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THE INCIDENCE OF PLEURAL MESOTHELIOMA IN CHRYSOTILE ASBESTOS TEXTILE WORKERS

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INTRODUCTION

The incidence of pleural mesothelioma in a group of chrysotile asbestos textile workers is analysed in relation to age, time since first exposure, and period of first exposure. Only 14 cases have occurred in this population, however, and no firm conclusions can be drawn. Similar analysis of other cohorts in which larger numbers of mesotheliomas have occurred should help to resolve some of the questions raised by these data.

ANALYSIS

A cohort of 567 men first employed in an asbestos textile factory before 1951, including 143 who worked before 1933, has been followed to the end of 1978. Details of the calculation of expected numbers from national death rates and of the follow-up are given in another paper[1], which also describes the mortality experience of later employees. For internal analyses, man-years of observation are subdivided into 10-year age groups (30-, 40-, 50-, 60-, 70-84), five-year periods since first exposure, and three exposure cohorts: cohort 1: 69 men with 20 or more years' exposure, with more than 10 prior to 1933; cohort 2: 74 men

[1] See p. 829

with 20 or more years' exposure, less than 10 of which were prior to 1933; and cohort 3: 424 men with 10 or more years' exposure first employed between 1933 and 1950. The 'internal' expected numbers in Tables 3, 4 and 5 are calculated in the usual way. For example, to compute the expected number of cases in a particular age group adjusted for time since first exposure, the overall observed incidence in the cohort in each exposure period is multiplied by the man-years of observation in the required age group in that exposure period, and the results are summed over all exposure periods. The overall sum of these expected numbers is equal to the observed number of cases.

INCIDENCE IN RELATION TO AGE AND TIME SINCE FIRST EXPOSURE

Mesotheliomas and man-years of observation are tabulated according to age and time since first exposure in Tables 1 and 2, which suggest that the absolute incidence increases with both. The increase with time since first exposure persists after adjustment for age (Table 3), except in cohort 1, where one of the two cases occurred only 23 years after first exposure. After adjustment for time since first exposure, however, there is no evidence of an increasing trend with age in any cohort (Table 4).

Table 1. Incidence (I) of mesothelioma $\times 10^3$ by age, with cases (O) and man-years (MY) in each cohort

		Age (yrs)				
		< 40	40-	50-	60-	70-84
Cohort 1	O:	0	0	0	1	1
	MY:	22.5	216.4	366.5	272.4	137.0
	I:	0.0	0.0	0.0	3.7	7.3
Cohort 2	O:	0	0	1	2	2
	MY:	33.7	351.5	550.0	419.5	132.9
	I:	0.0	0.0	1.8	4.8	15.0
Cohort 3	O:	0	0	2	5	0
	MY:	482.7	1874.2	2912.6	2161.6	661.5
	I:	0.0	0.0	0.7	2.3	0.0

Table 4. Distribution of mesotheliomas by age (O), and expected numbers adjusted for time since first exposure (E)

		Age (yrs)						
		< 40	40-	50-	60-	70-84	All ages	Trend test
Cohort 1	O:	0	0	0	1	1	2	NS
	E:	0.09	0.47	0.25	0.41	0.77	2.00	
Cohort 2	O:	0	0	1	2	2	5	NS
	E:	0.00	0.00	0.13	3.26	1.61	5.00	
Cohort 3	O:	0	0	2	5	0	7	NS
	E:	0.05	0.63	2.31	2.81	1.20	7.00	
Total	O:	0	0	3	8	3	14	NS
	E[a]:	0.14	1.10	2.70	6.48	3.58	14.00	

[a] 'Total' E is adjusted for both time since first exposure and cohort.

NS - not significant

INCIDENCE IN SUCCESSIVE PERIODS

The first mesothelioma death in this series was attributed to an 'endothelioma of the pleura' in 1936, but the second did not occur until 1968. The absence of cases during the intervening 32 years raises the possibility that the disease tended to be missed clinically until 10 years ago. The observed distribution in successive decades is compared (Table 5) with the numbers that would have been expected if calendar period were irrelevant to the diagnosis. There is little evidence of any improvement in diagnosis since 1931, which accords with an earlier review of the quality of diagnosis in this population (Knox et al., 1968). The marked increase in incidence in successive periods thus appears to be due largely to the long interval between first exposure and the appearance of the disease.

RISK IN RELATION TO DUST LEVEL

There can be no doubt that exposure prior to 1933 was extremely heavy, and the relative risk for lung cancer in men in cohort 1, who were exposed for more than 10 years to these conditions, was high (13 observed, 1.57 expected at national death rates). In this cohort the absolute excess of lung cancer was much greater than the number of mesotheliomas (approximately 11 against 2), but in subsequent cohorts with a much lower risk of developing lung cancer the absolute excess 20 or

In an earlier discussion of the implications of these data in relation to the current hygiene standard for chrysotile (Peto, 1978), it was assumed that excess mortality from both mesothelioma and bronchial carcinoma is likely to be roughly proportional to dust level. In the absence of more precise data on exposure patterns and fibre type it is difficult to see what alternative assumptions should be examined; but these results could be interpreted as evidence that the ratio of lung cancer to mesothelioma, which might be expected to vary considerably with age at first exposure and duration of exposure (Peto, 1979), may also depend on intensity of exposure. These issues may never be satisfactorily resolved. The incidence of mesothelioma among workers exposed to levels closer to 2 fibres/ml can, in principle, be studied, although it will be many years before such data are available and the excess of bronchial carcinoma in such workers may be too low to be estimated with any precision.

SUMMARY

Analysis of the incidence of pleural mesothelioma in asbestos textile workers in relation to age, time since first exposure, intensity of exposure and period of observation indicates that age *per se* is largely irrelevant; that is, the incidence 30 years after first exposure appears to be much the same irrespective of age at first exposure. This has been shown to be true in animal experiments and has been suggested on theoretical grounds for certain human cancers; it explains the evolution of lung cancer rates in relation to changing smoking habits but has not been demonstrated directly by human data. These results also suggest that mesothelioma incidence may not have been much underestimated in the past, which would imply that the recent marked increase in recorded rates is largely real and not merely a diagnostic artefact. The risk does not appear to have been much higher among men who were initially very heavily exposed. One possible explanation of this surprising observation is that chrysotile is eliminated, or ceases to be biologically active, more quickly than other types of asbestos.

RESUME

L'analyse de l'incidence du mésothéliome pleural chez les travailleurs de l'industrie textile exposés à l'amiante, en fonction de l'âge, du délai écoulé depuis la première exposition, de l'intensité d'exposition et de la

Peto, J. (1979) Dose response relationships for asbestos-related disease: implications for hygiene standards. Part II. Mortality. *Ann. N.Y. Acad. Sci.*, *330*, 195-203

Peto, R., Roe, F.J.C., Lee, P.N., Levy, L. & Clack, J. (1975) Cancer and ageing in mice and men. *Br. J. Cancer*, *32*, 411-426