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Mesothelioma mortality in Great Britain from 1968 to 2001

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Background The British mesothelioma register contains all deaths from 1968 to 2001 where mesothelioma was mentioned on the death certificate.

Aims To present summary statistics of the British mesothelioma epidemic including summaries by occupation and geographical area.

Methods Standardized mortality ratios (SMRs) were calculated for local authorities, unitary authorities and counties. Temporal trends in SMRs were also examined. Proportional mortality ratios (PMRs) were calculated using the Southampton (based on the 1980 standard occupational classification) coding scheme. Temporal trends in PMRs were also examined.

Results The annual number of mesothelioma deaths has increased from 153 in 1968 to 1848 in 2001. Current deaths in males account for about 85% of the cases. The areas of West Dunbartonshire (SMR 637), Barrow-in-Furness (593), Plymouth (396) and Portsmouth (388) have the highest SMRs over the period 1981–2000. The occupations with the highest PMRs are metal plate workers (PMR 503), vehicle body builders (526), plumbers and gas fitters (413) and carpenters (388).

Conclusions These data reinforce earlier findings that geographical areas and occupations associated with high exposure to asbestos in the past continue to drive the mesothelioma epidemic in Great Britain. However, the trends over time suggest a change in the balance of risk away from traditional asbestos exposure industries to industries where one could describe the exposure as secondary, such as plumbers and gas fitters, carpenters, and electricians.

Introduction

Mesothelioma is a rare form of cancer that principally affects the pleura and the peritoneum [1]. It is almost always fatal with most of those affected dying within a year of diagnosis [2]. Mesothelioma is closely related to asbestos exposure [2]. There is a long latency period between first exposure to asbestos and the development and diagnosis of mesothelioma, which is seldom less than 15 years, and can be as long as 60 years [3].

The UK Health and Safety Executive (HSE) maintain the British mesothelioma register. The register was originally set up in 1967 by the Medical Services Division of the then UK Department of Employment [1], in response to reports associating asbestos exposure with the occurrence of mesothelioma [4,5]. The original aims of the register were as follows:

i) To record the annual number of deaths from mesothelioma of the pleura or peritoneum associated with asbestos exposure;
ii) To ascertain trends in prevalence rates;
iii) To discover, if possible, tumours occurring without any exposure to known or suspected occupational causes;
iv) To provide part of the evidence on which preventive measures should be based [1].

The register originally received the approval of the British Medical Association's Central Ethics Committee and recently received approval for the receipt of data for validation purposes from the Department of Health's Patient Information Advisory Group. Initially, where possible, histological slides or blocks of material and detailed work histories were collected either from the subject directly or their next of kin, but these practices have long since been discontinued and this aim (iii) is no longer pursued. Other sources of information on cases are also no longer used (e.g. cases reviewed by pneumoconiosis medical panels, cases notified by pathologists and cases notified by employment medical

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advisers, the latter two having been on an occasional basis) [6]. Since the establishment of the register, a series of analyses have been published using data from the register [1,2,6–10].

This paper describes the course of the mesothelioma epidemic in Great Britain since the establishment of the mesothelioma register in 1968, incorporating geographical and occupational analyses.

Methods

Currently, the mesothelioma register comprises all deaths in Great Britain since 1968 where the cause of death on a person's death certificate mentioned the word 'mesothelioma'. Other data recorded on the register include date of birth, sex, last known occupation and postcode of residence at death. At the time of the analysis, the latest year for which mortality data were available was 2001.

Mesothelioma death records are currently supplied annually to HSE electronically by the Office for National Statistics (ONS) for deaths occurring in England and Wales and by the General Register Office for Scotland [GRO(S)] for deaths occurring in Scotland. Revision 10 of the International Classification of Diseases coding scheme (ICD10) includes specific codes for mesothelioma (C45). Prior ICD classifications recorded mesothelioma by site (e.g. the pleura), but many death certificates had a textual cause of death description simply expressed as 'mesothelioma'. According to the classification rules at the time, these deaths would have been recorded as 'site not specified' and would, therefore, not be reflected in the national death data according to the sites, such as the pleura and the peritoneum. Also, it has been recognized that many deaths from mesothelioma of the pleura would have been misclassified as deaths from lung cancer [11,12]. ICD10 was adopted for deaths in England and Wales in 2001 and for deaths in Scotland in 2000. Since then ONS and GRO(S) have selected deaths by ICD10 code rather than textual searches of cause of death descriptions as in previous years. However, to ensure that the compilation of the register after the introduction of ICD10 remains as complete as possible, ONS currently still carry out additional textual searches. In 2001, only a handful ($n = 5$) of death records for England and Wales mentioned mesothelioma, but were not coded to the ICD10 mesothelioma code. With the introduction of ICD10 in Scotland GRO(S) discontinued the process of textual searches.

Further checks of the completeness of the register are carried out by cross checking against a companion register also maintained by HSE of asbestosis deaths, and against cancer registration records where the morphology code is consistent with mesothelioma. Cancer registration records are obtained from ONS, the Information and Statistics Division of the Scottish Health Service and the Welsh Cancer Registry. Any registrations that are not already associated with a death on the register are flagged at the National Health Service Central Registers in Southport and Edinburgh for notification of eventual cause of death. In addition, validation checks on the data supplied are carried out to identify duplicate records and to identify any important missing information such as date of birth and date of death.

When the number of mesothelioma deaths occurring in a given year is first published by HSE, the figure includes all deaths that were registered during that year or during the 15 months following the year-end. This is different from the practice adopted in the publication of death statistics by ONS and GRO(S) in which deaths registered up to 9 months after the end of the year are included. Additional time taken in processing data means that the mesothelioma data are first published by HSE approximately 18 months after the year-end. This approach ensures that the vast majority of late death registrations for a given year are included. Where data permit, each mesothelioma death record is coded as being pleural, peritoneal or both, according to whether the mesothelioma is sited in the upper or lower torso.

Analysis by geographical area

The geographical analysis of mesothelioma deaths included deaths from 1981 to 2000. These years were chosen to give four 5 year blocks of data to facilitate analyses of trends in mesothelioma mortality over time and to provide consistency with the time period used for the occupational analyses. Great Britain is divided into 11 Government Office Regions (GORs). Each GOR can be subdivided into a combination of Unitary Authorities (UAs) and Counties. Counties can be further subdivided into their constituent Local Authorities (LAs). Mesothelioma deaths were assigned to current UA or LA (and thus county and GOR) on the basis of postcode of residence at death. Mortality rates for males and females in the different regions were expressed in the form of Standardized Mortality Ratios (SMRs) with associated 95% confidence intervals (CIs), with the general population of Great Britain being used as the standard population. SMRs for UAs and LAs were also calculated for each of four 5 year time periods with age standardization within each period. Tests for trend in SMRs over time were carried out for all areas where at least 20 deaths were observed or expected over the 20 year period using an adjusted test for trend [13]. Thus the tests were to determine whether the number of mesothelioma deaths within each area increased more or less rapidly than the total for Great Britain over the four time periods.

Analysis by occupation

The analysis by occupation included mesothelioma deaths at ages from 16 to 74 in 1980 to 2000 (excluding 1981 due to unreliable occupational coding because of an industrial dispute that year). The analysis was restricted to this time period because it was the longest time period over which occupations contained in the mesothelioma register could be consistently coded for occupation. Deaths in which the occupation supplied on the death certificate was not that of the deceased (e.g. a woman's husband) were excluded (310 men and 945 women were excluded on this basis). For the deaths included in the analysis, the occupation on the death certificate describes the last occupation of the deceased. Deaths from 1991 to 2000 initially coded to the Standard Occupational Classification 1990 (SOC90) were recoded to the Classification of Occupations 1980 (CO80) using bridging codes developed by the MRC Environmental Epidemiology Unit in Southampton. This in turn allowed recoding to the Southampton Classification of Occupations consistently for the entire 20 year period. This classification groups together the occupations within CO80 likely to encounter similar occupational hazards.

Relative mortalities for males and females within occupational groups were compared by means of proportional mortality ratios (PMRs) and their associated 95% CIs. Tests for trends in PMRs over time were carried out for all occupations where at least 20 deaths were observed or expected over the 20 year period—again using the adjusted test for trend [13]. Thus the tests were to determine whether the number of mesothelioma deaths within occupational groups increased more or less rapidly than the total for all occupations over the four time periods.

Results

The annual number of mesothelioma deaths from 1968 to 2001 for males, females and in total is presented in Figure 1. The annual number of deaths has increased from 153 in 1968 to 1848 in 2001. Currently deaths in males account for about 85% of the cases. The large differences in mesothelioma rates among males in different age groups are shown in Figure 2, which gives rates by age group for 3 year time periods from 1969 to 2001. In the early time periods, the death rates in those aged over 55 are more than an order of magnitude higher than those aged less than 45. In later periods, the difference spans more than two orders of magnitude. The rates in those aged over 55 have increased consistently over the time period of the register, whereas those in the youngest two age groups began to decrease during the 1990s. Rates for females (data not shown) are generally around an order of magnitude lower than for males. Trends over time are less clear-cut for females with rates in the youngest two age groups decreasing during the 1990s and then increasing again in 1999–2001. For the years 1999 to 2001, the crude mortality rate for males aged 20 or over was 70.9 per million and was 10.7 per million for females.

The discontinuation of medical enquiries in 1993 (sent by ONS to certifying doctors where death certificates had insufficient information to accurately classify deaths) resulted in the proportion of mesothelioma deaths for which the site cannot be identified, increasing from around 10–20% to over 45% (data not shown). However, it is likely that the majority of deaths with unspecified mesothelioma site are pleural cases. Deaths before 1993 show that the proportion of peritoneal mesothelioma deaths was higher in females (12%) than in males (6%). This may be a result of misdiagnosis of ovarian cancer [11].

Geographical analysis

Tables 1 and 2 set out the 20 unitary and local authorities with the highest and lowest mesothelioma mortality risks between 1981 and 2000 for males and females, respectively. Note that the areas are ranked by the appropriate bound of the confidence interval of the SMR (the lower bound for the areas with the highest mesothelioma

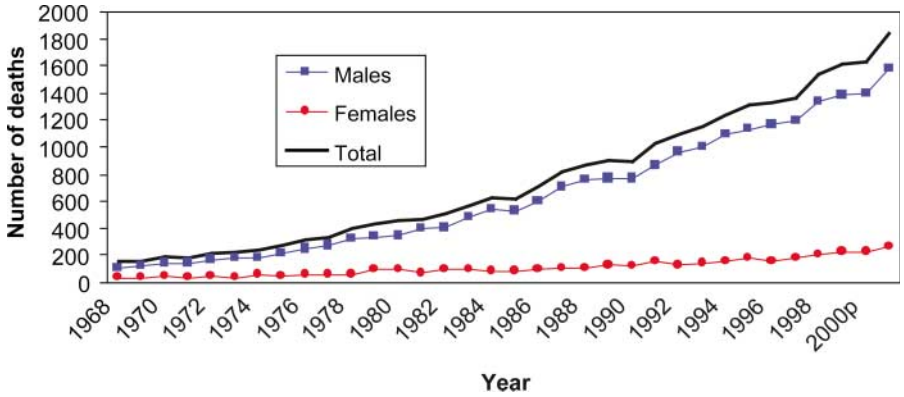

Figure 1. Mesothelioma deaths by sex and year. p, provisional.

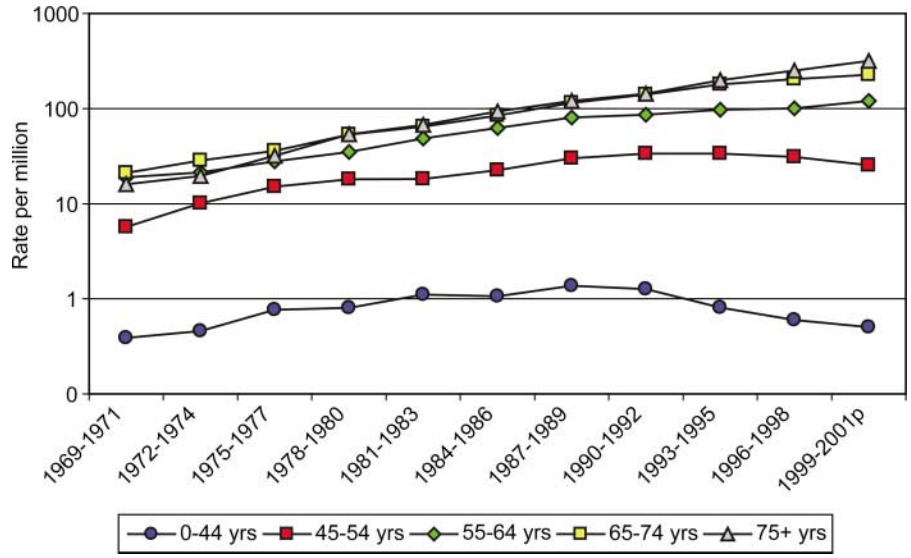

Figure 2. Average annual male mesothelioma death rates per million by age and time period. p, provisional.

mortality and the upper bound for those with the lowest mortality). Appendix 1 (available as Supplementary data at *Occupational Medicine* Online) gives the geographical distribution of mesothelioma SMRs and their 95% CIs for all areas in Great Britain, displayed in standard hierarchical format. The areas with the highest mesothelioma mortality rates in males were those areas associated in the past with shipbuilding: West Dumbartonshire (178 deaths; SMR = 637; 95% CI 547–738), Barrow-in-Furness (140 deaths; SMR = 593; 95% CI 499–699), Plymouth (298 deaths; SMR = 396; 95% CI 352–443), Portsmouth (222 deaths; SMR = 388; 95% CI 339–443), South Tyneside (187 deaths; SMR = 357; 95% CI 308–412), North Tyneside (219 deaths; SMR = 340; 95% CI 296–388) and Southampton (207 deaths; SMR = 325; 95% CI 282–373) [8,14]. The areas with the highest rates in women are mainly those associated with manufacture of asbestos products: Barking and Dagenham (53 deaths; SMR = 649; 95% CI 486–849), Sunderland (79 deaths; SMR = 575; 95% CI 455–716), and Blackburn and Darwin (31 deaths; SMR = 484; 95% CI 329–687) [14,15]. The results of the analysis of trends for males over time (not tabulated) showed that the unitary and local authorities of York, Stoke on Trent, Blaenau Gwent, Monmouthshire, Torfaen, Durham, Fylde, Bolsover, Newcastle-under-Lyme, Stafford, Nuneaton and Bedworth, Coventry, Walsall, South Norfolk, Bromley, and Salisbury were associated with a statistically significant trend at the 1% level of significance increasing more rapidly than the British average. These areas are not those traditionally associated with high occupational asbestos exposure [14]. The unitary and local authorities that were associated with a trend significant at the 1% level increasing less rapidly than the British average were Stockton on Tees, Medway, Portsmouth, Southampton, Plymouth, Swindon, Glasgow City, West Dunbartonshire, Barrow-in-Furness, the Derbyshire Dales, Newham, Tower Hamlets and Crawley. These areas are those traditionally associated with high levels of occupational exposure to asbestos [8,14]. See HSE fact sheet [16] for further details of the trend results.

Occupational analysis

Tables 3 and 4 set out the occupations (based on the Southampton occupation coding scheme) associated with the highest and lowest mesothelioma mortality for males and females aged 16–74, respectively. Note that the occupations are ordered by the appropriate bound of the confidence limit of the PMR (the lower bound for the occupations with the highest mesothelioma mortality and the upper bound for those with the lowest mortality). Appendix 2 (available as Supplementary data) sets out the detailed occupational distribution of mesothelioma PMRs for males and females aged 16–74 over the period from 1980 to 2000 (excluding 1981) in ascending order of occupation code. The occupations with the highest risk in males were metal plate workers (265 deaths; PMR = 502; 95% CI 444–565), vehicle body builders (83 deaths; PMR = 526; 95% CI 419–652), plumbers and gas fitters (619 deaths; PMR = 413; 95% CI 381–446), carpenters (887 deaths; PMR = 388; 95% CI 362–413), electricians (496 deaths; PMR = 279; 95% CI 255–304) and sheet metal workers (144 deaths; PMR = 235; 95% CI 198–275). Among women, the occupations associated with the highest risk were metal plate workers (2 deaths; PMR = 2746; 95% CI 346–10321), chemical workers (15 deaths; PMR = 554; 95% CI 310–913) and plastics workers (3 deaths;

Table 1. Highest and lowest risk UAs and LAs for males

Area	Deaths	Expected deaths	SMR	95% CI	
				Lower	Upper
Top 20 ranked areas with SMRs greater than 100					
West Dunbartonshire UA	178	28	637	547	738
Barrow-in-Furness	140	24	593	499	699
Plymouth UA	298	75	396	352	443
Portsmouth UA	222	57	388	339	443
South Tyneside	187	52	357	308	412
North Tyneside	219	64	340	296	388
Southampton UA	207	64	325	282	373
Medway UA	189	64	298	257	343
Barking and Dagenham	147	50	294	248	346
Eastleigh	94	31	303	245	371
Renfrewshire UA	129	51	255	213	303
Newham	136	54	250	210	296
Newcastle-upon-Tyne	202	85	238	206	273
Sunderland	205	87	237	206	272
Glasgow City UA	411	188	218	198	241
Havant	93	38	243	196	298
Crewe and Nantwich	81	34	240	191	299
Inverclyde UA	67	27	244	189	310
Hartlepool UA	67	28	241	187	306
Gosport	52	21	246	184	323
Bottom 20 ranked areas with SMRs less than 100					
Barnsley	16	71	22	13	36
Worcester	4	25	16	4	41
Powys UA	12	45	26	14	46
Staffordshire Moorlands	8	32	25	11	49
Bridgend UA	12	42	29	15	50
Herefordshire, County Of UA	20	59	34	21	53
Newcastle-under-Lyme	12	40	30	16	53
Cheltenham	10	34	29	14	54
Coventry	38	95	40	28	55
Scottish Borders UA	12	37	32	17	57
Monmouthshire UA	9	28	32	15	61
Perth and Kinross UA	17	45	38	22	61
Ryedale	5	19	27	9	62
Merthyr Tydfil UA	5	19	27	9	63
Stirling UA	8	25	33	14	64
Blaenau Gwent UA	8	24	33	14	65
Kensington and Chelsea	15	38	39	22	65
Torfaen UA	10	28	35	17	65
Aberdeenshire UA	27	61	44	29	65
Gwynedd UA	16	40	40	23	65

PMR = 1080; 95% CI 221–3131). This suggests occupations mainly associated with the construction trades (rather than use or manufacture of asbestos products) are now at highest risk.

The only occupation associated with a statistically significantly increasing trend over time (not tabulated) increasing at a higher rate than the British average at the 1% level of significance in men was other electronic maintenance engineers. The occupations associated with a trend increasing at a lower rate than the British average at the same level of statistical significance were chemical workers, metal plate workers and construction workers not elsewhere classified. This latter result is consistent with the pattern in the geographical analysis that rates of mesothelioma are rising more slowly in occupations involving the use of asbestos and manufacture of asbestos products, than in those occupations associated with the maintenance of buildings in which asbestos is present. See HSE fact sheet [17] for further details of the trend results.

Discussion

Because of the latency of mesothelioma, the majority of deaths occurring now will be due to asbestos exposures

Table 2. Highest and lowest risk UAs and LAs for females

Area	Deaths	Expected deaths	SMR	95% CI	
				Lower	Upper
Top 20 ranked areas with SMRs greater than 100					
Barking and Dagenham	53	8	649	486	849
Sunderland	79	14	575	455	716
Blackburn with Darwen UA	31	6	484	329	687
West Dunbartonshire UA	22	5	451	282	682
Leeds	115	35	328	271	394
Newham	29	8	348	233	499
South Ribble	17	5	367	214	588
Swale	16	5	297	170	482
Kirklees	41	18	226	162	306
Chorley	12	4	279	144	488
Nottingham UA	28	13	216	144	313
Southampton UA	22	10	221	139	335
Newcastle-upon-Tyne	29	14	204	137	294
Glasgow City UA	60	34	178	136	229
Broxtowe	13	5	252	134	432
Bracknell Forest UA	9	3	262	120	498
Redbridge	21	11	191	118	291
Maldon	7	2	281	113	578
Havering	21	12	180	112	276
Milton Keynes UA	12	6	210	109	368
Bottom 20 ranked areas with SMRs less than 100					
Brighton and Hove UA	2	14	14	2	50
Doncaster	3	14	22	5	64
Wealden	1	8	12	0	67
Cardiff UA	4	14	28	8	72
Rotherham	3	12	26	5	75
Leicester UA	4	13	31	9	81
Kingston Upon Hull, City Of UA	4	12	32	9	82
St Helens	2	9	23	3	83
Torfaen UA	0	4	0	0	83
Hinckley and Bosworth	0	4	0	0	84
Eastbourne	1	6	15	0	86
North Somerset UA	3	10	30	6	86
Sheffield	15	28	54	30	88
Waverley	1	6	16	0	89
Dumfries and Galloway UA	2	8	25	3	90
Birmingham	30	47	64	43	91
Canterbury	2	8	26	3	93
Manchester	10	20	50	24	93
Warwick	1	6	17	0	94
Barnsley	4	11	37	10	94

before the 1980s. The fact that the continuing increase in mesothelioma deaths in Great Britain is a consequence of past exposures in occupational settings is supported by the analyses reported here. For example, the much larger proportion of deaths among men and the clear identification of certain geographical areas and occupational groups as high-risk are consistent with what is known about past occupational exposures.

The extent to which other more subtle effects have contributed to the increasing number of deaths recorded on the register each year is difficult to determine. For example, it is likely that the proportion of accurately diagnosed mesothelioma deaths has increased since the 1960s, resulting in an increasingly small number of cases being missed over time. It is also possible that the introduction of ICD10 for coding mortality may have influenced the number of deaths recorded in Scotland since 2000 and England and Wales since 2001. However, every effort has been made to try to ensure that data have been collected on a consistent basis over time and the monitoring of the effect of ICD10 will continue.

Although nearly all mesothelioma cases are caused by asbestos, there is evidence to suggest that there are around 50–100 mesothelioma deaths each year not linked to asbestos exposure, with roughly equal numbers occurring in males and females. Several lines of

Table 3. Highest and lowest risk occupations for males

Southampton occupation code*	Occupation description	Deaths	Expected deaths	PMR	95% CI	
					Lower	Upper
Top 20 ranked occupations with PMRs greater than 100						
146	Metal plate workers	265	53	502	444	565
153	Vehicle body builders	83	16	526	419	652
144	Plumbers and gas fitters	619	150	413	381	446
104	Carpenters	887	229	388	362	413
137	Electricians	496	178	279	255	304
145	Sheet metal workers	144	61	235	198	275
138	Electrical plant operators	54	21	263	197	343
132	Production fitters	850	406	209	196	224
174	Construction workers nec	486	228	213	195	232
143	Electrical engineers (so described)	140	65	216	181	253
194	Boiler operators	83	38	219	175	272
136	Electrical and electronic production fitters	27	10	260	171	378
39	Managers in construction	123	61	200	166	237
27	Chemical engineers and scientists	52	24	221	165	290
149	Welders	204	108	188	163	215
169	Builders etc.	338	195	174	156	193
30	Professional engineers nec	276	160	173	153	194
160	Painters and decorators nec	361	224	161	145	178
111(O)	Managers nec	212	138	154	134	175
148	Scaffolders	36	19	188	132	260
Bottom 20 ranked occupations with PMRs less than 100						
178	Railway signal workers	3	15	20	4	58
185	Bus conductors and drivers' mates	5	20	25	8	58
55	Petrol pump attendants	0	6	0	0	57
94	Compositors	2	13	16	2	56
74	Other textile workers	22	60	36	23	55
78	Food processors	24	69	35	22	52
15	Doctors	10	36	28	13	52
163	Assemblers (vehicles and other metal goods)	15	48	31	17	51
82	Glass and ceramics furnace workers	0	7	0	0	50
68	Leather and shoe workers	9	34	26	12	50
42	Butchers	23	71	33	21	49
18	Pharmacists	1	12	8	0	47
8	Government administrators	10	39	25	12	47
76	Bakers	9	40	23	10	43
1	Lawyers	4	26	15	4	40
175	Face trained coalminers	17	72	23	14	38
127	Fettlers and dressers (metal)	0	11	0	0	35
59	Cooks and kitchen porters	15	71.0	21	12	35
47	Farmers	114	441	26	21	31
88	Other coal miners	64	266	24	19	31

*1980 Occupation codes not accounted for by Southampton codes are identified by (O) after the code number. nec denotes not elsewhere classified.

argument suggest an estimate of this order of magnitude [18].

International comparisons

In the USA, based on SEER data, the age-adjusted mesothelioma incidence rate in males stayed around 20 per million during the 1990s. The rate for females stayed around 4 per million over the same time period [19]. In Australia, the incidence rates per million population aged 20 or older in 1999 were 53.3 for males and 10.2 for females [20]. In New Zealand, the incidence rate per million men in 1995 was 25 [21]. The incidence rate per million in Denmark during 1983–1987 was 13.3 [22]. During 1995–1999, the age-adjusted incidence rate for men was 16.6 per million and 2.3 for women [23]. The incidence of mesothelioma in Great Britain (70.9 per million in men) remains around the highest in the world.

Geographical analysis

In an analysis of mesothelioma deaths by geographical area, deaths should ideally be assigned to the areas in which exposure occurred. However, this is not possible in

Table 4. Highest and lowest risk occupations for females

Southampton occupation code*	Occupation description	Deaths	Expected deaths	PMR	95% CI	
					Lower	Upper
Occupations with PMRs greater than 100 and statistically significant						
146	Metal plate workers	2	0	2746	346	10321
75	Chemical workers	15	3	554	310	913
346(O)	(Foremen/labourers etc.) Other	40	13	312	223	425
86	Plastics workers	3	0	1080	221	3131
204(O)	Other material processing—all other (excluding metal) nec	2	0	1169	142	4250
98	Tailors and dressmakers	18	8	222	132	352
54	Postal workers	9	4	249	114	473
57	Sales representatives	8	3	242	105	478
74	Other textile workers	20	12	165	101	254
Occupations with PMRs less than 100 and statistically significant						
46	Caterers	29	46	63	42	90
124	Machine tool operators	1	7	14	0	77
17	Nurses	32	63	50	35	71

*1980 Occupation codes not accounted for by Southampton codes are identified by (O) after the code number. nec denotes not elsewhere classified.

practice, since area coding is according to the area of residence at time of death, as recorded on the death certificate. It is likely that the majority of subjects exposed to asbestos in the workplace will have retired in close proximity to where they received their asbestos exposure. However, as death certificates only record the most recent address, an appreciable number of deaths will be assigned to areas other than those in which the exposure took place. Thus the analyses presented of SMRs by geographical region are likely to dilute the observed differences between the 'high-risk' and the 'low-risk' areas.

The link between the heavy asbestos exposure and the shipbuilding industry is well known [24,25]. Asbestos was used widely in insulation and workers were exposed to it during building fitting and refurbishment and in ship breaking activities. This is supported by the results of the geographical analysis in which the areas with the highest mesothelioma excess in males tend to be those areas containing ports and dockyards.

Other areas with significantly elevated SMRs for men include those areas with a large railway industry [25] that made extensive use of asbestos in the past, and areas containing factories that used raw asbestos during manufacture and production of asbestos-containing products [8].

Most of the areas where the relative number of mesothelioma deaths increased more rapidly than for Great Britain as a whole tend to be those of lower overall risk, and conversely, those where numbers increased less rapidly tend to be those of higher overall risk. It is likely that this effect has occurred for two reasons. Firstly, elevated levels of mesothelioma mortality in areas that contained specific high-risk industries in the past have tended to reduce as other sources of exposure developed over a wider range of areas. Secondly, the effect of the risks is being diluted due to migration from high-risk areas to other parts of the country. This will become increasingly more apparent over time.

Occupational analysis

PMRs summarise the relative mortality among occupational groups and do not provide a direct indication of overall mortality. Measures that provide an indication of overall mortality such as the SMR could not be produced here because the annual mortality data for the population of Great Britain is not routinely coded for occupation.

As for the geographical analyses, the occupational analyses should ideally be carried out according to the occupations in which exposures occurred. The analysis reported here of PMRs based on last full-time job (as recorded on death certificates) will, therefore, dilute the observed difference in relative risk between the jobs which entail asbestos exposure and those that do not. The potential for dilution is considerable as workers move from high-risk occupations to more sedentary ones as they approach retirement. This dilution will also be highest in those high-risk industries in the past, such as shipbuilding, railway engineering and manufacture of asbestos-related products as these industries continue to reduce in size (although the latter group do not emerge as a single occupational group in this analysis).

Workers in asbestos manufacturing are not brought together under a single occupational code and do not emerge as an identifiable high-risk group in this analysis. However, the analysis shows that the occupations with the highest risks can generally be associated with three broad areas of asbestos use: shipbuilding, railway carriage

and locomotive building, and the installation and maintenance of lagging or other insulation materials in buildings or industrial plants.

Conclusions

These data show that the geographical areas and the occupations associated with high exposure to asbestos in the past continue to drive the mesothelioma epidemic in Great Britain. However, an examination of trends over time shows that the mesothelioma mortality due to specific high-risk industries of the past has fallen as other sources of exposure have developed over a wider range of occupation groups and geographical areas. This result is partly because of a likely increase in the dilution of the results over time due to the use of death certificate data.

This reflects our growing understanding of the changing balance of risk away from traditional asbestos exposure industries to those where one could describe the exposure as secondary, such as building maintenance trades.

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