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THE INCIDENCE OF ASBESTOSIS IN A FIBROCEMENT INDUSTRY

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ABSTRACT

An epidemiological study of the incidence and clinical aspects of asbestosis was carried out in a fibrocement industry in the Barcelona environs. Out of 840 workers, 729 were examined, using the following procedures: medical questionnaire, biotype (weight and height), physical examination, chest radiography (P-A and obliques), PFT (static lung volumes, FEV, FEV_1, flow-volume curves, R_{aw}, SG_{aw}, $DLCO_{SB}$), laboratory procedures (CBC, serum proteins, ANF, RF, asbestos bodies in the sputum).

Asbestosis was found in 214 workers (30%). In the initial stages of the disease and as a radiological diagnosis, pleural involvement appears earlier and more frequently than parenchymal, 26% and 13%.

There is a well-defined linear relationship between asbestosis incidence and years of exposure: from no case in the group with less than 5 years of exposure and almost 9% in the group with 5–9 years of exposure, to 69% for those with 30 or more years of exposure.

Pulmonary crepitations is the most significant physical finding (1/3 of the patients). The clinical symptoms and the pulmonary function tests suggest beyond doubt a bronchial involvement in asbestosis.

The problem of asbestosis in Spain was almost ignored until 1974. The "Instituto Territorial de Barcelona, Servicio Social de Higiene y Seguridad del Trabajo", after observing several cases of asbestosis, embarked on a continuous program of surveying all the industries with asbestosis risk in the Barcelona area. This paper is the report on the first industry studied, a fibrocement factory located 35 km from Barcelona. The factory was set up 70 years ago, has a payroll of 850 workers, and consumes about 9 000 tons of asbestos annually, most of it chrysotile, and crocidolite in a much smaller amount. The preliminary results of the survey were presented earlier[5].

The hygienic evaluations of the factory have recently been determined with the following mean values: from 0.165 fibers/cm^3 to 12.8 fibers/cm^3, with a total average of 2.8 fibers/cm^3.

Since most of the workers had been rotating through the years in the different jobs, and because of the fact that the hygienic conditions of the past are not known, but may be assumed to have been different from, and certainly much worse than the present ones, the dose-response relationship based on the concentration of fibers multiplied by years of exposure, could not be accurately computed.

SUBJECTS AND METHODS

A total of 729 workers, 710 men and 19 women, were examined until June 1977. The mean age of the workers was 43.9 years ranging from 16–62 (S. D. = 14.6, mode = 45). The procedures carried out included the following: medical questionnaire, biotype (weight and height), physical examination, chest radiography (P-A and obliques), pulmonary function tests (static lung volumes, FEV, FEV_1, % FEV_1, flow volume curves, R_{AW}, SG_{AW}, $DLCO_{SB}$) and laboratory tests (CBS, serum proteins, ANF, RF and asbestos bodies in sputa). The radiological findings were described according to the International Classification I. L. O. U/C 1971 of Radiographies of Pneumoconiosis. Three qualified radiologists read the films independently and without knowing the subjects' occupational history; cases with contradictory radiological findings were read anew by all three radiologists together and then discussed in order to arrive at a diagnostic consensus.

The clinical diagnosis of asbestosis was based on the occupational history of asbestosis risk and on the radiological findings, with a total disregard of all other data: clinical symptoms, physical signs, pulmonary function tests, and laboratory procedures.

RESULTS

Occupational history was mainly directed to pneumoconiosis exposures. As mentioned before, the years of employment were equated to the years of asbestosis risk. Silicosis was diagnosed in eight instances, but all of them had an occupational history of silicosis risk.

Radiological findings are presented in Table 1. Out of 729 workers 214 have asbestosis (29.4%). The pleural involvement is approximately double that of the lungs, 25.7% as compared to 12.8%. Pulmonary asbestosis without pleural participation was found in only 3.7%. Pleural plaques calcified and/or not calcified were seen in just a few cases. Silicosis, as mentioned before, was diagnosed in eight workers, but all of them with a known occupational history of silicosis risk previous to their present employment.

The radiological findings according to exposure time are listed in Table 2. There is a definite correlation between the incidence of asbestosis and exposure time: from no case in the group with less than 5 years of exposure, and 9% in the group with 5 to 9 years of exposure, to 68.9% among those with 30 or more years of exposure. It is also evident that pleural involvement appears earlier than asbestosis of the lung, while being also more common, i. e. 25.9% as against 12.8%, at least in the initial stages of the disease.

TABLE 1
General radiological findings.

Clinical findings	N	%
Total with asbestosis	214	29.4
Pleural asbestosis (only)	121	16.6
Pulmonary asbestosis (only)	27	3.7
Pleural-pulmonary asbestosis	66	9.1
Pleural asbestosis (alone and combined)	187	25.7
Pulmonary asbestosis (alone and combined)	93	12.8
Silicosis and asbestosis	8	1.1
Total examined	729	

TABLE 2
Radiological findings and exposure time.

Radiological diagnosis	Exposure time (years)							
	< 5 (N=36)	5–9 (N=70)	10–14 (N=309)	15–19 (N=166)	20–24 (N=37)	25–29 (N=37)	> 30 (N=74)	Total (N=729)
Pleural asbestosis (only)	0	5	41	30	8	10	27	121
Pulmonary asbestosis (only)	0	1	13	15	10	10	17	66
Pleural-pulmonary asbestosis	0	0	9	7	1	3	7	27
Total	0	6	63	52	19	23	51	214

Among clinical symptoms only respiratory symptoms (cough, expectoration and dyspnea) are here considered. Out of 729 workers 527 have one or more symptoms, i. e. 72%. The incidence of clinical symptoms is higher in those with, than in those without, asbestosis, and the differences are all statistically significant. Thus, for all the symptoms combined – 77% and 70%, cough – 52% and 49%, expectoration – 47% and 40%, and dyspnea – 63% and 50%. No definite differences could be observed in the incidence of clinical symptoms according to exposure time.

Abnormal physical signs, pulmonary crepitations, rhoncus and sibilants, and clubbing of the fingers were observed more frequently in workers with, than in workers without, asbestosis, and the differences are statistically significant: pulmonary crepitations – 34% and 5%; rhoncus and sibilants – 18% and 5%; clubbing of the fingers – 14% and 4%. The presence of pulmonary crepitations in workers with asbestosis was observed in increasing frequency according to years of exposure. Thus, in the group of workers with an exposure of less than 10 years, pulmonary crepitations were observed in 16% of the cases; the incidence is

32% for those with 10–14 years of exposure, and 39% for those with 25 or more years of exposure. No definite correlation could be established in the other physical signs in relation to exposure time.

Out of 729 workers 309 (42%) have abnormal pulmonary function tests. Comparing both groups, with and without asbestosis, the incidence of abnormal pulmonary function tests was found to be 56% and 36.5%, respectively. In workers with asbestosis obstructive syndrome was detected in 40% of the cases, while the restrictive syndrome and the mixed-type syndrome were observed in 17% of the cases. The percentages for the workers without asbestosis were 26% and 11%, respectively. For statistical comparison a selected group of 175 workers with asbestosis, and another group of 139 workers without asbestosis (Table 3), were matched (with similar mean values for age, height and years of exposure). The VC, TLC, FEV, FEV_1 and $DLCO_{SB}$, were found to be reduced in workers with asbestosis compared with workers without asbestosis. The differences have statistical significance. The RV/TLC is significantly increased in patients with asbestosis. Finally, both groups, with and without asbestosis, present similar mean values of RV, $FEV_{25-75\%}$, R_{AW} and SG_{AW}.

TABLE 3
Pulmonary function tests.

	Test	Asbestosis (mean ± S.D.) for 175 workers	No asbestosis (mean ± S.D.) for 139 workers	Statistical significance ("t")
Pulmonary volumes	VC	3.42 ±0.70	3.81 ±0.71	−4.86
	RV	2.38 ±0.63	2.38 ±0.58	−
	TLC	5.81 ±0.97	6.19 ±0.87	−3.58
	RV/TLC%	41.13 ±7.50	38.51 ±7.51	+3.00
Respiratory mechanics	FVC	3.41 ±0.67	3.78 ±0.72	−4.68
	FEV_1	2.52 ±0.60	2.74 ±0.67	−3.01
	$FEF_{25\%-75\%}$	2.25 ±1.07	2.38 ±1.09	−1.05
	R_{AW}	2.78 ±1.62	2.70 ±2.31	0.31
	SG_{AW}	0.148 ±0.08	0.168 ±0.11	−1.66
Pulmonary diffussion capacity*	$DLCO_{SB}$	29.05 ±6.42	33.03 ±6.77	−3.34
	K_{CO}	6.37 ±1.07	6.59 ±1.12	−1.11

*In "Asbestosis" group 49 workers, in "No asbestosis" group 79 workers.

The laboratory tests' results are not particularly relevant. Worthy of mention are only the scarce positive findings of ANF and RF (1%). Asbestos bodies in the sputum were detected in 5% of the cases, with a similar incidence in both groups, with and without asbestosis.

DISCUSSION

Asbestosis occurs in countries where asbestos is either produced or/and consumed. Spain has no asbestos mines, but the consumption of asbestos has been increasing for the last few decades and at present amounts to approximately 100 000 tons annually. Almost all cases of asbestosis in Spain have been described by Lopez-Areal[3,4] who from 1945–1974 reported 39 cases. Our Institute has embarked on a continuous program of surveying all the industries with asbestosis risk in the Barcelona area; nearly 300 cases of asbestosis have been detected since 1975. The present work is an crossover epidemiological and clinical study of the first surveyed industry. It is not a longitudinal study, which means that already sick, retired, or dead, workers or those who left their jobs, have been statistically lost.

Out of 729 workers 214 have asbestosis (29.5%). There is a clear-cut linear relationship between the incidence of asbestosis and the years of exposure. It seems that pleural thickening appears sooner and more often than parenchymal involvement. The reason for this is unknown. It is worthy of note that pleural plaques, calcified or not calcified, were only exceptionally detected. The incidence of pleural plaques, as mentioned in literature, varies considerably from study to study[1,2,6,7,8]. For this there exists no definite explanation at present, except perhaps geographical factors.

Clinical symptoms were established in 72% of the studied population. This high incidence might be explained by several factors. Firstly, clinical symptoms are subjective descriptions given by the patient himself; secondly, they are collected as answers to a written questionnaire and not formulated orally by the physician; and thirdly, most of the workers have a vindictive attitude and are eager to obtain compensation benefits, and so they tend rather to exaggerate their troubles. Nevertheless, when comparing the two groups, with and without asbestosis, a higher incidence of cough, expectoration, and dyspnea will be observed in the former group. Among the physical signs studied, pulmonary crepitations was the most frequently observed. The presence of pulmonary crepitations for epidemiological purposes is risky since it varies easily depending on the observer's ability, while also lacking objectivity. It becomes, however, extremely valuable information for reaching or confirming the diagnosis of asbestosis in a given individual case.

The restrictive syndrome has usually been considered the type of pulmonary dysfunction characteristic of asbestosis. However, in this study the restrictive and mixed type syndromes in workers with asbestosis were observed in 17% of the cases, while the obstructive syndrome was detected in 40%; the percentages for the workers without asbestosis were 11% and 26%, respectively. It seems therefore that in asbestosis a certain role is played by the bronchial factor. Bronchial pathology would be manifested clinically by the appearance or an exacerbation of the chronic bronchitic symptoms, and physiologically by the presence of the obstructive syndrome. Here we have an overlapping between non-specific chronic bronchitis – so frequently present in city dwellers, particulary smokers – and the bronchitis provoked or specially aggravated

through the inhalation of asbestos dust. The magnitude of each factor is difficult to pin-point.

In 10% of the workers with asbestosis the DLCO was altered. This figure appears rather low, but is not so if one considers that we were dealing with active workers in most of whom the disease was still in the initial stages. The decrease in DLCO is in part due to the pathology of the alveolocapillary membranes and the interstitial spaces and to reduced pulmonary volumes, but mainly to a maldistribution of ventilation and a changed V/Q relationship.

For some unknown reason the ANF and RF were found positive in a few instances. Asbestos bodies in the sputa were detected in 5% of the cases, with no significant difference between the two groups, with and without asbestosis. As is well known the presence of asbestos bodies in the sputum has no diagnostic meaning indicating simply present or past asbestos exposure.

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