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Mesothelioma incidence projections in South East England

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Abstract

Objective: We estimated the past and future age-standardised incidence rates of mesothelioma by birth cohort and by period of diagnosis in South East England.

Methods: We extracted data on patients diagnosed with mesothelioma (ICD-10 C45) between 1960 and 2009 from the Thames Cancer Registry. We calculated the age-standardised incidence rates using the European standard population. We used age-cohort and age-period modelling to estimate the age-specific incidence rates for the 1900 to 1950 birth cohorts and the 1935 to 2034 calendar periods.

Results: A much more pronounced increase in mesothelioma incidence between 1972 and 2007 was observed in males than in females. In both sexes, the incidence rates increased in successive generations up to the 1945 birth cohort. Projection of rates in the future showed an increase in incidence in males until 2022 and a decrease thereafter. Among females, the incidence rate was predicted to increase gradually until reaching its maximum around 2027, and to remain stable thereafter.

Conclusion: The occurrence of mesothelioma is closely linked to occupational exposure to asbestos in the 1960s and 1970s and due to the long latency period the incidence of mesothelioma is projected to increase until the 2020s.

Background

Pleural mesothelioma is a malignant tumour of the membrane surrounding the lung. It is currently considered an incurable tumour with a median survival approaching one year.[1]

The leading cause of mesothelioma is occupational exposure to asbestos fibres. Asbestos was widely used in many industries in the UK from the 1950s up until the mid-1980s. In the earlier part of this period, asbestos exposure occurred most commonly in mining, ship building, manufacturing of asbestos textiles and cement, but in the later period those working in plumbing, insulation, demolition and and construction industries became the largest at-risk group. The importance of the low levels of ‘ambient’ asbestos in many public and private buildings from the 1950s and 1960s is unknown.

The incidence of mesothelioma started increasing in the 1970s. The number of new cases of mesothelioma diagnosed in the UK in 2008 was approximately 2,400 and is expected to rise.[2] Previous predictions of future numbers of mesothelioma deaths in the UK suggest that male mesothelioma deaths would peak around 2020.[3]

In South East England, approximately 440 cases of mesothelioma were diagnosed in the most recent year. The relatively high number of mesothelioma cases in South East England compared to the UK overall is probably due to the high exposure to asbestos in the ship building industry.[1] We aimed to project the past and future incidence rates by birth cohort and by period of diagnosis among males and females in South East England.

Methods

Study population

From the Thames Cancer Registry (TCR) database, we identified 8,250 patients diagnosed with mesothelioma (ICD-10 C45) between 1960 and 2009. The TCR is one of 12 population-based cancer registries in the United Kingdom and covers the residential populations of London, Surrey, Sussex and Kent. In this area, registration is initiated by pathology and clinical information received from hospitals. Trained cancer registration officers seek additional information from the medical records on demographic details, disease stage and treatment. Data are quality assured when added to a central database and updated continuously.

Statistical analysis

For the analyses, age at diagnosis was categorised into 5-year age groups with the midpoint representing the group, for example, 0-5 year olds were represented by “2”, and hence age groups were 2, 7, etc., through to 87 (85+ years). We categorised the year of diagnosis into 5-year periods, which were represented by the midpoints of 1962 (for 1960-1964), 1977 etc., through to 2007. We assumed that the age specific incidence rates were constant for patients younger than 27 years of age, extrapolating their 1962 rates backwards and their 2007 rates forwards in time. We used a Poisson regression age cohort model [4] to estimate age specific rates in the cohort dimension and an age-period model to extrapolate in the period dimension. We then calculated the age-standardised rates (per 100,000 European standard population) for birth cohorts and cross-sectionally for the different calendar periods. Because the earlier and later cohort estimates were based on a small number of cases, and were therefore less robust, we report estimates for the 1900 to 1950 birth cohorts and the 1960 to 2009 calendar periods.

Ethics

Cancer registries in England have approval from the National Information Governance Board to carry out surveillance using the data they collect on all cancer patients under section 251 of the NHS Act 2006. Therefore separate ethical approval was not required for this study.

Results

The age-standardised incidence rates of mesothelioma were higher among males than females (Table 1; Figure 1). The male/female incidence ratio changed from 2:1 in 1962 to 6:1 in the 1980s and 1990s falling back to 5:1 in the 2000s (Table 1; Figure 1). Incidence rates increased from 1962 to 2007 (Table 1). This increase occurred more rapidly among males (0.05 in 1962 to 5.52 in 2007) and more gradually in females (0.02 in 1962 to 1.13 in 2007).

Firstly, an age-cohort Poisson regression model was fitted to the empirical data, where the response variable was the number of recorded diagnoses, and age group at diagnosis and birth cohort were treated as explanatory variables, and the logarithm of the population at risk was included as the offset term in the model. The age-standardised incidence rates increased in successive generations up to the 1945 cohort when the estimated incidence rates were 9.04 per 100,000 among males and 1.96 per 100,000 among females (Figure 2). The incidence rate decreased in the generation born after 1945.

Secondly, the estimated rates from the age-cohort model were combined with the empirical data to form the input to an age-period Poisson regression model. This model was specified in the same way as the age-cohort model but with birth cohort replaced by period of diagnosis. We projected that the incidence rates in males will increase until the 2020s and decrease thereafter (Figure 3). Among females the incidence rates were projected to increase gradually until reaching a peak in the late 2020s and remaining relatively stable thereafter. Projections further into the future became less robust.

Discussion

The relatively high incidence of mesothelioma in the area covered by the Thames Cancer Registry is probably due to the occupational exposure to asbestos particularly in the ship building industries present in South East England and thereby affecting mostly men.[5] Mesothelioma incidence rates were found to be higher among males than females. This is in accordance with other studies in the UK [1, 2] and around the world.[6-10] The male preponderance is contrasted by a follow-up study of a rural Turkish cohort, which found a higher incidence of mesothelioma in females than males.[11] People in this cohort were exposed from birth to asbestos-containing soil mixtures "(white soil)". White soil was used in whitewash or plaster materials for walls; as insulation and water proofing; for floors and roofs; for baby powder and also in pottery.

A British study published in 1995 reported a peak in imported asbestos between the 1960s and 1970s.[3] The use of blue and brown asbestos was banned in the UK in 1985. Given the estimated median induction time of 32 years for occupation-related mesothelioma[12], this would explain both our observation of the rapid increase in incidence rates in the calendar periods 1972 to 2007, as well as the high incidence rates of mesothelioma among generations born up to the 1945 birth cohort and the decreasing incidence in the birth cohorts thereafter.

Incidence rates in males were projected to increase in each period until about 2022 and to decrease thereafter, whereas in females the incidence rates are estimated to peak around

2027. In general, using age-period-cohort modelling, studies around the world project fairly similar timing of peak incidence. A study in Denmark also predicted the future annual number of mesothelioma cases to peak around 2015 or later.[13] A study conducted in France predicted a much later peak in mortality between 2025 and 2050, which is related to the later peak in French import of asbestos in 1975. [14] A recent US study, reported significantly increased mesothelioma incidence from the late 1970s through the mid-1990s and projections in this study indicate that the number of male mesothelioma cases peaked during 2000-2004.[15] An early peak in the US compared to the UK is due to the timing of maximum exposure, where a maximum exposure in the US occurred from the 1930s to the 1960s. [16] Workers born after 1929 would have had fewer years of exposure to asbestos, hence the earlier decline in mesothelioma cases.

A previous UK study projected the peak in the number of deaths due to mesothelioma to occur in 2020, which is slightly earlier compared to the projections in our study.[3] More recent publications from the same group predicted the peak of mesothelioma deaths to occur another five years sooner. [17, 18] In these latter two studies the estimated population exposure to asbestos was included in the model for prediction of mesothelioma mortality. A study in Australia applying both modelling approaches projected the mesothelioma incidence to peak between 2014 and 2021, where the age-period-cohort model projected a later incidence peak than the model that incorporated projections based also on asbestos exposure.[19] Analyses that base the projection on the modelling of exposure to asbestos in the population on assumptions about distribution, dose and dose rates of the exposure may not be very accurate, especially in the period after the import of asbestos had stopped. The age-period-cohort modelling used in this study allows for separate effects of age, calendar period and birth cohort. It does not take into account any available data on asbestos exposure in the population, but allows indirectly for this through the impact of this exposure on the empirical mesothelioma rates. We consider that both strategies of analysis have merits and we note that the predictions of future disease pattern are in general agreement.

Conclusion

We project that the incidence rates of mesothelioma in South East England will continue to increase and will peak in the 2020s and slightly later for females than for males.

Competing interests

The author(s) declare that they have no competing interests.

Authours' contribution

HM led the study design. SPR and VHC performed the analyses. SPR, VHC, ML, MDP and HM contributed to the interpretation of the findings. SPR drafted the manuscript and VHC, ML, MDP and HM reviewed and revised the paper. All authors have approved the final version of the manuscript

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Figure legends

Figure 1: Age-standardised incidence rates (ASR) per 100,000 of mesothelioma, by sex and period of diagnosis, South East England, 1962-2007.

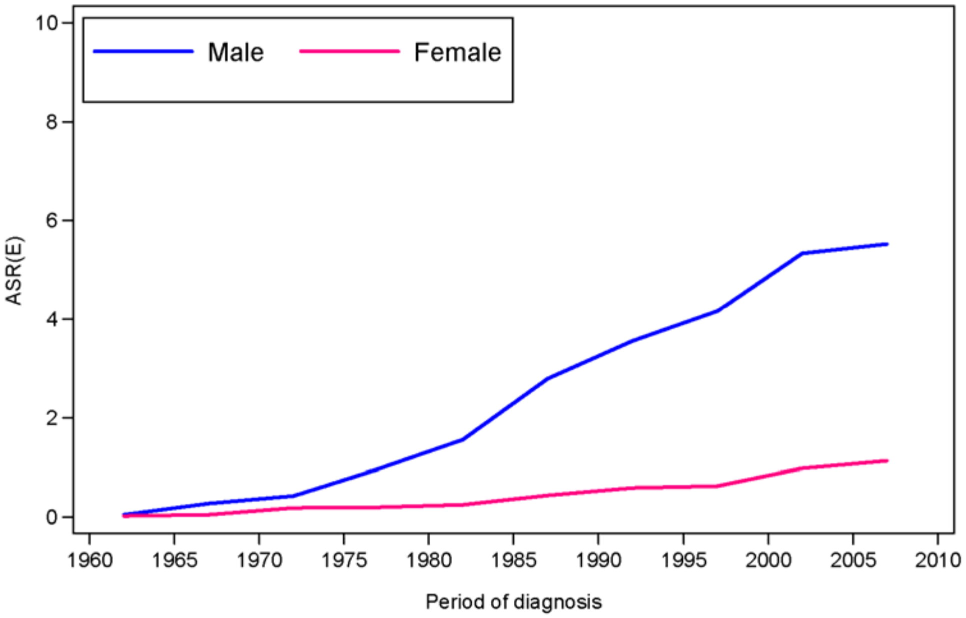


Figure 2: Age-standardised incidence rates (ASR) of mesothelioma by sex and cohort of birth, South East England, 1900-1950.

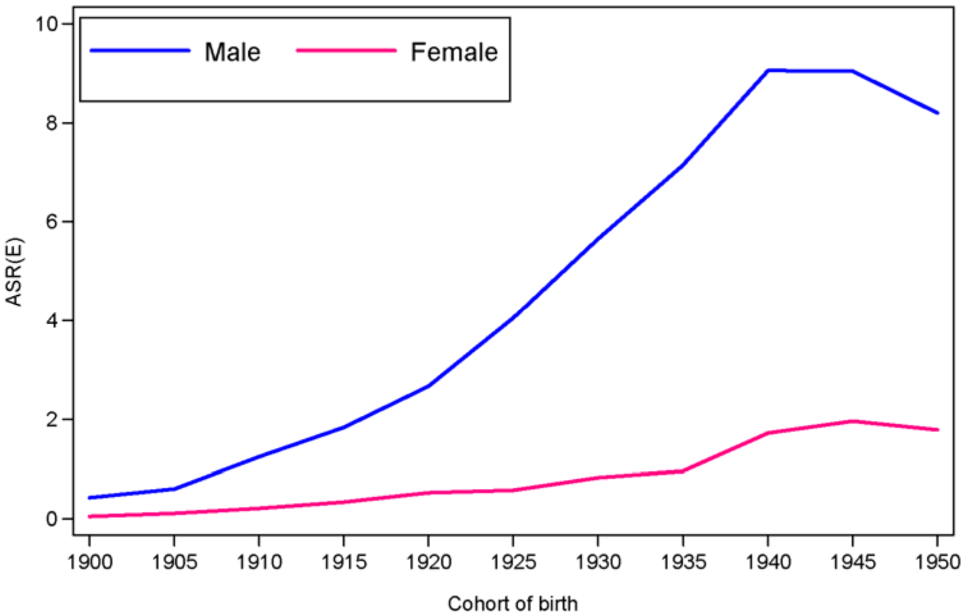
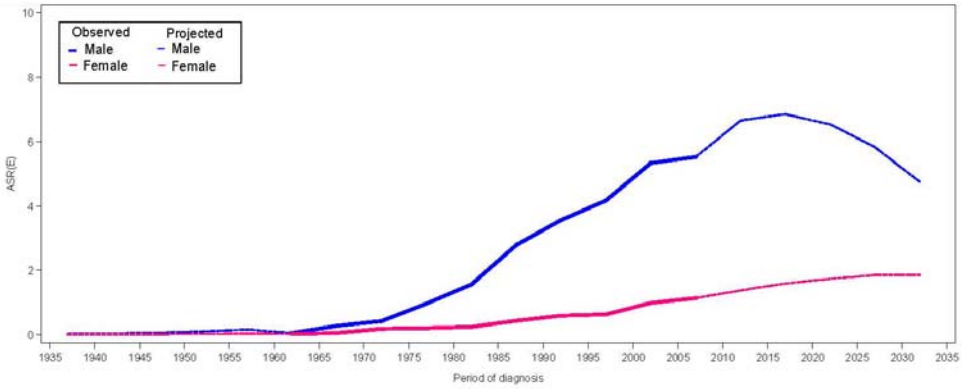


Figure 3: Observed and projected age-standardised incidence rates (ASR) of mesothelioma by sex and period of diagnosis, South East England, 1935-2032.



Observed
Male
Female
Projected
Male
Female
ASR(E)
Period of diagnosis

Tables

Table 1: Number of cases, age-standardised incidence rates (ASR) and 95% confidence interval (CI) of mesothelioma, by sex and calendar period, South East England, 1962-2007.

	Males			Females			
Period	**Number of cases**	**ASR**	**(95% CI)**	**Number of cases**	**ASR**	**95%CI**	**Male: Female incidence ratio**
1962	8	0.05	(0.02-0.09)	5	0.02	(0.00-0.04)	2.34
1967	45	0.27	(0.19-0.35)	10	0.05	(0.02-0.08)	5.43
1972	71	0.42	(0.32-0.52)	41	0.19	(0.13-0.24)	2.27
1977	162	0.97	(0.82-1.12)	44	0.20	(0.14-0.26)	4.89
1982	262	1.56	(1.37-1.75)	53	0.24	(0.18-0.31)	6.41
1987	753	2.79	(2.58-2.99)	155	0.43	(0.36-0.50)	6.47
1992	954	3.56	(3.33-3.79)	201	0.59	(0.50-0.68)	6.06
1997	1151	4.16	(3.92-4.41)	222	0.62	(0.53-0.71)	6.69
2002	1557	5.33	(5.06-5.60)	362	0.98	(0.87-1.09)	5.44
2007	1748	5.52	(5.26-5.78)	446	1.13	(1.02-1.24)	4.88