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MESOTHELIOMA MORTALITY IN BRITAIN: PATTERNS BY BIRTH COHORT AND OCCUPATION

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OBJECTIVES

To assess the impact of asbestos exposure on successive cohorts of the British population and on different occupational groups.

METHODS

Data were taken from the HSE's mesothelioma register, which has records of all death certificates in Great Britain since 1968 on which mesothelioma was recorded. Death rates by age and birth cohort were modelled by Poisson regression. Occupational effects were assessed by calculating proportional mortality ratios, based on the occupations recorded on death certificates. The main cohort and occupational analyses reported here are based on data up to 1991. The data for 1992–1994 have recently been released and the final set of figures compares the observed data for these three years with expected values based on projections of the age-cohort model fitted to the date up to 1991.

COHORT ANALYSIS

Male mesothelioma death rates show a clear pattern by age and cohort (see Fig. 1 for clarity, only alternate 5 year cohorts are shown and the youngest observation point for each cohort, which has zero deaths for most cohorts, has also been omitted).

Rates increased steeply with age and with a similar age-specific pattern for each cohort. At all ages for which a direct comparison can be made, rates increase from cohort to cohort up to the 1940s. The multiplicative model:

$r_{ac} = A_a C_c$, where r_{ac} is the rate for age group a in cohort c,
$\{A_a\}$ are age factors common across cohorts and
$\{C_c\}$ are cohort factors common across ages

provides a very close statistical fit to the observed rates. The details of the fitting process have been described elsewhere (Peto *et al.*, 1995). The estimated lifetime risk of mesothelioma implied by this model for each cohort rises over 20-fold from the cohort born around 1900 to that born around 1945, for which the lifetime risk is

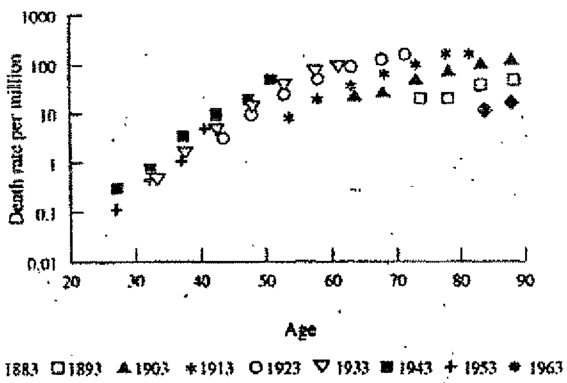

Fig. 1.

about 1.3%. Rates then fell and the 1950 and 1955 cohorts had risks 30 and 50% lower, respectively, than those for the 1945 cohort. The pattern for females was similar, though the age and cohort slopes were less steep.

OCCUPATIONAL ANALYSIS

The occupations with the highest PMRs are shown in Table 1. All have clearly raised potential for asbestos exposure, and building workers, especially plumbers and gas fitters, carpenters and electricians are the largest high risk group. The groups with risks clearly raised above the average only account for about half the recorded deaths.

In order to display PMRs across the whole range of occupations without the picture being confused by the imprecisely determined PMRs of small job groups, Fig. 2 shows the PMRs for 27 major job groups. These job groups were selected initially by choosing each job group which accounted for more than 1% of total (all cause) male deaths. There were 28 such job groups. Two of these groups (sales representatives and sales managers nec) had very similar PMRs and have been combined into a single category. Two job groups which fell below the 1% of total deaths boundary but which had natural links with job groups above that boundary were combined with their larger partner and treated as a single group: face trained coal miners with other coal miners and teachers in higher education with teachers nec. The final result is a set of 27 job groups which together account for 63% of all deaths.

The PMRs for these 27 groups show a wide spread from 0.25 for farmers up to 4.45 for plumbers and gas fitters, an 18-fold difference. As one moves up the spectrum of risk three broad groupings can be distinguished. Between the lowest two or three jobs and the highest dozen or so jobs the PMRs are very closely bunched between 0.5 and 0.9. Coal miners and farmers have PMRs which fall clearly below this range and motor mechanics (although they have a wide confidence limit) are closer to these two lowest risk groups than to the next highest group. The 11 job groups with PMRs above 0.9 (they are in fact all above 1) show a

Table 1.

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Table 1. Proportional mortality ratios (PMRs) of men aged 16–74 from mesothelioma in England and Wales 1979–80, 1982–90

Job group	PMR (all men = 1)	Number	Percent	Cumulative percent
Metal Plate Workers	7	110	2.5	2.5
Vehicle Body Builders	6.19	35	0.8	3.2
Plumbers and Gas Fitters	4.43	201	4.5	7.7
Carpenters	3.66	258	5.8	13.5
Electricians	2.91	161	3.6	17.1
Upholsterers	2.83	19	0.4	17.5
Construction Workers	2.56	187	4.2	21.7
Boiler Operators	2.54	39	0.9	22.5
Electrical Plant Operators	2.54	18	0.4	22.9
Chemical Engineers and Scientists	2.48	18	0.4	23.3
Sheet Metal Workers	2.33	48	1.1	24.4
Scaffolders	2.26	11	0.2	24.7
Production Fitters	2.16	304	6.8	31.4
Professional Engineers nec	2.11	105	2.3	33.8
Plasterers	2.03	27	0.6	34.4
Welders	2.03	70	1.6	35.9
Managers in Construction	1.97	40	0.9	36.8
Dockers and Goods Porters	1.95	69	1.5	38.4
Electrical Engineers (so described)	1.87	39	0.9	39.2
Technicians nec	1.72	24	0.5	39.8
Builders and Handymen	1.64	98	2.2	42
Laboratory Technicians	1.64	27	0.6	42.6
Draughtsmen	1.61	28	0.6	43.2
Machine Tool Operators	1.33	179	4	47.2
Painters and Decorators nec	1.31	100	2.2	49.4

steady and quite steep gradient of increasing risk with no obvious break points. All these jobs have a clear potential for above-average asbestos exposure.

There are no indications in the PMR values of the central group of jobs for making any sub-grouping; however, with two exceptions (production and maintenance managers and lorry drivers) the manual occupations within this group lie at

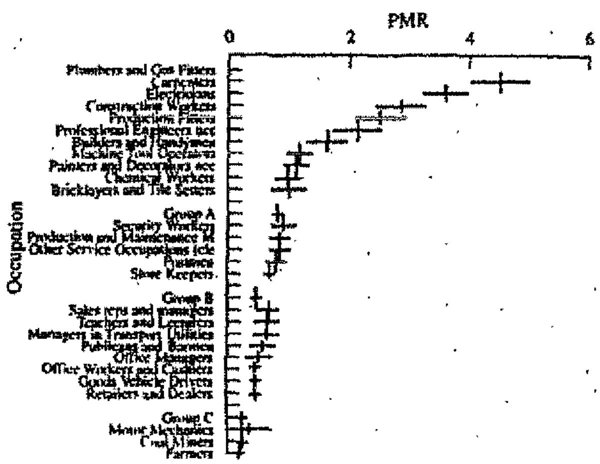

Fig. 2.

Table 2. Observed male mesothelioma deaths up to 1994 by age group and birth cohort, and (in brackets) difference from numbers predicted on the basis of projections based on data up to 1991

Cohort: men born in period	Age group 30–34	35–39	40–44	45–49	50–54	55–59	Total observed–projected difference for cohort
July 1938–June 1943	5	18	63	178 (+ 16)	282 (+ 24)	21 (− 3)	37
July 1943–June 1948	7	33	90 (+ 10)	135 (− 13)	20 (+ 5)	—	2
July 1948–June 1953	4	23 (+ 2.4)	39 (− 3.6)	1 (− 4.9)	—	—	− 6.1
July 1953–June 1958	4 (+ 0.9)	7 (− 1.8)	2 (+ 0.7)	—	—	—	− 0.2

the higher risk end and the non-manual occupations at the lower risk end. If the high and low ends of this middle group are aggregated in this way the average PMRs for the two sub-groups are significantly different: 0.8 (95% CI, 0.72, 0.89) for the higher (mainly manual) group; and 0.57 (95% CI, 0.52, 0.62) for the lower (mainly non-manual) group. If the lowest three job groups are combined, their PMR is significantly lower again, 0.28 (95% CI, 0.23, 0.35). These groups are shown on Fig. 2 as Groups A, B and C (labelled in order of decreasing risk).

Of course, the boundaries between these groups are to some extent arbitrary. However, this grouping does capture the main features of the data in terms of the distribution of PMRs and (apart from group C) shows a good degree of coherence in the kinds of occupation within the groups. It is worth noting that none of the 167 smaller job groups in the full occupational classification (data not shown here) has a PMR significantly lower than that of group C, so this group can reasonably be taken to define the lowest risk group for mesothelioma (in the period of observation). In relation to this group, group B has about twice the mesothelioma risk and group A about three times the risk.

The relative risks between these groups have been fairly stable over time and overall death rates for the three higher risk groups have increased about 6-fold between 1968–73 and 1987–91. The low risk group's rate has increased 3-fold over the same period.

COHORT PATTERNS IN THE LATEST DATA

The results described above are all based on data up to 1991. After a delay while the national mortality statistics system was being computerised, the mesothelioma data for the three years 1992–1994 have now been released. It is of interest to examine whether the new data are consistent with the data up to 1991 and in particular whether the age-specific rates for the more recently born cohorts (for whom asbestos exposure has almost certainly fallen, as controls have been more strictly applied, and usage has fallen) continue to rise in line with the pattern seen in earlier cohorts. The comparisons are shown in Table 2.

These data show that the observed numbers in the most recent 3 years have been slightly higher than projected for the earliest of the four cohorts shown, close to the projected values for the 1943–48 cohort and below the projected values for the two later cohorts.

CONCLUSIONS

Asbestos exposure sufficient to cause mesothelioma has been widespread in the male population. Building workers have been at high risk and should continue to be alert to the dangers of working on asbestos materials.

REFERENCE

Peto, J., Hodgson, J. T., Matthews, F. E. and Jones, J. R. (1995) Continuing increase in mesothelioma mortality in Britain. *Lancet* 345, 535–39.

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