Mesothelioma mortality by occupation statistics in Great Britain, 2022

July 2022

Contents

Summary

The information in this document relates to Health and Safety Statistics published by the Health and Safety Executive in 2022. The document can be found at: www.hse.gov.uk/statistics/causdis

Introduction

This fact sheet presents updated mesothelioma mortality statistics by last recorded occupation of the deceased within Great Britain from 2011-2020 and time trends over the longer period of 2001-2020. The document can be found at www.hse.gov.uk/statistics/causdis/index.htm.

Background information about mesothelioma and statistics for mesothelioma deaths in Great Britain as a whole and by geographical area within Great Britain are also available at www.hse.gov.uk/statistics/causdis/index.htm.

These statistics are based on the last occupation of the deceased, as recorded on death certificates. The Proportional Mortality Ratio (PMR) presented for each occupation compares the frequency that the occupation is recorded for mesothelioma deaths with the frequency that it is recorded for deaths from all causes of death as a whole.

PMRs thus provide a way of highlighting occupations that may be associated with higher than average mortality from mesothelioma.

The analyses of temporal trends in occupational PMRs within Great Britain should be interpreted as an indication of how the proportion of deaths with a particular occupation recorded has changed over time, rather than the absolute numbers.

The PMR statistics are limited by the fact that only the last occupation of the deceased is recorded on death certificates which, given the typically long period that the disease takes to develop, may not always be the relevant occupation in terms of past exposure to asbestos. The analysis is restricted to deaths occurring at ages 16-74 years since occupations are routinely recorded on death certificates only for deaths in this range in England and Wales.

Overall deaths increased more than 35% over the period of analysis (i.e. since 2001), and around 10-fold since the late 1960s when consistent recording of mesothelioma in Britain began. However, deaths below age 75 years – those included in this analysis – have reduced over the last 10 years. Nevertheless, since the value of these statistics is in the relative comparison of the frequency of recording of different occupations on mesothelioma death certificates rather than in the absolute number of deaths for each occupation, the statistics still provide useful information about the occupations are more likely to have been a source of past asbestos exposure.

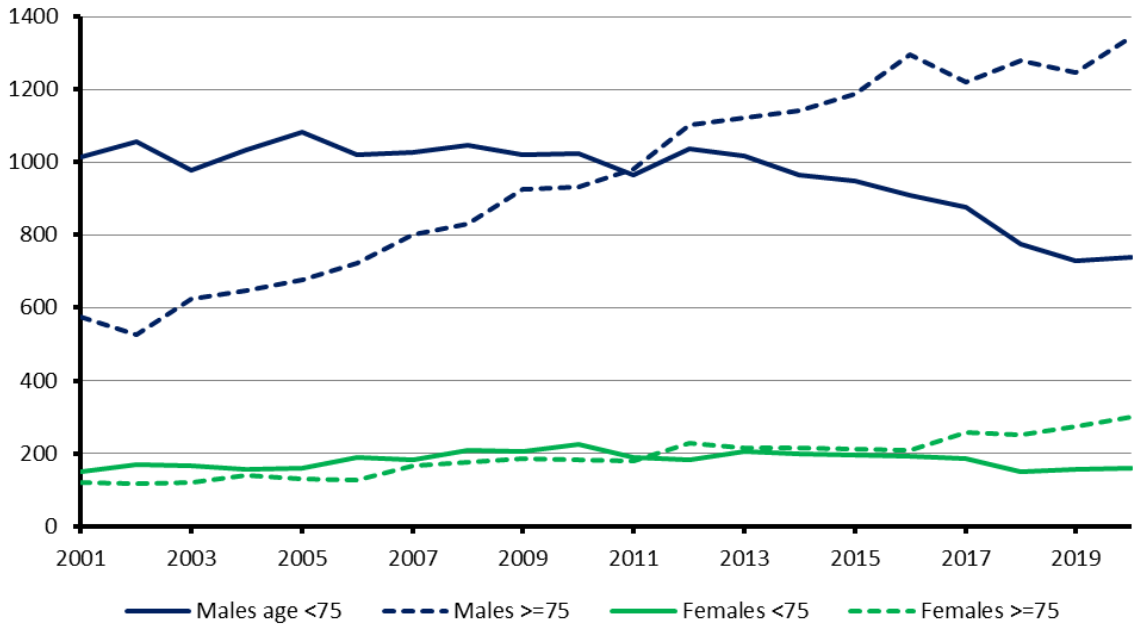

Figure 1: Male and female mesothelioma deaths 2001-2020 by age category

Results

Data tables

Full results of the PMR calculations by occupation in Great Britain are available in Excel tables at:

www.hse.gov.uk/statistics/tables/mesooccupation.xlsx.

Tables show the number of mesothelioma deaths and PMRs for both males and females by Standard Occupational Classification (SOC) major (1-digit code), sub-major (2-digit code), minor (3-digit code) and unit (4-digit code) groups based on:

- SOC2010 codes for 2011-2020 deaths (tabs 1 and 2);
- SOC2000 codes for 2001-2010 deaths (tabs 3 and 4); and,
- 3-digit SOC2010 codes for 2011-2020 deaths by birth cohort (tabs 5 and 6).

SOC codes form a nested hierarchy: the first digit of any full 4-digit unit group code gives its major group, the first two digits gives it sub-major group and the first three digits gives its minor group.

Tables include ranks from highest to lowest PMR within each 1- to 4-digit level separately (groups with 10 or fewer observed or expected mesothelioma deaths are not included in the rankings due to the uncertainty associated with smaller numbers).

Methods and limitations

The observed number of deaths in a particular occupation does not represent the actual number of deaths that are attributable to asbestos exposures in that occupation.

PMRs summarise mortality among occupational groups relative to the average level for Great Britain as a whole and do not represent absolute measures of risk.

PMRs are expressed as a percentage: values higher or lower than 100 indicate mesothelioma rates that are higher or lower, respectively, than the average for all occupations combined. The corresponding confidence interval should be used to assess whether such an effect could merely be due to random variation.

Occupations with the highest PMRs and where the lower limit of the associated Confidence Interval (CI) are above 100 constitute those that can most reliably be said to have an excess of mesothelioma deaths compared to the average for all occupations, and

are, therefore, those most likely to be reflecting an effect due to past occupational asbestos exposure.

Last occupation of the deceased

These analyses are limited by the fact that death certificates record only the last occupation of the deceased. For example, a case of mesothelioma caused by work in the construction industry will only be assigned to that occupation in this analysis if the individual is still in that kind of work when they retired (or died). The long latency period of mesothelioma means that individuals may move between occupations before the onset of the disease and thus there is considerable potential for dilution of the observed difference in risk between occupations.

The dilution will be stronger for those kinds of work where there have been substantial reductions in the relevant workforce (e.g. shipyards, railway rolling stock). The occupations with the highest PMRs will tend to be those which are genuine sources of risk, but PMRs may understate the true relative risk level. PMRs of other occupations will overstate the level of risk (if any) associated with these jobs; occupations with the lowest PMRs will be those which do not entail asbestos exposure, and which are unlikely to be the final full-time occupation for individuals with asbestos exposure.

Role of environmental asbestos exposure

Occupation is recorded on death certificates for deaths at ages 16-74 as a matter of course: for mesothelioma deaths occupation is recorded regardless of whether the deaths were caused by ‘occupational exposure’ to asbestos. This is particularly important to the interpretation of mesothelioma PMRs for women. Whilst some occupations are recorded as the last occupation on female mesothelioma deaths in appreciable numbers, fewer occupations show evidence that the PMRs are increased. Those occupations that do show increased PMRs in women are not those where the direct handling of asbestos materials at work was likely to have been taking place routinely. Many of these deaths may reflect ‘environmental’ asbestos exposure, which potentially included any exposures accrued indirectly in the working environment.

Deaths occurring in the latest 10-year period (2011-20) still predominantly relate to the cohort of people who were younger during the period of peak asbestos use in the 1960s and 1970s when there were far less stringent controls that required today (see tables MESOOCCUPATION05 and MESOOCCUPATION06 which show results for 2011-20 deaths by birth cohort).

The latest occupational analyses of female mesothelioma deaths suggest there is some variation in the average risk of mesothelioma among those who worked in jobs not involving the use of asbestos. For example, proportional mortality ratios are somewhat higher for teachers and administrative occupations than those for nurses, sales occupations and process operatives, and this may suggest the potential for asbestos

exposure during work time was somewhat higher in these jobs during the period of peak use. However, past exposures in buildings may have contributed to the background risk seen across all of these kinds of jobs to some extent, and other sources of exposure – for example, in housing stock – are also likely to have contributed.

Other research confirms that, while still caused by asbestos, a majority of mesotheliomas among women (and a similar absolute number among men, though these constitute a smaller proportion of the larger male total) were not directly attributable to occupational or domestic asbestos exposures[1]. This, together with an overall increase in mesothelioma deaths among women, suggests there was an increase in the 'background' risk among those who did not work with asbestos, but who lived through the period of peak asbestos use. During this period the opportunities for unwitting exposure may have been widespread. This background risk – which has since reduced[2] – is likely to at least partly account for deaths with occupations not typically associated with asbestos exposure recorded on the death certificate. The background risk will also apply to men of the same generation.

Reliability of unit group coding

The coding of occupation is likely to be more reliable at the minor group (3-digit code) level than the unit group (4-digit code) level since the recorded information about the job title on death certificates does not always give sufficient information to accurately assign a 4-digit code.

Overall PMRs for 2011-2020 and time trends for 2001-2020

This section presents time trends in PMRs for selected occupations within different levels of the SOC hierarchy where occupational categories based on SOC2000 and SOC2010 were equivalent.

Trends for a particular occupation indicate how the proportion of deaths with a particular occupation recorded has changed over time, rather than the absolute numbers.

The charts show trend lines with solid bold **black** lines to indicate a statistically significant annual trend. Those with **green** lines indicate trends of borderline significance, and for those with **blue** lines trends were not significant. The dashed lines represent the 95% confidence intervals.

[1] Rake C, Gilham C, Hatch J, et al. Occupational, domestic and environmental mesothelioma risks in the British population: a case control study. *British Journal of Cancer* 2009;100(7):1175-83.

[2] Gilham C, Rake C, Hodgson J at al. Past and current asbestos exposure and future mesothelioma risks in Britain: The Inhaled Particles Study (TIPS). *International Journal of Epidemiology* 2018;47(6):1745-1756.

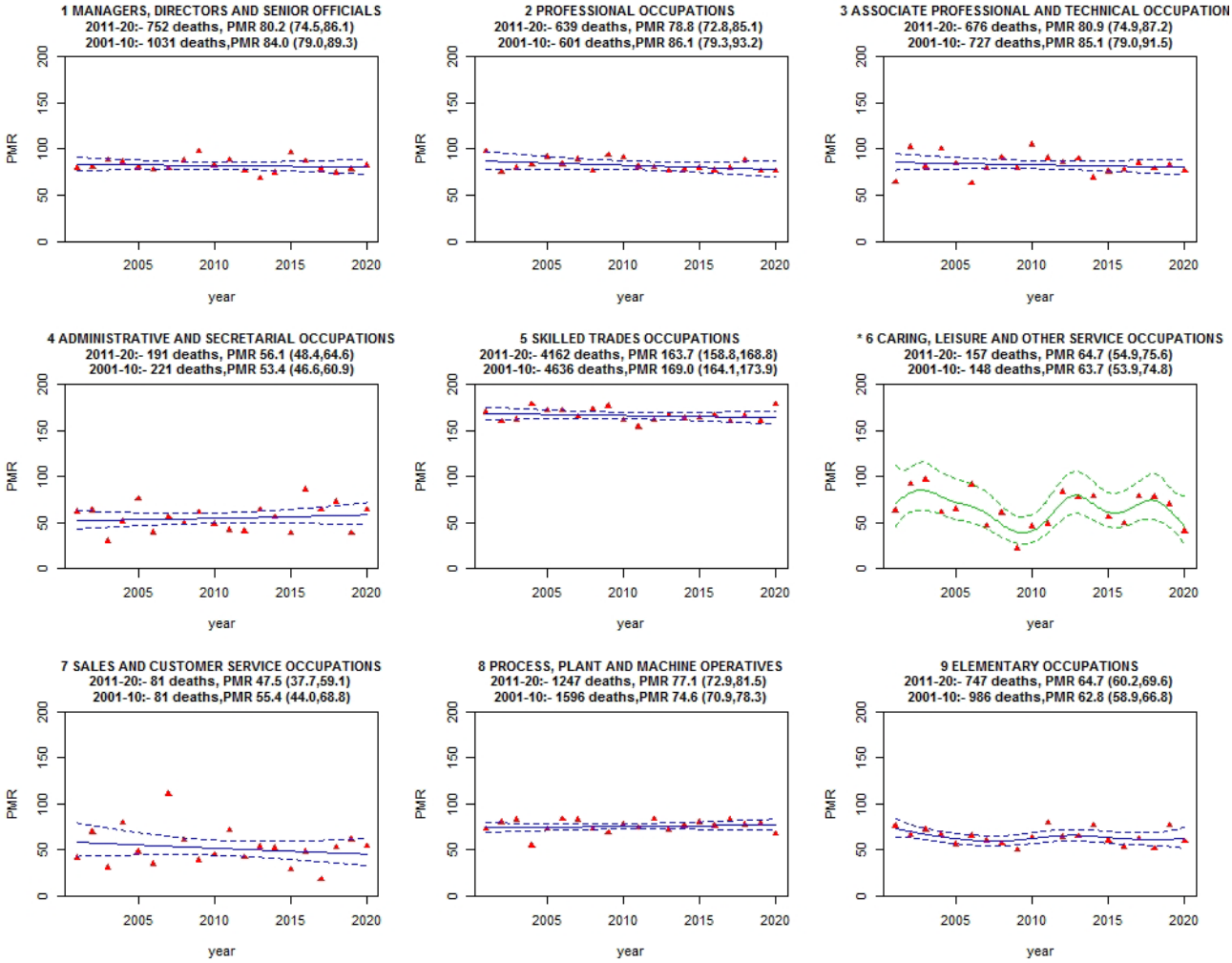

Figure 2: Mesothelioma PMRs by SOC major group, males, 2001-2020

SOC major group (1-digit)

Among males, major group 5 (Skilled trades occupations) was the only major group with statistically significantly elevated mesothelioma mortality (PMR=163.7, 95% CI: 158.8, 168.8), with 4162 deaths amongst those aged 16-74 for the period 2011-20.

This major group contains a number of more specific codes with significantly elevated PMRs, including the only two elevated 2-digit codes, seven of the ten highest ranking 3-digit codes and the 1st (5315 Carpenters and joiners), 2nd (5314 Plumbers and heating and ventilating engineers), 4th (5216 Pipe fitters), 7th (5236 Boat and ship builders and repairers), 8th (5241 Electricians and electrical fitters), 9th (5322 Floorers and wall tilers) and 10th (5225 Air-conditioning and refrigeration engineers) highest ranking 4-digit codes.

The remaining eight major groups generally have consistently significantly lower PMRs compared to the average for all occupations.

Figure 2 shows the temporal trends in the mesothelioma PMRs for males for the nine SOC major groups. There was little evidence of any change in the PMRs over the period 2001-2020 at the major group level.

Among females there were two major groups with statistically significantly elevated mesothelioma mortality; major group 4 (Administrative and secretarial, PMR=124.5, 95% CI: 112.5, 137.3 with 397 deaths amongst those aged 16-74 for the period 2011-20) showed evidence of an increasing trend; and major group 2 (Professional Occupations, PMR=116.6, 95% CI: 102.3, 132.4 with 239 deaths). Otherwise there was no evidence of any change in the PMRs over the period 2001-2020 for these groups (Figure 3).

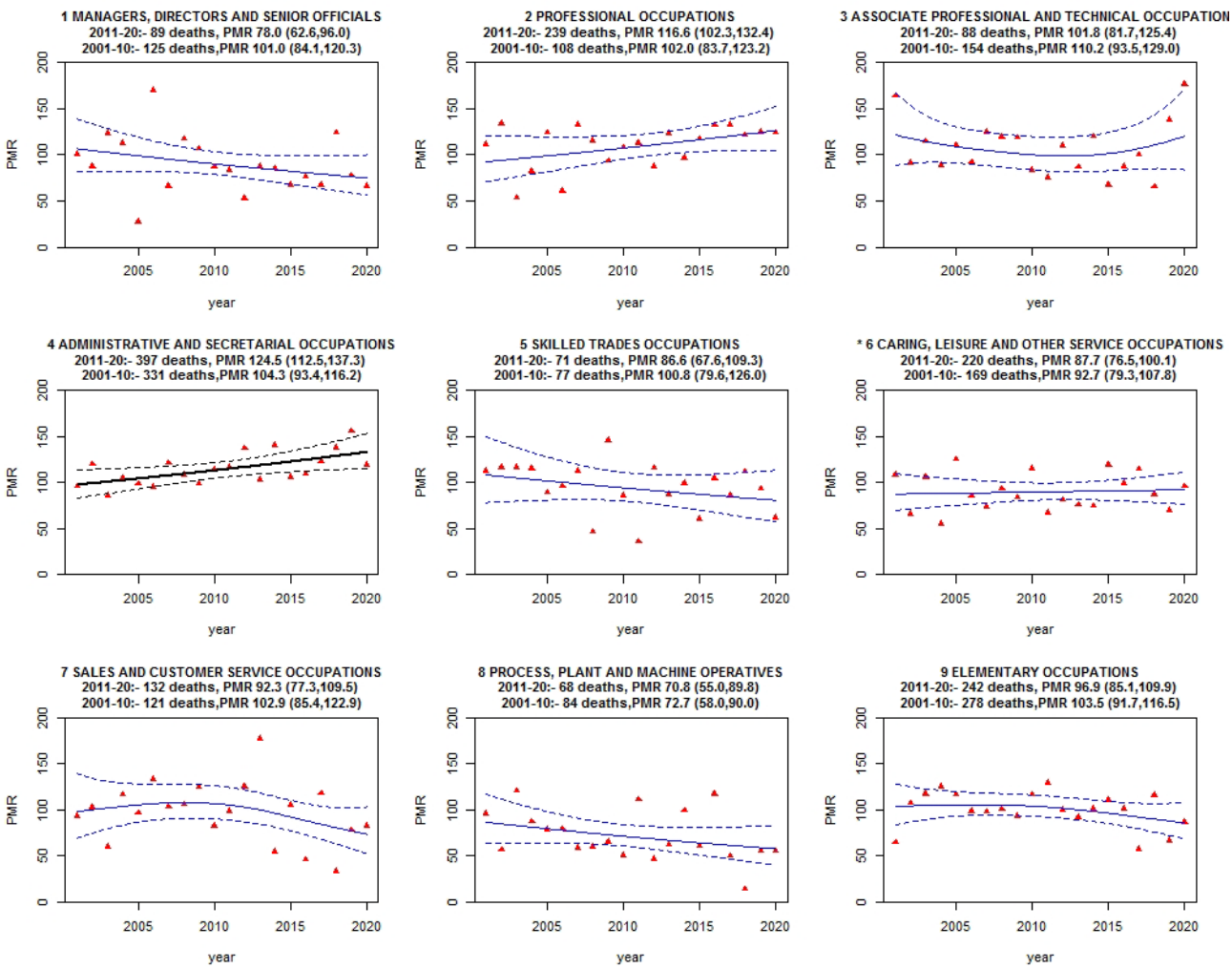

Figure 3: Mesothelioma PMRs by SOC major group, females, 2001-2020

SOC sub-major group (2-digit)

There were two statistically significantly elevated sub-major occupational groupings in the period 2011-2020 for males:

- 53 Skilled construction and building trades (2409 deaths, PMR=245.9, 95% CI: 236.2, 255.9), and
- 52 Skilled metal, electrical and electronic trades (1495 deaths, PMR=146.1, 95% CI: 138.7, 153.6).

The corresponding SOC2000 codes for 2001-2010 were also similarly elevated.

Figures 4a and b shows the results of the trend analyses for these two sub-major groups. There is some evidence of a reduction in the PMR for sub-major group 52 over time.

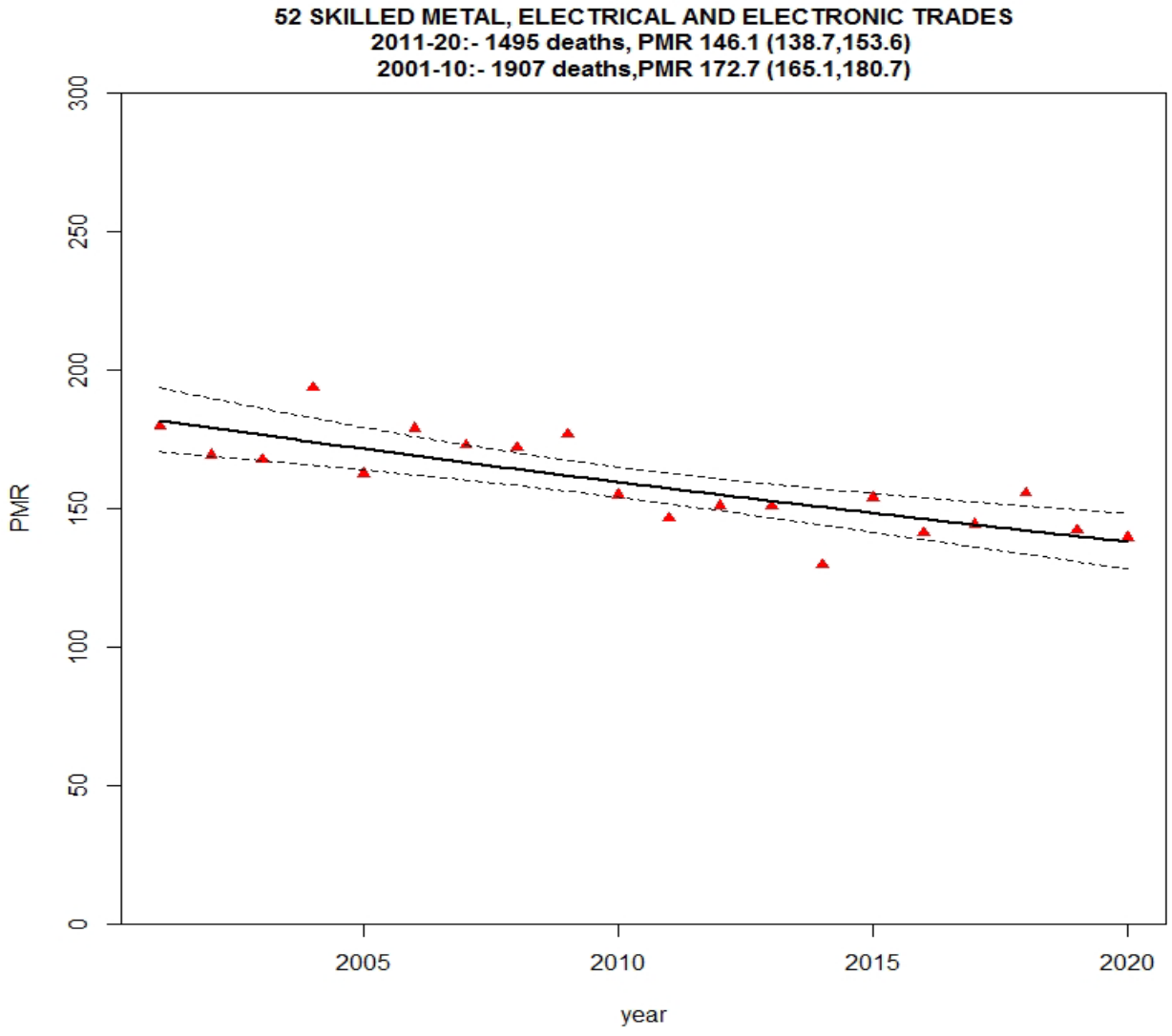

Figure 4a: Mesothelioma PMRs for SOC sub-major group 52, males, 2001-2020

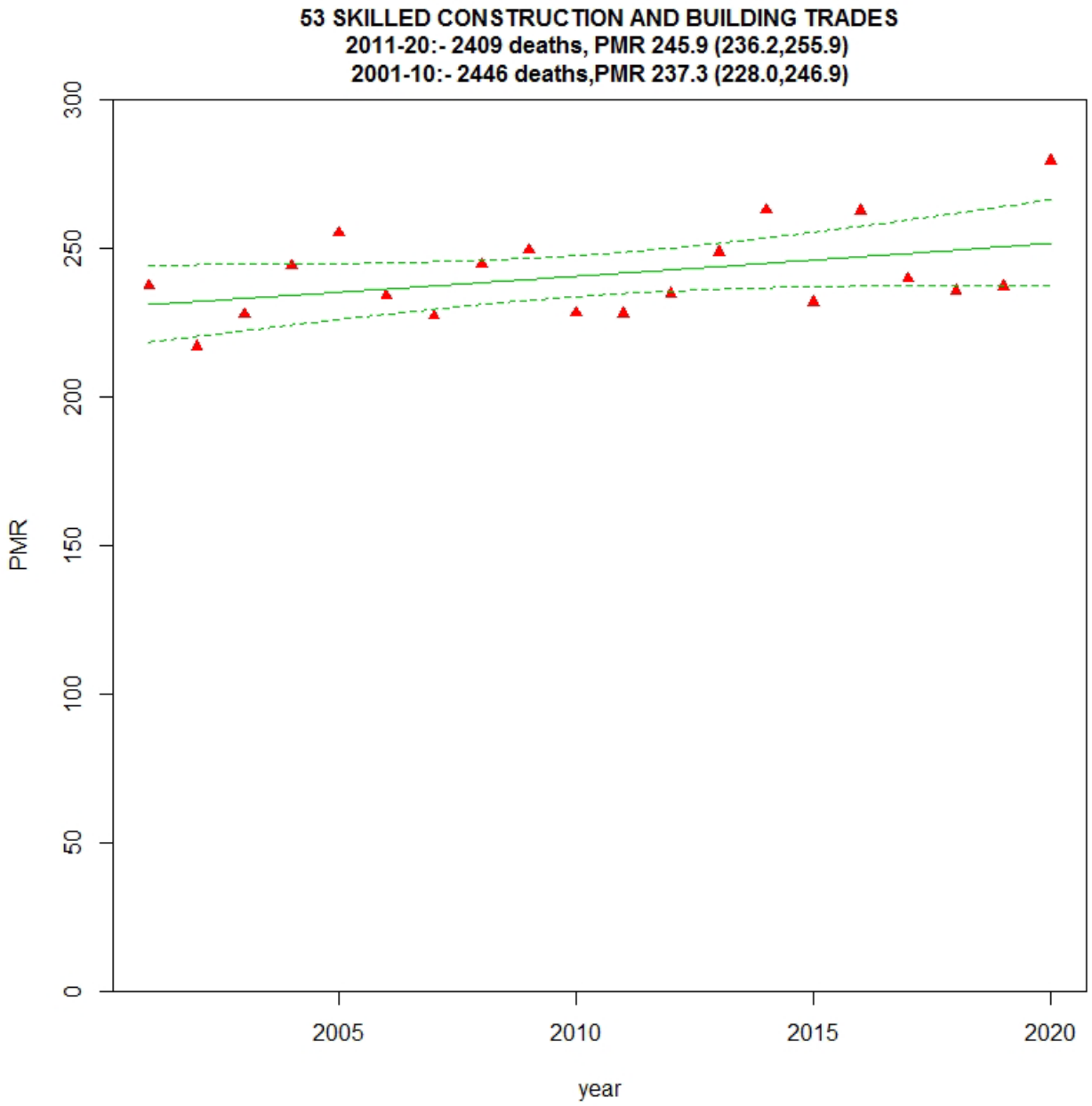

Figure 4b: Mesothelioma PMRs for SOC sub-major group 53, males, 2001-2020

For females the first and third of the top three sub-major groups were statistically significantly elevated during the period 2011-2020:

- 23 Teaching and educational professionals (111 deaths, PMR=139.7, 95% CI: 114.9, 168.3). The PMR for the corresponding SOC2000 code for 2001-2010 was not elevated.
- 91 Elementary trades and related occupations (54 deaths, PMR=131.9, 95% CI: 99.1, 172.1). The PMR for the corresponding SOC2000 code for 2001-2010 was elevated.

- 41 Administrative occupations (253 deaths, PMR=130.7, 95% CI: 115.1, 147.8). The PMR for the corresponding SOC2000 code for 2001-2010 was not elevated.

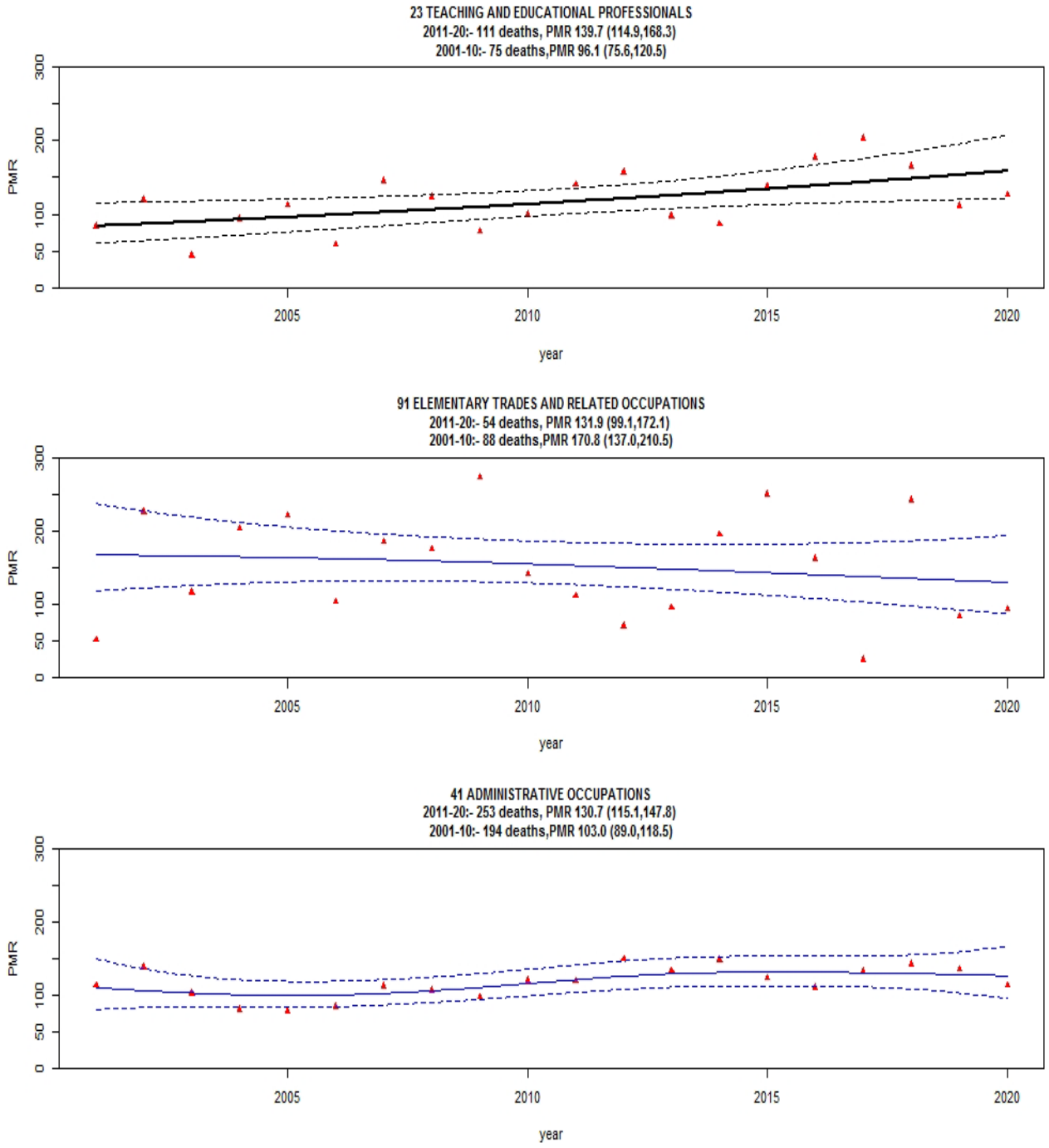

Figure 4c: Mesothelioma PMRs for SOC sub-major groups 23, 41 and 91, females, 2001-2020

SOC minor group (3-digit)

For males, mesothelioma PMRs for eight SOC minor groups were statistically significantly elevated for the period 2011-2020, all of which have at least some association with building-related activities:

- 531 construction and building trades (1992 deaths, PMR=274, 95% CI:262.1, 286.3) 1st
- 524 electrical and electronic trades (694 deaths, PMR=209.7, 95% CI:194.4, 225.9) 2nd
- 532 building finishing trades (388 deaths, PMR=167.4, 95% CI:151.1, 184.9) 3rd
- 814 construction operatives (189 deaths, PMR=158.4, 95% CI:136.6, 182.6) 4th
- 521 metal forming, welding and related trades (204 deaths, PMR=142.6, 95% CI:123.7, 163.6) 5th
- 311 science, engineering and production technicians (72 deaths, PMR=130.3, 95% CI:102, 164.1) 8th
- 812 plant and machine operatives (398 deaths, PMR=124.7, 95% CI:112.8, 137.6) 10th
- 522 metal machining, fitting and instrument making trades (406 deaths, PMR=124.5, 95% CI:112.6, 137.2) 11th

There is some evidence of a reduction in the PMR for minor group 524 (Electrical and electronic trades) (Figures 5A & 5B).

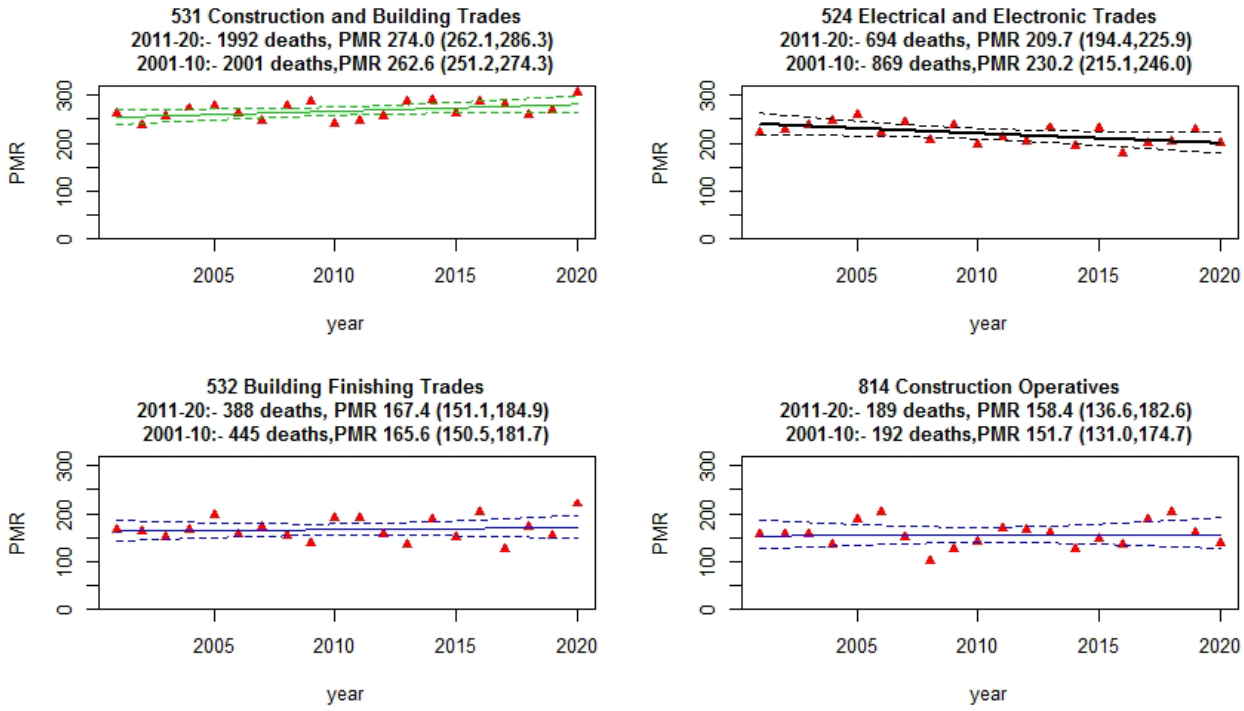

Figure 5A: Mesothelioma PMRs for selected SOC minor groups, males, 2001-2020

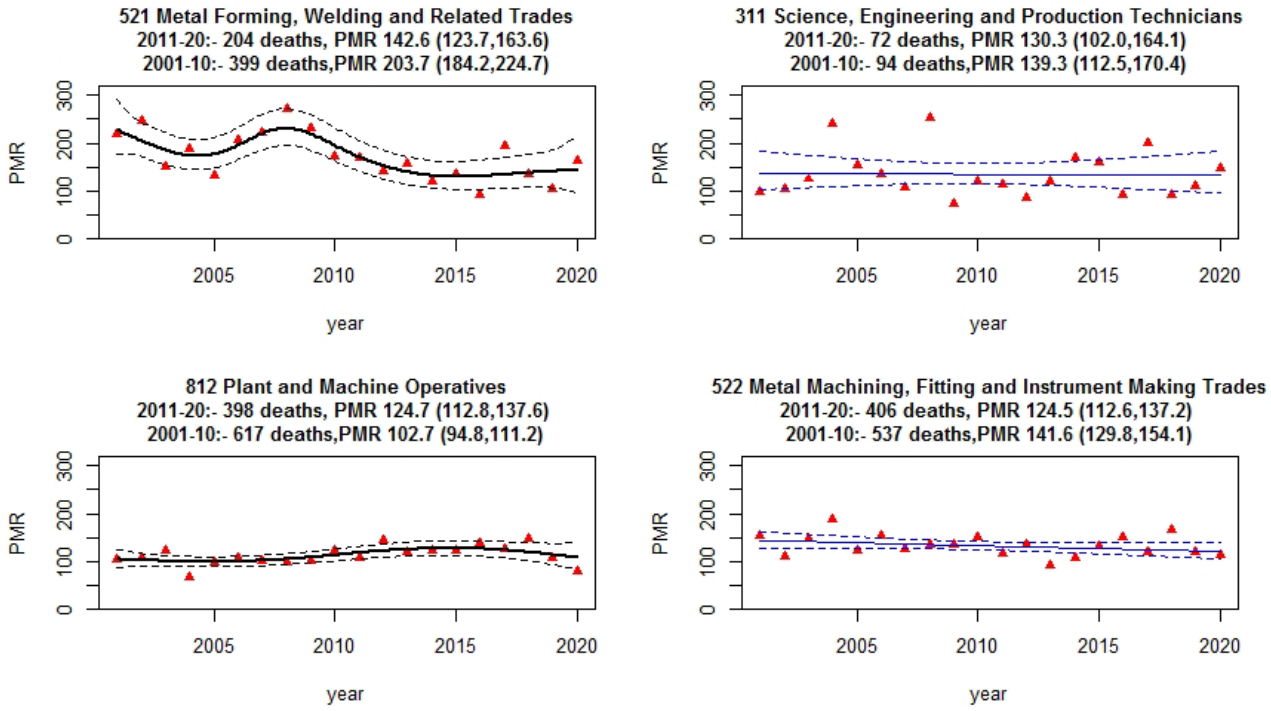

Figure 5B: Mesothelioma PMRs for selected SOC minor groups, males, 2001-2020

For females, mesothelioma PMRs for four SOC minor groups were statistically significantly elevated for the period 2011-2020:

- 413 Administrative Occupations: Records (32 deaths, PMR = 187.2, 95% CI: 128.1, 264.3) 1st
- 921 Elementary Administration Occupations (16 deaths, PMR = 183.6, 95% CI: 105.0, 298.2) 2nd
- 415 Other Administrative Occupations (91 deaths, PMR = 154.9, 95% CI: 124.8, 190.2) 5th
- 231 Teaching and Educational Professionals (111 deaths, PMR = 139.7, 95% CI: 114.9, 168.3) 9th

Figure 5C shows an increasing trend amongst 231 (Teaching and educational professionals).

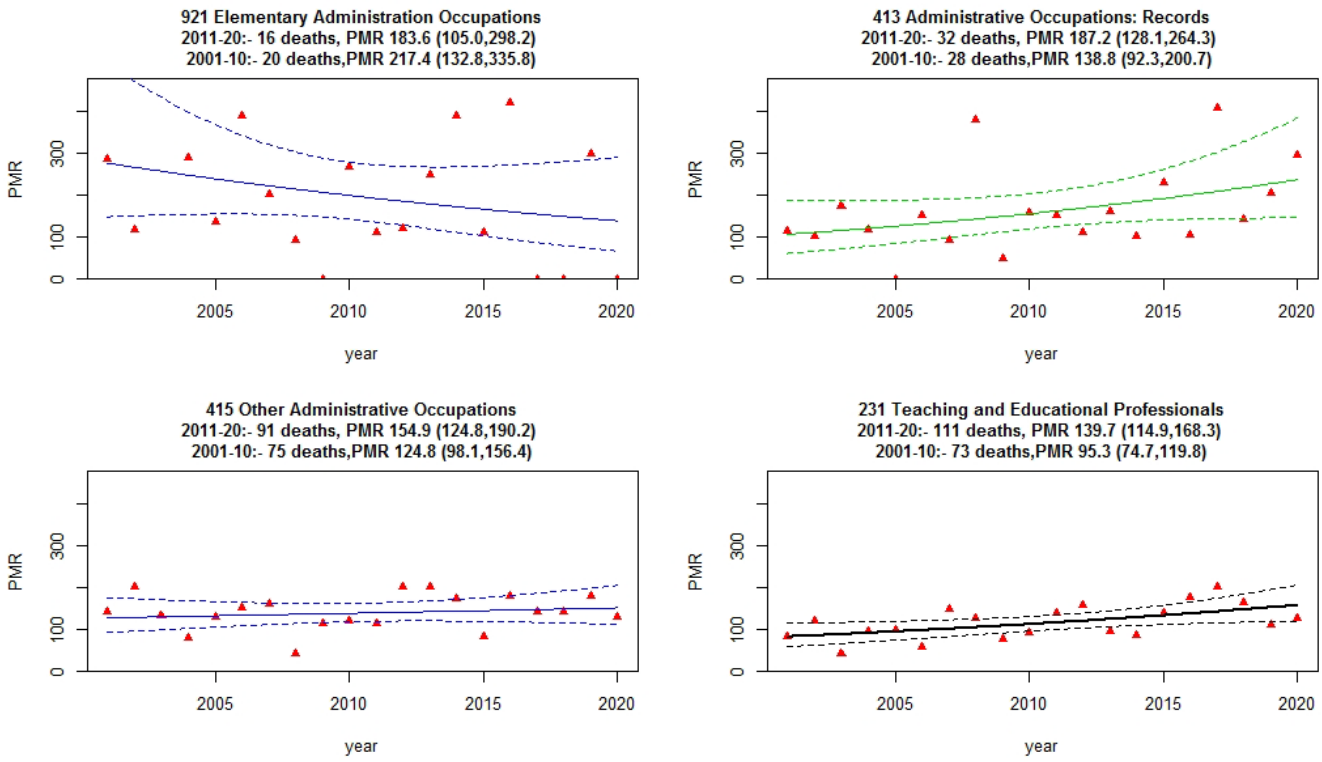

Figure 5C: Mesothelioma PMRs for selected SOC minor groups, females, 2001-2020

SOC unit group (4-digit)

For males, PMRs were statistically significantly elevated for 24 of the 186 SOC unit groups with at least 10 observed or expected mesothelioma deaths. Results for these groups are listed below. Again, a substantial proportion of these unit groups were associated with building activities.

Unit groups with the highest PMRs (higher than 300 the top four):

- 5315 carpenters and joiners (961 deaths, PMR=479.6, 95% CI:449.7, 510.9)
- 5314 plumbers and heating and ventilating engineers (451 deaths, PMR=351.7, 95% CI:320, 385.7)
- 8124 energy plant operatives (36 deaths, PMR=342.2, 95% CI:239.7, 473.8)

5216 pipe fitters (53 deaths, PMR=320.2, 95% CI:239.8, 418.8)Unit groups with high PMRs (PMR of 200 to 300, 5th to 13th):

- 2123 electrical engineers (17 deaths, PMR=297.6, 95% CI:173.3, 476.5)
- 2424 business and financial project management professionals (46 deaths, PMR=288.4, 95% CI:211.2, 384.7)
- 5236 boat and ship builders and repairers (66 deaths, PMR=279.3, 95% CI:216, 355.4)

- 5241 electricians and electrical fitters (564 deaths, PMR=270.2, 95% CI:248.3, 293.4)
- 5322 floorers and wall tilers (57 deaths, PMR=236.4, 95% CI:179, 306.3)
- 5225 air-conditioning and refrigeration engineers (18 deaths, PMR=233.9, 95% CI:138.7, 369.7)
- 5213 sheet metal workers (52 deaths, PMR=213.7, 95% CI:159.6, 280.3)
- 1122 production managers and directors in construction (111 deaths, PMR=210.8, 95% CI:173.4, 253.9)

1259 managers and proprietors in other services n.e.c. (178 deaths, PMR=210, 95% CI:180.3, 243.2)Other unit groups with elevated PMRs (PMRs of 100 to 200, 14th to 22nd, 29th, 32nd and 33rd):

- 8149 construction operatives n.e.c. (115 deaths, PMR=193.1, 95% CI:159.4, 231.8)
- 8125 metal working machine operatives (264 deaths, PMR=190.8, 95% CI:168.4, 215.2)
- 8141 scaffolders, stagers and riggers (50 deaths, PMR=179.8, 95% CI:133.4, 237)
- 5442 furniture makers and other craft woodworkers (36 deaths, PMR=179, 95% CI:125.4, 247.9)
- 5319 construction and building trades n.e.c. (438 deaths, PMR=176.1, 95% CI:160, 193.4)
- 5214 metal plate workers, and riveters (22 deaths, PMR=172.2, 95% CI:108, 260.8)
- 3563 vocational and industrial trainers and instructors (33 deaths, PMR=171, 95% CI:117.7, 240.1)
- 1139 functional managers and directors n.e.c. (36 deaths, PMR=170, 95% CI:119, 235.3)
- 5323 painters and decorators (282 deaths, PMR=169.5, 95% CI:150.3, 190.4)
- 2434 chartered surveyors (41 deaths, PMR=141.2, 95% CI:101.3, 191.6)
- 5223 metal working production and maintenance fitters (327 deaths, PMR=138.9, 95% CI:124.2, 154.8)

5249 electrical and electronic trades n.e.c. (60 deaths, PMR=132.9, 95% CI:101.4, 171.1) (n.e.c.= Not Elsewhere Classified)

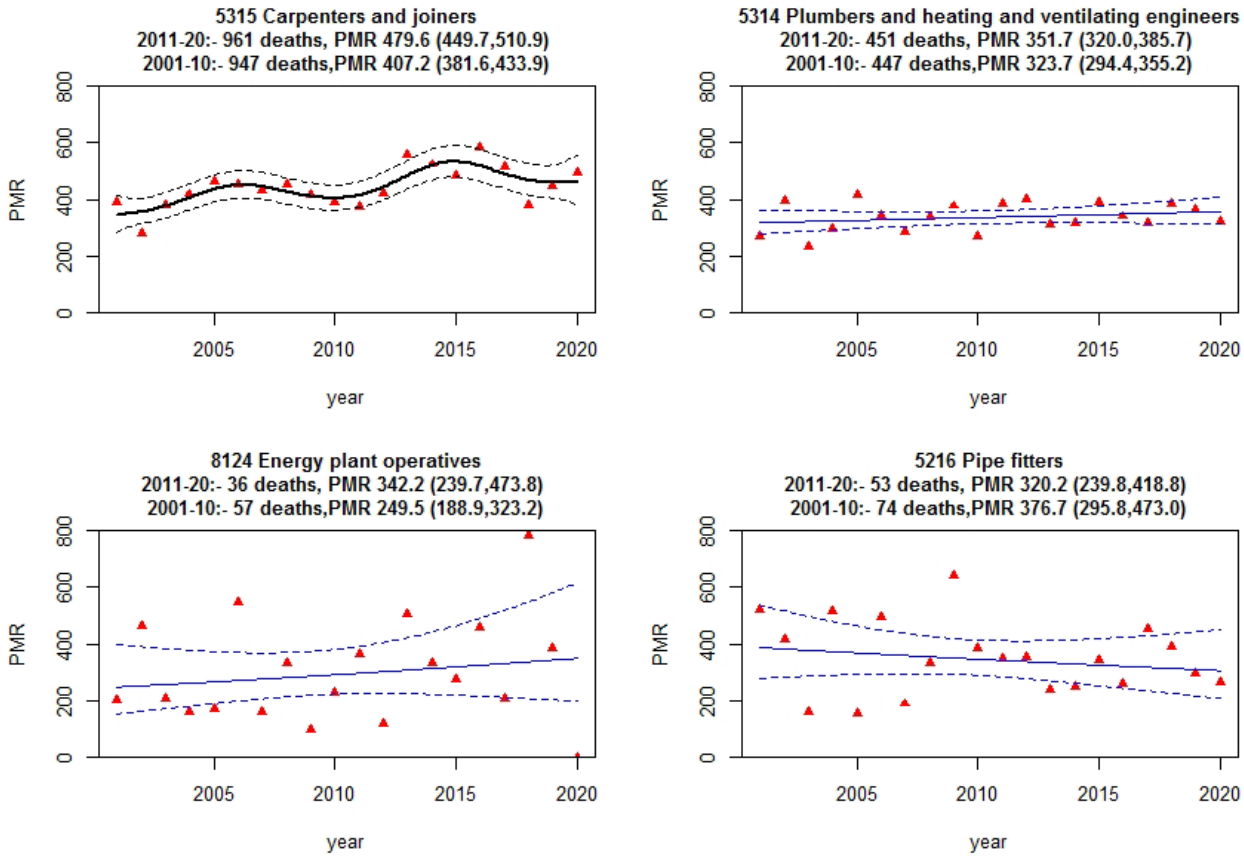

Figure 6A: Mesothelioma PMRs for selected SOC unit groups, males, 2001-2020

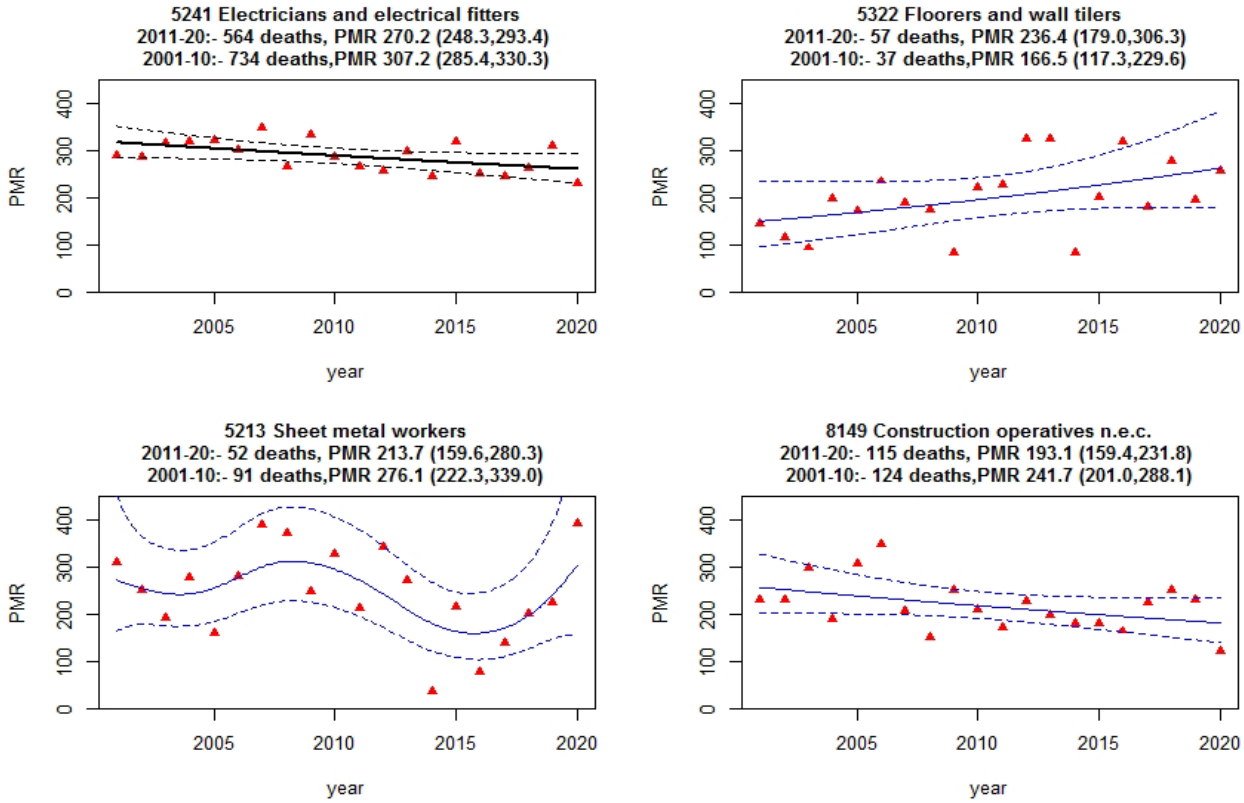

Figure 6B: Mesothelioma PMRs for selected SOC unit groups, males, 2001-2020

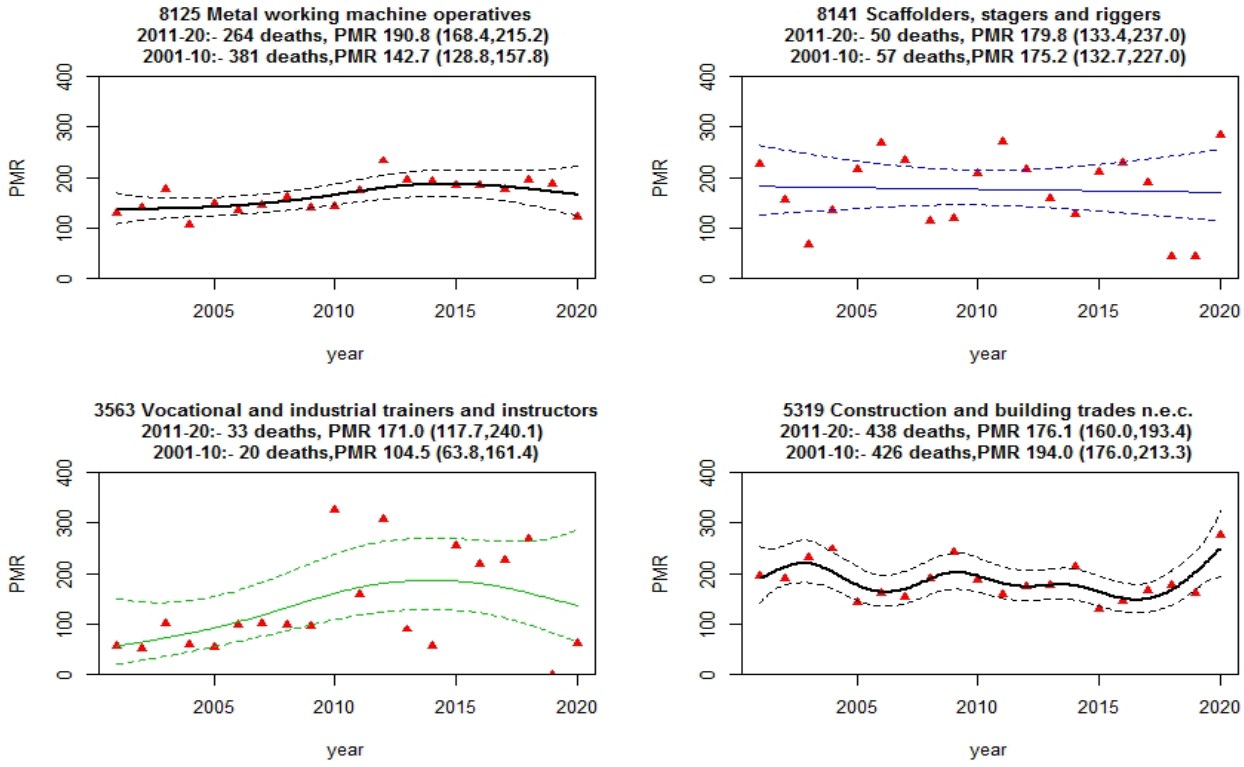

Figure 6C: Mesothelioma PMRs for selected SOC unit groups, males, 2001-2020

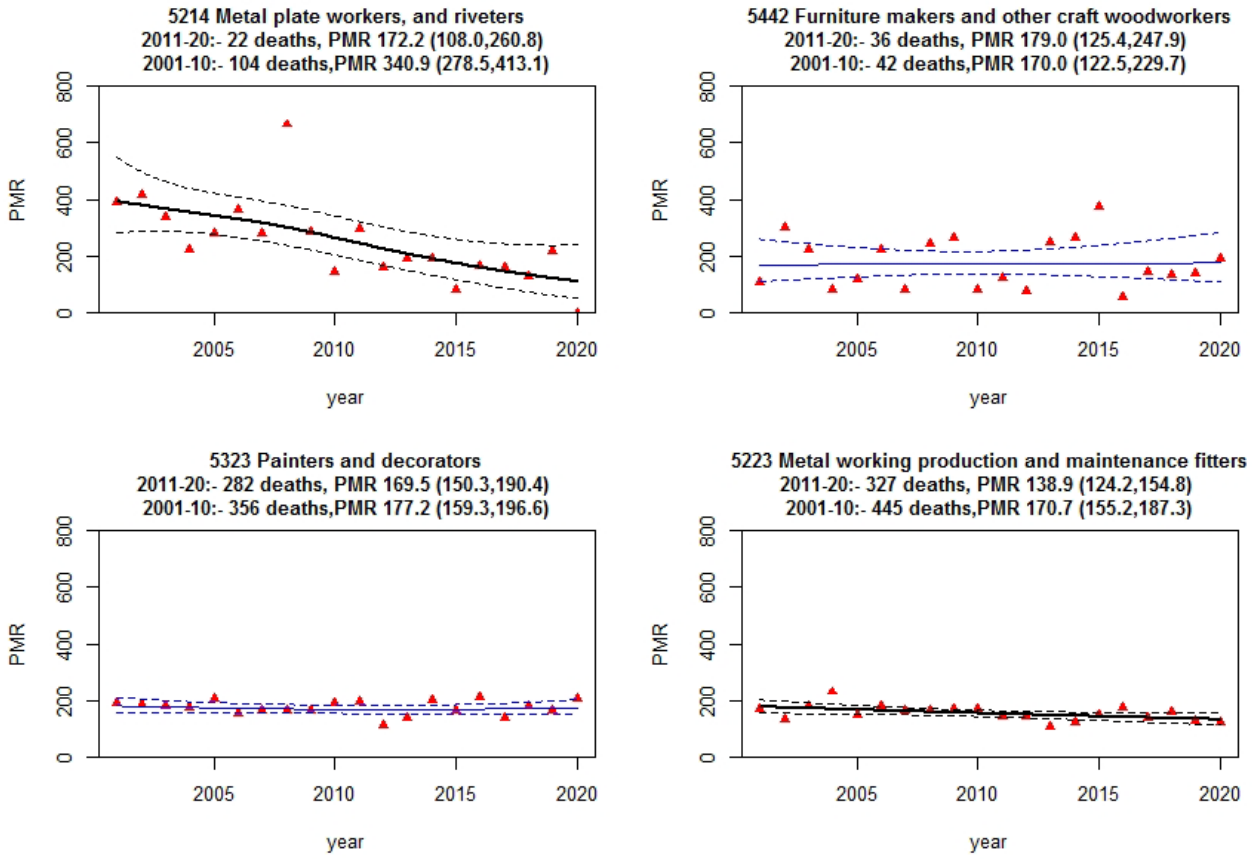

Figure 6D: Mesothelioma PMRs for selected SOC unit groups, males, 2001-2020

For females, PMRs were statistically significantly elevated for four of the 38 SOC unit groups with at least 10 observed or expected mesothelioma deaths:

- 9219 elementary administration occupations n.e.c. (13 deaths, PMR=338.9, 95% CI:180.4, 579.5) 1st
- 4131 records clerks and assistants (17 deaths, PMR=267.9, 95% CI:156, 429) 2nd
- 2315 primary and nursery education teaching professionals (83 deaths, PMR=215.7, 95% CI:171.8, 267.4) 3rd
- 4159 other administrative occupations n.e.c. (91 deaths, PMR=160, 95% CI:128.8, 196.4) 6th

Annex 1 – Technical notes

These analyses are based on 49% of male and 41% of female mesothelioma deaths on the mesothelioma register for the period 2001-2020. This is mainly due to the age restriction of 16-74 years (the age range for which last occupation of the deceased is routinely recorded on death certificates in England and Wales), but also due to missing or invalid occupation codes for some deaths below age 75 years (1.5% of male and 9.2% of female deaths).

Death data for all causes of death combined required for the calculation of PMRs from 2011-20 for England and Wales were supplied by the Office for National Statistics (ONS). For deaths registered after 1 April 2011, occupations have been classified according to the Standard Occupational Classification 2010 (SOC2010), and for deaths during 2001-2010 occupations have been classified according to the Standard Occupational Classification 2000 (SOC2000).

A small number of deaths in this analysis occurring during 2001-2010 originally coded to either SOC90 or SOC2010 were recoded SOC2000 using a probability matching algorithm provided by the ONS combined with additional checks made against the job description.

Information about the Standard Occupational Classification is available from the Office for National Statistics:

www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc

In this analysis, mortality in the different occupational groups is represented by Proportional Mortality Ratios (PMRs) and associated 95% confidence intervals. A PMR for a particular occupation is the ratio of the observed number of deaths for that occupation to the expected number of deaths, with that ratio expressed as a percentage (i.e. multiplied by 100).

The expected number of deaths is calculated as the number of mesothelioma deaths that would have been recorded for that occupation if the proportion of mesothelioma deaths was equal to the proportion of total deaths from all causes in that occupation. Since mesothelioma incidence is also strongly related to age, the calculation also takes account of differences in the distribution of ages between occupational groups. A worked example of how the PMR is calculated for a particular occupation is given below.

Statistics have been calculated for 1 to 4 digit codes i.e. major, sub-major, minor, and unit groups of SOC2010 for the period 2011-20 and SOC2000 for the period 2001-10.

The statistical models shown in the graphs, involved fitting a smoothed term for the year in a Poisson Generalized Additive model (GAM) to identify annual trends. In a most cases a Poisson error term was assumed; for a small number of cases a Negative Binomial or Normal (Gaussian) error term was assumed as this provided a better fit to the data.

Example PMR calculation

The table below illustrates the calculation of a PMR for men in “occupation X”. Column 3 gives the proportion of all mesothelioma deaths by age (=column 2 divided by column 1). This proportion is applied to the number of deaths from all causes by age in occupation X, given in column 4, to give the expected number of deaths from mesothelioma in this occupation in column 5. The total observed number of mesothelioma deaths in occupation X was 500 (not shown in table). Dividing this by the total expected number of deaths (sum of column 5 = 230 deaths) expressed as a percentage gives a PMR of 217 in this case.

	Deaths				
	All men			Men in occupation X	
Age group	All causes (1)	Mesothelioma deaths (2)	Proportion from mesothelioma (3) = (2) / (1)	All-cause deaths (4)	Expected deaths (5) = (3) * (4)
16-19	16,500	1	0.000061	6,400	0.388
20-24	21,732	1	0.000046	7,833	0.360
25-29	18,072	5	0.000277	7,907	2.188
30-34	20,544	16	0.000779	7,770	6.051
35-39	27,300	76	0.002784	6,443	17.937
40-44	42,576	199	0.004674	6,222	29.082
45-49	61,236	402	0.006565	6,243	40.984
50-54	102,900	705	0.006851	6,391	43.787
55-59	187,416	1,145	0.006109	6,269	38.300
60-64	308,988	1,436	0.004647	5,367	24.943
65-69	433,956	1,499	0.003454	4,997	17.261
70-74	550,296	1,315	0.002390	3,729	8.911
All ages 16-74	1,791,516	6,800		75,571	230

Confidence intervals and statistical significance

A PMR calculated for an occupational group may be greater or less than 100 by chance. Confidence intervals are used to give an indication of the uncertainty associated with each PMR due to this random variation. A 95% confidence interval is such that, if the calculation could be repeated many times with different samples of the events, then the confidence interval will contain the true value of the PMR 95% of the time. If the lower confidence limit is greater than 100 then the PMR is said to be statistically significantly elevated. Likewise, if the upper confidence interval that is presented is lower than 100 then the PMR is said to be statistically significantly reduced. In this analysis, confidence intervals are calculated assuming Poisson variability in the mesothelioma count for each occupation.

National Statistics

National Statistics status means that statistics meet the highest standards of trustworthiness, quality and public value. They are produced in compliance with the Code of Practice for Statistics, and awarded National Statistics status following assessment and compliance checks by the Office for Statistics Regulation (OSR). The last compliance check of these statistics was in 2013.

It is Health and Safety Executive's responsibility to maintain compliance with the standards expected by National Statistics. If we become concerned about whether these statistics are still meeting the appropriate standards, we will discuss any concerns with the OSR promptly. National Statistics status can be removed at any point when the highest standards are not maintained, and reinstated when standards are restored.

Details of OSR reviews undertaken on these statistics, quality improvements, and other information noting revisions, interpretation, user consultation and use of these statistics is available from www.hse.gov.uk/statistics/about.htm

An account of how the figures are used for statistical purposes can be found at www.hse.gov.uk/statistics/sources.htm.

For information regarding the quality guidelines used for statistics within HSE see www.hse.gov.uk/statistics/about/quality-guidelines.htm

A revisions policy and log can be seen at www.hse.gov.uk/statistics/about/revisions/

Additional data tables can be found at www.hse.gov.uk/statistics/tables/.

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