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Oral cavity and laryngeal cancers among man-made mineral fiber production workers

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MOULIN JJ, MUR JM, WILD P, PERREAUX JP, PHAM QT. Oral cavity and laryngeal cancers among man-made mineral fiber production workers. *Scand J Work Environ Health* 12 (1986) 27–31. From 1975 to 1984, the incidence of cancer was determined among workers employed in a French man-made mineral fiber (MMMF) production plant. The cohort, including 1 374 fully active or retired men, represented 12 793 person-years. Forty-one patients had cancer, 19 of which were in the upper respiratory and alimentary tract and five of which were lung cancers. The number of lung cancers observed did not significantly differ from that expected [standardized incidence ratio (SIR) 0.7]. However the incidence of upper respiratory and alimentary tract cancers was significantly higher (SIR 2.2), especially for those in the larynx (SIR = 2.3), pharynx (SIR 1.4), and buccal cavity (SIR 3.0). The relative risk of cancers in the upper respiratory and alimentary tracts seemed to increase with the length of exposure to glass fibers and exceeded the value of 3.0 for more than 10 years of exposure. This result does not seem to be attributable to an excess of tobacco and/or alcohol consumption. No previous survey of the MMMF industry has shown such a risk, except in Italy. Thus this finding has to be confirmed.

Key terms: cancer incidence, occupational epidemiology.

Man-made mineral fibers (MMMF) have recently become more extensively used. They are used for thermal and acoustic insulation, in the textile industry, and for the reinforcing of plastic material. Although the chemico-physical properties of these fibers make them different from asbestos, their carcinogenicity must be considered. MMMF intrapleural inoculation in experimental models has produced cancers (22, 23, 25).

Several epidemiologic surveys have been conducted in Europe and in North America (1, 2, 4, 5, 6, 7, 9, 10, 13, 14, 18, 21). They were aimed at investigating an excess of cancer incidence among populations working in the MMMF industry. Probably because of the analogy with asbestos, these surveys were mainly focused on malignant tumors of the lung which, furthermore, are the first cause of mortality from cancer in the male population of industrialized countries.

In France, where seven MMMF factories are established, no epidemiologic survey has been conducted until now, probably because of the difficulties in the follow-up due to confidentiality constraints. In the present paper we report the results of a historical prospective study of cancer incidence. The study was conducted in a factory where an industrial physician had noticed an excess of cancers in the upper respiratory and alimentary tracts, ie, cancers in the pharynx, larynx, and buccal cavity.

Subjects and methods

The factory, located in the north of France, produces glasswool used mainly for thermal insulation in the building industry, shipyards, and car manufacturing and for the production of household appliances. The first production lines started in 1940 and are still in operation. Annual production was 5 000 t in 1950, 15 000 t in 1960, and 50 000 t in 1980. The manufacturing processes generate discontinuous fibers coated with a thermosetting binder essentially made of water, phenol, formol, ammonia, urea, and oil. The mean diameter of the fibers produced by the factory is 6.4 μm , 30 % have diameters < 3 μm , and 10 % are < 1 μm .

The cohort under study consists of all male workers present at the factory between 1 January 1975 and 31 December 1984 who had been working for at least one full year. Person-years, including those of active and retired workers, were computed from this period. The members of the cohort lost to follow-up (101 persons, 465 person-years) were considered still living and thus still contributed to the person-years. The total size of the cohort was 1 374 men, of whom 96 % were French. Their occupational history in the factory since the date of entry was reconstituted. The cases of cancers in this cohort were identified from the social insurance records of the company. The coverage is unknown but probably very good. Diagnoses were ascertained by histological reports, hospital records, or from attending physician's reports. Tobacco consumption was estimated on the basis of information from the subjects still present in the factory in 1983 (966 men). No data concerning alcohol consumption could be obtained.

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Environmental surveys were performed in 1981 in order to measure the pollution by fibers. For these surveys, occupational groups were identified according to place of work, and workers were asked to wear sampling equipment during their workshift. In order to calculate the standardized incidence ratio (SIR) for cancers, we estimated the expected numbers of cancers, for five-year age groups and for the whole period, by using data from three regional cancer registers existing in France (8, 19, 20). These data were found to be homogeneous. Moreover, using the incidence/mortality ratio, we estimated the case coverage to be above 95 %. Thus the calculated standardized incidence ratios are probably accurate. The criteria for diagnosis were the same as in the cohort. The reference incidence rates, for each age group, were determined as the average rates in the three registers, weighted according to the population size concerned with each register. The registers concerned the period between 1975 and 1981 but did not include the population of the region where the factory was established. In order to verify that this reference (the only one we could use) was not too incorrect, we checked that mortality rates by cancer, in the region where the plant is located, did not differ markedly from those of regions having registers. For the standardized incidence ratios 95 % confidence intervals were computed on the basis of the Poisson distribution.

Results

In 1984 the mean age of the cohort was 44.4 (SD 11.3) years, the mean length of employment being 16.6 (SD 8.8) years. Table 1 shows the age distribution of the person-years.

The results of the inquiry about tobacco consumption are given in table 2. For the whole cohort, they do not differ from values obtained from a poll of the French male population of the same age in 1979. There was no difference in tobacco consumption, inside the factory, according to occupation. The two environmental surveys showed low fiber concentrations, the average respirable fiber concentrations being below 0.2 fibers/cm³. More detailed values have been given elsewhere (12).

During the 10 years of survey, 41 subjects were affected by cancer, 19 cases of which occurred in the upper respiratory or alimentary tract (table 3). Three patients had a cancer in two locations (soft palate + tongue, tonsil + hypopharynx, and larynx + tonsil). Precise histologies were determined by hospital departments but were reported for only six cases (squamous-celled carcinomas). The comparison with the statistics of the incidence registers (table 4) showed a significant excess for cancer in the upper respiratory and alimentary tracts (SIR 2.18, $p < 0.01$), whereas there was no significant difference for lung cancers (SIR 0.74) and other malignant tumors (SIR 0.77). An increased incidence of laryngeal cancers (observed 5, SIR 2.30) as pharyngeal (observed 5, SIR 1.40) and oral cavity cancers (observed 9, SIR 3.01) was observed. The mean time since first exposure was 17.6 years.

The cohort was divided into the administrative staff, the maintenance staff, and the production workforce. The last category was divided according to work duration in workplaces contaminated by fibers (production, storage, handling, manufacture). Upper respiratory and alimentary tract cancers were not in excess among the administration and maintenance workers. On the contrary, they were in excess among workers exposed to glass fibers, and this excess was

Table 1. Person-years by age group and by time since first employment.

Time since first employment	Age group (years)						Total
	15—24	25—34	35—44	45—54	55—64	65—74	
1—9 years	740	2 737	1 102	453	59	5	5 096
10—19 years	—	847	2 054	1 184	350	84	4 519
≥ 20 years	—	1	565	1 542	880	190	3 178
Total	740	3 585	3 721	3 179	1 289	279	12 793

Table 2. Tobacco consumption in different groups of employees and in France.

Group	Cigarette smoking category					Current pipe or cigar smokers (%)	Number
	Never smokers (%)	Ex-smokers (%)	Current smokers				
			1—10 /d (%)	11—20 /d (%)	>20 /d (%)		
Nonmanual workers	27.1	32.8	7.4	25.4	5.7	1.6	122
Nonexposed manual workers	23.6	23.1	10.0	33.7	8.6	1.0	208
Exposed manual workers	23.6	28.1	11.5	27.5	7.9	1.4	636
France (poll of men between 18—64 years of age, 1979)		43.2 ^a	18.5	25.0	10.2	3.1	384

^a Never smokers and exsmokers combined.

significant in the stratum of workers exposed for more than 10 years. Moreover, a relationship between the duration of exposure and the standardized incidence ratio for upper respiratory and alimentary tract cancers seemed to appear, but could not be statistically confirmed. For lung cancers, as well as for other cancers, the standardized incidence ratios did not depend on the type of occupation or duration of exposure to fibers (table 4).

Discussion

This survey, conducted in France, provides two main results. First, it does not reveal any excess in lung cancers among workers exposed to MMMF. According to a recent literature review published by Saracci & Simonato (17), four surveys did not indicate any excess in lung cancers, whereas five others did. However, in those five surveys, the excess in lung cancers had no significant relationship with fabrication processes or with the duration or intensity of exposure. Second, a significant excess of cancers in the upper respiratory and alimentary tracts was found, and the incidence seems to be correlated with the duration of exposure. This excess may be underestimated due to the fact that the vital status (and medical history) was unknown for 101 subjects lost to follow-up. As far as we know, this observation has not yet been mentioned in the litera-

ture. In table 5, which summarizes information published in Europe and North America, no such risk can be observed, except for Italy. In this country, Bertaz-

Table 3. Number of observed cases of cancer.

ICD ^a (8 th revision)	Site	Number
	Buccal cavity	
140	Lip	1
141	Tongue	2
144	Floor of mouth	4
145	Soft palate	1
	Tongue + soft palate	1
	Pharynx	
146	Oropharynx	2
148	Hypopharynx	2
	Tonsil + hypopharynx	1
161	Larynx	
	Larynx	4
	Larynx + tonsil	1
150	Esophagus	1
151–158	Digestive system	7
162	Bronchus and lung	5
	Other	
170	Bone	1
185	Prostate	2
189	Kidney	1
191	Central nervous system	1
200	Malignant lymphoma	2
203	Multiple myeloma	2
140–208	All neoplasms	41

^a ICD = International Classification of Diseases.

Table 4. Cancer incidence analysis by site and by duration of exposure. (ICD = International Classification of Diseases, SIR = standardized incidence ratio, 95 % CI = 95 % confidence intervals)

Group	Person-years	Upper respiratory and alimentary tract cancers (ICD 140–149, 161)			Lung cancer (ICD 162)			Other cancers		
		Observed	SIR	95 % CI	Observed	SIR	95 % CI	Observed	SIR	95 % CI
Administration	881	—	0.00	0.00–4.61	1	1.43	0.04–7.96	2	0.95	0.12–3.44
Maintenance	2 088	1	0.71	0.02–3.98	—	0.00	0.00–3.07	1	0.27	0.01–1.51
Production workforce										
Nonexposed	1 206	1	1.67	0.04–9.29	—	0.00	0.00–9.22	1	0.59	0.01–3.28
1–9 years	4 434	3	2.02	0.41–5.84	2	1.82	0.22–6.57	4	1.08	0.29–2.77
10–19 years	2 771	7	3.04	1.22–6.27	1	0.63	0.02–3.48	5	0.94	0.31–2.20
≥20 years	1 413	7	3.33	1.34–6.87	1	0.56	0.01–3.10	4	0.73	0.20–1.86
Total	12 793	19	2.18	1.31–3.41	5	0.74	0.24–1.72	17	0.77	0.45–1.24

Table 5. Data from studies of male workers producing man-made vitreous fibers.

Study	Person-years	Buccal cavity and pharynx		Larynx	
		Observed	Expected	Observed	Expected
Saracci et al (18) ^a	121 119	14	12.08	4	5.05
Olsen & Jensen (13) ^{a, b}	49 634	5	4.4	3	2.0
Saracci et al (18) ^c	248 438	6	6.60	7	4.18
Enterline & Marsh (6) ^c	341 089	23	21.35	10	9.78
Enterline & Marsh (6) ^c	41 934	3	2.96	—	1.37
Morgan (9) ^c	47 088	5	3.7	2	1.7
Morgan et al (10) ^c	..	3	2.61	2	1.2
Claude & Frenzel-Beyme (2) ^{b, c}	33 755	..	..	2	2
Bertrazzi et al (1) ^{b, c}	19 698	..	..	4	0.98

^a Cancer incidence analysis.

^b Included in Saracci's study (18).

^c Mortality study.

zi et al (1) reported a significant excess in laryngeal cancers; deaths due to this disease were significantly more frequent than expected in the group with the longest exposure and among the most heavily exposed workers. Three additional cases are presently known, and the authors are continuing the follow-up. Moreover, in the same country, Maggioni et al (7) recorded eight cases of laryngeal cancers. We believe that attention should be paid to the fact that similar findings originate from southern European countries, where cancers of the upper respiratory and alimentary tracts are frequent (11, 26).

The cancer in the locations observed by us are known to have a close relationship with alcohol and tobacco consumption (11, 15, 16). As shown among current employees, tobacco consumption does not seem more frequent among the cohort than in the general population. Moreover, the fact that there was no increase in the incidence of lung cancers associated with tobacco consumption (3) (SIR 0.74) on the one hand and of esophageal cancers associated with alcohol consumption (24) (SIR 0.7) on the other suggests that these factors did not confound our results. Furthermore, the relationship between the incidence of cancers in the upper respiratory and alimentary tracts and the duration of exposure lets us suspect the etiologic role of glass fibers. Although the concentrations of respirable fibers were low in the factory studied, fibers probably entered the buccal cavity, pharynx, and larynx, regardless of their diameters or lengths. This probability rules out the notion of "respirable fibers." However, environmental fiber concentrations may have been higher in the past.

Conclusions

This study, conducted in France, points out an increased incidence of cancers of the pharynx, larynx, and buccal cavity associated with the duration of exposure to MMMF. This result is not apparently explained by an excess in alcohol or tobacco consumption. In the absence of similar findings, except from another southern European country (Italy), additional surveys are required to substantiate our results.

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