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Conclusions from our studies on mesothelioma risk in relation to asbestos lung burden and occupational history (see Gilham et al (2018) International Journal of Epidemiology 47(6):1745-1756 "Past and current asbestos exposure and future mesothelioma risks in Britain: The Inhaled Particles Study". Updated results are shown in table 1 and figure 1.)

The UK has the highest mesothelioma rate in the world largely because of our heavy use of amosite (brown asbestos) in building materials, which peaked between 1960 and 1975 then fell sharply and ended before 1980. Crocidolite (blue asbestos) use was lower and ended before 1970. These, together with a few other mineral fibre types, are called amphibole asbestos. They can still be measured in lung tissue 60 years after exposure. Chrysotile (white asbestos) causes a much lower mesothelioma risk than the amphiboles, probably because it is eliminated rapidly from the lung. Chrysotile contributed 88% of UK asbestos imports from 1955 to 1990 but only 2% of the asbestos fibres seen in the lungs of recently diagnosed lung cancer and mesothelioma patients. Chrysotile imports declined steeply after 1980 and were banned in 1999.

British men born in the 1940s who worked through the period of peak amphibole asbestos use (1960-1975) are at very high risk of developing mesothelioma (1 in 17 for carpenters, 1 in 50 for plumbers, electricians, painters and decorators, and about 1 in 100 for other construction workers). High risks occurred in earlier generations of workers in various other occupations, particularly shipbuilding and some asbestos factories, but they now account for a very small proportion of mesotheliomas.

Predicted lifetime mesothelioma risks for the whole UK population and for those with no history of occupational exposure are summarised in table 1. Our studies on asbestos lung burden and mesothelioma risk predict a lifetime risk of about 1 in 10,000 at a lung burden of 1 fibre of amphibole asbestos per mg of lung tissue. Lung burdens in men and women reporting no occupational exposure show that environmental exposures in people born since 1975 were 20 times lower than in those born in the 1940s. The British mesothelioma death-rate has been falling for 20 years in people aged under 50 and is now falling rapidly at all ages below 70. In 2019 there were 13 male and 6 female mesothelioma deaths in people aged 45-54 (i.e. those born around 1970). 25 years earlier in 1994 there were 137 male and 15 female deaths at age 45-54 (i.e. those born around 1945).

Table 1. Predicted UK lifetime mesothelioma risks per 10,000 people for all men and all women, and for people with no occupational exposure

	All men	**All women**	**No occupational exposure (both sexes)**	
Year of birth	Predicted lifetime risk per 10,000	Predicted lifetime risk per 10,000	Average lung burden (fibre/mg)	Predicted lifetime risk per 10,000
1940-54	**72**	**14**	17	17
1955-64	**23**	**10**	8	8
1965-74	**12**	**6**	2.4	2.4
1975-84	2.4	0.8	0.8	0.8
1985-92	0.4	0.4	0.4	0.4

Figures **in bold** in table 1 are projected from national mesothelioma death-rates. All other risks in table 1 are estimated from amphibole asbestos concentrations in lung samples obtained at operation for

pneumothorax (collapsed lung) or lung cancer, assuming a lifetime risk of 1 in 10,000 per fibre/mg. (See note below on calculation of risks in table 1.) Mesothelioma is so rare below age 45 (about 5 deaths per year in Britain) that the lifetime risk in people born since 1975 cannot be estimated from national death-rates.

The 20-fold reduction in the lung burdens of men and women with no occupational exposure from 17 fibre/mg (born 1940-54) to 0.8 fibre/mg (born 1975-84) shows that the heaviest exposure to people not working with asbestos occurred during the period up to the 1970s when asbestos building materials were being installed, with much less exposure from subsequent fibre releases in the asbestos-containing buildings where they lived or worked since 1980. It is therefore not surprising that teachers born before 1950 who were working during the 1960s and 1970s when asbestos was being installed in many schools now have higher mesothelioma risks than other people of the same age. There is as yet no evidence of excess risk in teachers born since 1955, although the numbers of cases are still too low for reliable risk estimation.

These data contradict other evidence presented to this committee, due mainly to confusion between current death-rates caused by widespread occupational and environmental asbestos exposure before 1980 and the much lower risks at exposure levels since 1980. Our main conclusions are:
1. There is no evidence that teachers born since 1955 are at greater risk than other people.
2. Occupational mortality data for teachers and other occupational groups up to age 75 provide a reliable prediction of lifetime risk in each generation, because the risk continues to increase after age 75 in the same way in every birth cohort.
3. The evidence that most non-occupational exposure occurred during installation of asbestos materials suggests that unnecessary asbestos removal is likely to increase exposure to building occupants as well as causing dangerous exposure to some removal workers.
4. More stringent regulatory airborne asbestos limits following clearance operations (0.01 fibre/ml in the UK, 0.001 fibre/ml in Germany) would not guarantee lower subsequent average exposures to building occupants, which are generally so much lower than 0.001 fibre/ml that they cannot be measured reliably by air monitoring.

Despite these apparently reassuring conclusions there are continuing concerns. Most mesotheliomas caused by current exposure will be in building occupants rather than exposed workers because so few people now work with asbestos. However, our lung burden studies suggest that plumbers and decorators are still being exposed, and some asbestos removal workers may be at very high risk. Removal work since the 1980s could also have led to increased exposure to the general population in some buildings. Our data suggest that environmental exposure was still falling up to about 20 years ago, but this conclusion is based on small numbers of lung samples, and there is no good evidence on more recent trends in airborne levels in buildings. It is worrying that there were 12 British mesothelioma deaths below age 40 in the latest 2 years of mortality data (2018-2019: 6 per year) and only 27 in the previous 10 years (2008-2017: 2.7 per year). A further 10 years of national mortality data will show if this is a chance finding. Whether exposures to workers and to the general population continued to fall or increased over the last 20 years can be answered more quickly by more extensive lung burden studies on stored samples taken at operation for pneumothorax (collapsed lung) from men and women born since 1980, particularly teachers and asbestos removal workers. Exposure to children can be estimated from lung burdens in people operated for pneumothorax before age 18.

Note on calculation of risks in table 1.

Birth-cohort analysis of British mesothelioma death-rates shows that the lifetime risk in each generation is about 50 times the risk up to age 50. Lifetime risks to British men and women born before 1975 were therefore projected from their observed risks up to age 50. All other risks in table 1 are predicted from our lung burden data on the assumption that the risk to age 50 is 2 per million per fibre/mg. The trends in average lung burden and risk to age 50 (figure 1) show that this was true for each generation of women. The risk per fibre/mg was somewhat higher for men born before 1965, many of whom suffered heavy occupational exposure. Most mesotheliomas in women were caused by non-occupational exposure, so their dose-response is likely to give better risk predictions for the effects of current much lower exposure levels.

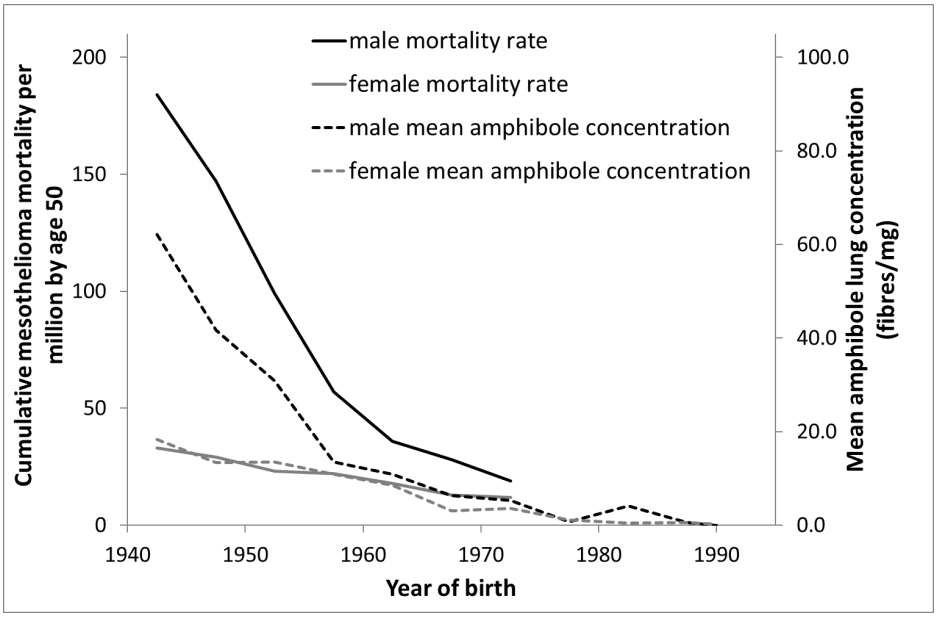

Figure 1. Mean amphibole asbestos lung burdens in men and women by year of birth. Corresponding British mesothelioma risks up to age 50 are scaled to match a burden of 1 fibre/mg to a risk of 2 per million by age 50.

The very low mean lung burden for men and women born 1985-92 shown in table 1 (0.4 fibre/mg) is unreliable, and a larger sample in which a few heavily exposed people were seen might give a substantially higher average. Higher lung burdens were seen in a few construction workers born in 1975-84.

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