EFFECT OF CHILDREN'S AGE AND LIFE EXPECTATION ON MESOTHELIOMA RISK[1]

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It is generally accepted that the major risk from "low" level exposures to asbestos is the development of mesothelioma.

Children have a greater likely life expectancy than adults. It is therefore essential to assess whether such longer life expectancy relatively increases the children's risk of developing mesothelioma as compared with equally exposed adults.

Doll & Peto (1985), (D&P), commented that "The risk of mesothelioma is very much higher when exposure occurs early in life ..." and Peto (1989) tabulated data predicting that the mesothelioma risk, expressed as deaths before age 80 per 1000 men resulting from a 5 fibres/ml.years cumulative exposure over 5 years, was 7.5 for exposure from age 0, 2.1 for exposure from age 20 and 0.3 for exposure from age 40. That is, the risk from exposure from age 0 was 25 times greater than from an equal exposure from age 40. Peto et al (2006) indicated that the effect of exposure to asbestos from birth increased the mesothelioma risk by a factor of 5.

Conversely, Hodgson and Darnton (2000), (H&D), concluded that mesothelioma risk levelled out after about 60 years from exposure and therefore that for mesothelioma risk to age 80 there was no further increase in risk from exposures below age 20.

The above H&D assumption was based on falling mesothelioma incidences with long follow up in some cohorts.

However, H&D failed to address the fact that most cohorts involved workers whose likely age at death would have been significantly below age 80 and also failed to address earlier deaths due to asbestos-induced deaths other than mesothelioma. For example, in the Quebec cohort the median age at death was about 68 years and out of 8009 deaths there were 657 deaths from lung cancer, 174 more than expected, and 108 deaths from pneumoconiosis, Liddell et al (1997). 33 cases of mesothelioma were observed in men not exposed to crocidolite. If only 12% of these additional lung cancer or pneumoconiosis cases had survived to develop mesothelioma, the number of mesothelioma cases would have been doubled.

Dr. Darnton has very kindly provided an excel spreadsheet that permits non-truncated relative mesothelioma risks to be quantified down to first exposure at age 0.

From Dr. Darnton's spreadsheet adjustment factors to convert estimates of mesothelioma mortality prior to age 80 due to asbestos exposure starting at age 30 to other start ages are as shown in Table 1 below:

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[1] This is the text of a submission by R. Howie to the (UK) Committee on Carcinogenicity for its review of the Relative Vulnerability of Children to Asbestos.

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Table 1

Start age	0	5	10	15	20	25	30	40	45	50
Factor	7.0	5.3	4.0	3.0	2.1	1.5	1	0.4	0.2	0.1

Table 1 above is effectively an expanded version of Table 9 of H&D.

From Table 1, pre-school and school aged children are significantly more likely to develop mesothelioma by age 80 than equally exposed adults.

For example, if a class of five year olds and their 30 year old teacher were all exposed to a cumulative exposure of, say. 0.01 fibres/ml.year of amosite, the mesothelioma risks, from H&D, would be ~160 per million for each of the children as compared with 30 per million for the teacher.

A further factor that must be addressed is increasing life expectancy.

From ONS (2011) the Cohort life expectancies of babies born in 2012 are 90.5 years for boys and 94.0 years for girls. In addition, it is anticipated that about one third of the babies born in 2012 will survive to age 100, ONS (2012).

It is therefore necessary to assess the consequences of survival to ages 90 and 100.

Dr. Darnton's spreadsheet has been modified to take account of such increases in survival. Table 2 shows the adjustment factors for children to age 90 relative to 30 year old adults surviving to age 80 and Table 3 shows the corresponding adjustment factors for children to age 100 relative to 30 year old adults surviving to age 80. Adjustment factors relative to adults to age 80 have been calculated to permit the H&D model to be to applied to give quantitative risk estimates

Table 2: Adjustment factors for children and young adults likely to survive to age 90 relative to adults at age 30 who will survive to age 80

Start age	0	5	10	15	20	25	30
Factor	11.3	8.9	7.0	5.3	4.0	3.0	2.1

Table 3: Adjustment factors for children and young adults likely to survive to age 100 relative to adults at age 30 who will survive to age 80

Start age	0	5	10	15	20	25	30
Factor	17.3	14.0	11.3	8.9	7.0	5.3	4.0

From Tables 2 and 3 the "absolute" mesothelioma risk to pre-school and school aged children increases with increasing life expectancy. However, the children's risk relative to that of 30 year old adults with likely survival to the same ages as the children declines. This decline is due to the relatively larger increase in initiation/development times for the 30 year olds as compared with the younger children, e.g. for 5 and 30 year olds to age 80 the times available for initiation/development of mesothelioma are 75 and 50 years respectively whereas for

5 and 30 year olds to age 90 the times available for initiation/development are 85 and 60 years respectively, 75 years to 85 years for 5 year olds v 50 years to 60 years for 30 year olds.

If the above example of a 0.01 fibres/ml.year cumulative exposure to amosite were applied, the risk to the 5 year old children with life expectancies of 80, 90 and 100 years would be ~160, ~270 and 420 per million per child respectively and the risk for 30 year olds with the same life expectancies would be 30, ~60 and 120 per million respectively.

Increasing life expectancy therefore has a significant impact on mesothelioma risk for both children and young adults.

Some experts may contend that the effects of biological clearance, particularly for chrysotile, will become progressively more important as life expectancy increases.

Any such contention would be based on the fallacy that what counts is clearance between exposure and diagnosis of mesothelioma rather than clearance between exposure and the start of the process that initiates the steps/stages that result in mesothelioma.

Many studies of mesothelioma latent periods have been based on cohorts likely to have been heavily exposed to asbestos, e.g. Yates et al (1997) studied 272 mesothelioma cases, of which 189, 70%, had worked in occupations where "heavy" exposures were likely.

Some papers have suggested that mesothelioma latent periods increase as exposure levels decrease, e.g. Bianchi et al (1997), Yeung et al (1999). For example, Bianchi et al (1997), reported that mean latency periods (years) were 29.6 among insulators, 35.4 among dock workers, 43.7 in a heterogeneous group defined as various, 46.4 in non-shipbuilding industry workers, 49.4 in shipyard workers, 51.7 among women with a history of domestic exposure to asbestos, and 56.2 in people employed in maritime trades.

Increased life expectancy may therefore result in persons with low level exposures who might not previously have lived long enough to develop mesothelioma now living long enough to develop the disease.

It is considered that the increased risk to children and the further increased risk due to increasing life expectancy should be reflected in permissible airborne asbestos fibre levels in buildings.

HSE (2005) comments that the Clearance Indicator of 0.01 fibre/ml is used in the interpretation of reassurance and background samples. Note that "Reassurance" samples are effectively measures of environmental fibre levels in the buildings of interest. Although the above comment in HSE (2005) is directly contrary to the Approved Code of Practice, HSC (2006) which states that the Clearance Indicator is "not an acceptable permanent environmental level", the above comment is widely interpreted as implying that as long as 0.01 fibres/ml is not exceeded, the environment is "safe"

The environmental levels necessary to maintain the same mesothelioma risk as imposed on 30 year olds by annual exposures to 0.01 fibres/ml.years of amosite can be quantified from H&D.

If a background cumulative exposure of 0.01 fibre/ml.year were deemed acceptable for today's adults, background levels would have to be reduced to 0.001, 0.0005 and 0.0003 fibres/ml for 5 year olds with life expectancies of 80, 90 and 100 years respectively and to 0.0007, 0.0004 and 0.0002 fibres/ml respectively in residential properties where babies may be exposed to asbestos from birth.

It will be appreciated that for a given airborne asbestos fibre concentration the cumulative exposure over any given period varies directly with the number of hours of exposure per week, e.g. in residential premises where a baby may be exposed for 16 hours per day for 7 days a week, the exposure duration per week would be 112 hours compared with 40 hours for a nominal occupational exposure.

Such increased exposure per week would increase the cumulative exposure and therefore increase the mesothelioma risk.

Peto et al (2006) suggested that young children exposed for 168 hours per week are at a 10-20 fold increased risk of developing mesothelioma. It is assumed that this increased risk includes the factor of 5 increase for exposure from birth.

The above environmental levels in residential properties therefore have to be reduced to take account of occupants’ likely exposure durations.

In addition, it is essential that more stringent clearance and background requirements be applied to asbestos operations in buildings likely to be occupied by children than in buildings occupied only by adults.

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