioma mortality among insulators in the United States; they ascribed this phenomenon to the workers' exposure to asbestos. Some of the studied insulators had been working in the construction industry. In a more recent report from the United Kingdom, Peto et al (2) pointed out that the construction trade is one of those in which an excess incidence of asbestos-related cancer—in particular mesothelioma of the pleura—can be expected in the future. In the United Kingdom, preventive steps were earlier directed primarily towards the more asbestos-specific trades and neglected the end users (2). The aim of this study was to analyze the incidence of pleural tumors among various categories of Swedish construction workers and to determine to what extent its change over time differs from that of the general male population.

Study population and methods

National cancer registration

Since 1958, new findings of tumors are reportable by law to the national cancer registry. Most notifications to the registry contain data on tumor site and pathology. Almost all pleural tumors are reported as mesotheliomas. The national incidence of pleural tumors and lung cancer has been calculated as the age-standardized incidence, with the Swedish 1980 population taken as the standard. For the calculation of expected numbers, 5-year period incidence rates for 5-year age groups (≤19, 20–24, …. , 80–84, ≥85) have been used.

Data on asbestos import

Data on the import of asbestos have been obtained from Statistics Sweden.

Cohort studies on Swedish construction workers

In 1968 the employers and trade unions in the Swedish construction industry agreed to establish a jointly run

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occupational health service (Bygghälsan) available to all construction establishments and all construction workers nationwide. The preventive medical services comprised, among others, a health examination program to which all construction workers were invited with an interval of 2–3 years. Although participation was voluntary, the participation rate was higher than 80%. At the health check-ups, nurses with special training interviewed the workers concerning their exposures and recorded codes of current and previous occupation. One purpose was to establish a health surveillance system for the whole industry (3). Altogether some 370 000 male workers were examined during the period 1971–1992, most of them more than once. On the basis of the occupation code recorded at the first check-up, examinees were classified into 22 different major categories.

The cohort of examinees has been followed for mortality and cancer incidence by linkage to various national registers, the cancer register, the register of deceased people, and a register of migrants. Less than 0.1% of the cohort was lost to follow-up. The incidence of pleural tumors and lung cancer has been expressed for various categories as the standardized incidence ratio (SIR) with the 95% confidence interval (95% CI). For the calculations, reference rates have been taken as rates for 5-year age groups and 4-year calendar periods.

Results

Asbestos use in Sweden

Import is the only source of asbestos in Sweden. Compared with that of many other European countries, the import was modest during the years between the two world wars. Although the import rose sharply during the mid-1950s to a level of some 10 000 tonnes annually (figure 1), it was still at a rather low level compared with that of other countries of a similar population size and so was the subsequent increase during the 1960s to some 20 000 tonnes annually. The peak import occurred in the early 1970s, although it was briefly interrupted in 1973. The sharp and rapid decline in 1976, on the other hand, became permanent, thanks in particular to the immediate cessation of the use of asbestos-containing products in the construction industry. A total ban of asbestos use was enforced in 1982, although it permitted continued use for brake lining, gaskets and the like under special circumstances and subject to individual authorization until less hazardous materials were available for such special applications.

Swedish national pleural tumor incidence

Since the mid-1970s the annual number of pleural tumors has increased substantially, in particular among men (figure 1). The total number accumulated during the first 10 years of the registry, was of the same magnitude as the annual numbers in the late 1990s, and the number of cases among men was only twice the number of those among women. The annual number and the incidence rate leveled off during the 1990s. Actually, the annual incidence has consistently been lower after the peak in 1992.

Tumors of the lung and pleura in construction workers

In 1971–1998, the cohort of examined construction workers showed an excess incidence of pleural tumors (SIR 1.64, 95% CI 1.43–1.87), but only a slight excess of lung cancer (SIR 1.03, 95% CI 1.00–1.07) (table 1). The pleural tumor incidence was high in the six heavily exposed groups when taken together (SIR 3.18, 95% CI 2.57–3.90), but also in the remaining 16 groups, when taken together (SIR 1.20, 95% CI 1.00–1.44). With regard to lung cancer there was an excess incidence for the heavily exposed only (SIR 1.14, 95% CI 1.06–1.23).

In the cohort of examinees in the heavily exposed occupations combined, the high excess of pleural tumor incidence in 1975–1998 could be seen mainly during the very early periods of the follow-up. The excess declined

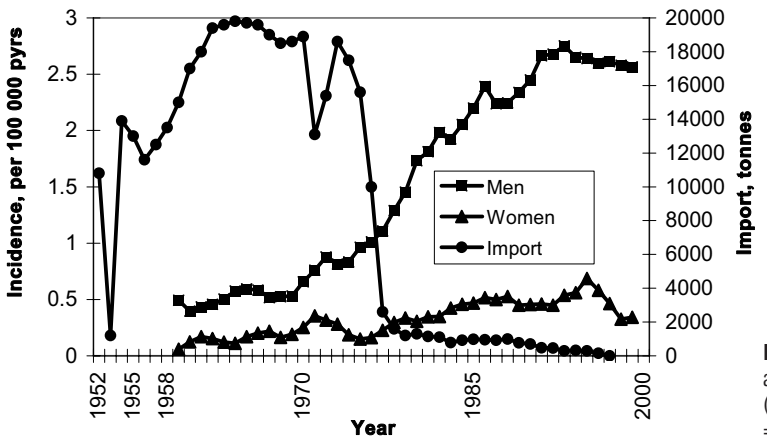

Figure 1. Annual import of asbestos in Sweden and age-standardized incidence of tumors of the pleura (International Classification of Diseases, 7th revision =162.2) by gender. (pyrs = person-years)

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Table 1. Cancer incidence in 1971–1998 among the Swedish construction workers examined by Bygghälsan. (SIR = standardized insidence ratio, 95% CI = 95% confidence interval)

Category	Pleural tumors				Lung cancer			
	Observed	Expected	SIR	95 % CI	Observed	Expected	SIR	95% CI
Heavily exposed	92	28.9	3.18	2.57–3.90	693	608.3	1.14	1.06–1.23
Other professions	123	102.2	1.20	1.00–1.44	2312	2292.2	0.99	0.97–1.05
All examinees	215	131.1	1.64	1.43–1.87	3005	2906.4	1.03	1.00–1.07

during the subsequent follow-up periods (table 2). During the most recent follow-up period, however, the standardized incidence ratio was again high in heavily exposed groups, particularly so for plumbers and painters. No similar pattern over the follow-up periods was found in the combination of occupations not heavily exposed (table 2) or for lung cancer in the combination of the heavily exposed occupations (figure 2).

For the heavily exposed occupations combined, the birth cohorts showed different pleural tumor excess incidences (figure 3) with the highest incidence for those born in 1900–1909. Furthermore, those born in the 1930–1939 birth cohort had a higher incidence than those borne during the two preceding decades. Among the painters, the 1930–1939 birth cohort had an excess pleural tumor incidence of the same level as the birth cohorts of the beginning of the century. For lung cancer there was a steady decrease in incidence over the birth cohorts when compared with that of the general male population (figure 4).

Table 2. Pleural tumor incidence by category and calendar period. (SIR = standardized incidence ratio, 95% CI = 95 % confidence interval)

Category	Observed	Expected	SIR	95 % CI
Examinees not heavily exposed to asbestos (N=247 466)				
1975–1979	3	5.34	0.56	0.12–1.64
1980–1984	15	13.81	1.09	0.61–1.79
1985–1989	31	22.36	1.39	0.94–1.97
1990–1994	37	31.14	1.19	0.84–1.64
1995–1998	34	27.92	1.22	0.84–1.70
1975–1998	120	100.57	1.19	0.99–1.43
All heavily exposed to asbestos (N=108 431)				
1975–1979	7	1.36	5.15	2.07–10.6
1980–1984	14	3.69	3.79	2.07–6.37
1985–1989	17	6.22	2.73	1.59–4.38
1990–1994	20	8.88	2.25	1.38–3.48
1995–1998	33	8.61	3.83	2.64–5.38
1975–1998	91	28.76	3.16	2.55–3.88
Floorers (N=5443)				
1975–1998				
Insulators (N=2923)	6	1.34	4.47	1.64–9.75
1975–1998	5	0.66	7.52	2.44–17.7
Plumbers (N=25 664)				
1975–1979	4	0.38	10.46	2.84–27.0
1980–1984	9	1.05	8.58	3.91–16.3
1985–1989	5	1.79	2.80	0.90–6.53
1990–1994	6	2.55	2.36	0.86–5.12
1995–1998	11	2.48	4.44	2.21–7.94
1975–1998	36	8.3	4.34	3.04–6.01
Painters (N=25 712)				
1975–1979	3	0.53	5.68	1.17–16.6
1980–1984	2	1.27	1.57	0.19–5.69
1985–1989	2	2.02	0.99	0.12–3.58
1990–1994	3	2.7	1.11	0.23–3.25
1995–1998	7	2.33	3.00	1.21–6.19
1975–1998	17	8.92	1.91	1.01–10.1
Sheet metal workers (N=12 084)				
1975–1998	9	2.48	3.64	1.66–6.89
Electricians (N=36 605)				
1975–1998	19	7.23	2.63	1.58–4.11

Discussion

In spite of the cessation of most asbestos use in Sweden 25 years ago, the annual number of pleural tumors among men in the late 1990s was still substantially higher than the annual number of fatal work accidents in Sweden (4). This is a relevant comparison, as almost all of such tumors are fatal within a year and most likely caused by previous occupational exposure to asbestos. As there are reasons to believe that the number of lung cancers attributable to asbestos exposure can be estimated to be of the same order of magnitude as the number of cases of pleural tumors, the total number of these two fatal diseases is accordingly more or less three times the number of fatal work accidents.

Although there are indications that the incidence of pleural tumors among Swedish men has slowly started to decline, the incidence during the most recent 4-year follow-up period among construction workers was possibly higher than in previous periods. In some job categories, the incidence of pleural tumors may still be increasing. The concerned job categories share the feature of having been exposed during repairing or other tasks involving manipulation on existing asbestos-containing material. Such groups are electricians and floor layers, but probably even painters. Although the manufacturing of floor and wall covering material containing asbestos was prohibited already in 1976, the risks continue far beyond. In particular, the work with floors is interesting, as the installation of the new carpet presented

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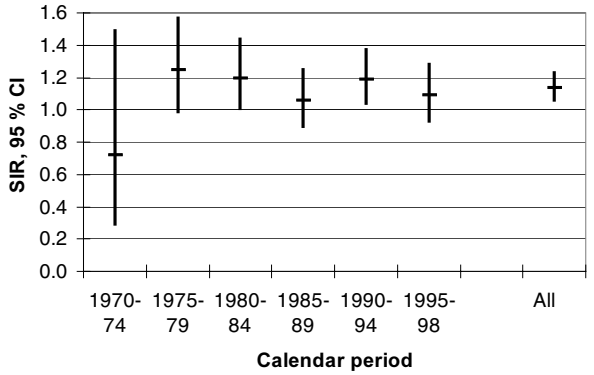

Figure 2. Incidence of lung cancer (International Classification of Diseases, 7th revision=162.1) by calendar period among Swedish construction workers heavily exposed to asbestos. (SIR = standardized incidence ratio, 95% CI = 95% confidence interval)

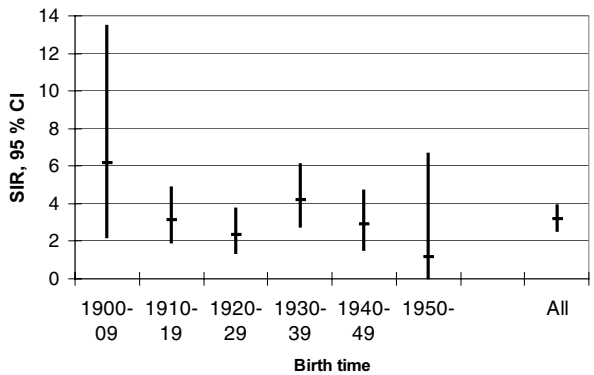

Figure 3. Incidence of pleural tumors (International Classification of Diseases, 7th revision=162.2) by time of birth among Swedish construction workers heavily exposed to asbestos. (SIR = standardized incidence ratio, 95% CI = 95% confidence interval)

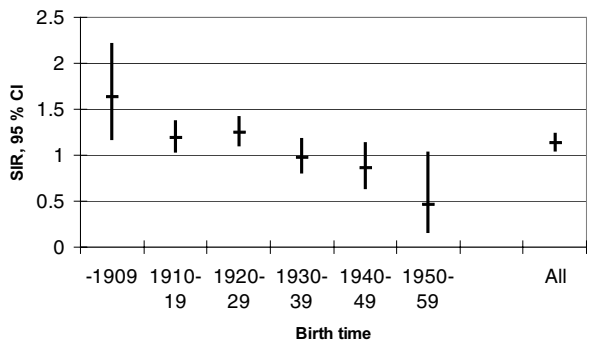

Figure 4. Incidence of lung cancer (International Classification of Diseases, 7th revision=162.1) by time of birth among Swedish construction workers heavily exposed to asbestos. (SIR = standardized incidence ratio, 95% CI = 95% confidence interval)

no problem, while, at the time of replacement some 20 years later, it became a major source of exposure. As the backside of the carpet contained asbestos fibers for the purposes of reinforcement and resistance to alkaline environment and had been glued to the floor, it had to be scrapped away, and exposure to asbestos was caused by the needed grinding. In earlier periods, asbestos had been used as fillers in paints, and also painters might have been exposed when grinding on old paint at the time of repainting.

In contrast to the pleural tumor incidence, the incidence of lung cancer among the heavily exposed construction workers showed a consistent decline with time of birth relative to that of Swedish men in general. The various antismoking activities by the occupational nurses combined with continuous feedback from lung cancer incidence data on smokers and nonsmokers among their peers may explain the decrease in smoking rates among the workers in the whole industry.

During the medical examinations and interviews, questions were also asked about the handling of and possible exposure to asbestos-containing material. As the interviews concerning work and exposures took place at the medical check-ups long before their tumors were diagnosed, recall bias is unlikely. This is even more the case for those first examined before the mid-1970s before all discussions in society about asbestos hazards. Out of the first 85 of the workers diagnosed with a pleural tumor, only 13 reported past exposure to asbestos (5). Such a lack of knowledge about one's own exposure probably explains why the proportion of pleural mesotheliomas reported as occupational diseases is so low in some countries.

In conclusion, the findings suggest that another wave of asbestos-induced disease may appear in the most pronounced end-user trades in the construction industry due to the continued handling of old asbestos-containing building material during repairing and refurbishing activities.

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