Children and smoking: the family circle

Anne Charlton
Cancer Research Campaign, Education and Child Studies Research Group, School of Epidemiology and Health Sciences, University of Manchester, Manchester, UK

Children’s and adults’ smoking can form a ‘family circle’. Young women and their male partners who are less well-educated and less affluent are most likely to smoke during the woman’s pregnancy. The harmful effects on the fetus, including low birth weight and increased risk of respiratory diseases, are carried forward into childhood. The frequent minor ailments can cause absence from school, falling behind with school work and perhaps under-achievement. Children of mothers who smoked during pregnancy are likely to have smaller stature which can also affect self-esteem.

Passive smoking in the home exacerbates these effects and adds others. The child, therefore, can become disenchanted with school and reject its norms and is then at increased risk of becoming a smoker. These young smokers are most likely to leave school early, to start families early and to smoke during pregnancy, thus continuing the ‘family circle’ or ‘cycle of deprivation’. Practical action is needed.

The issue of children and smoking is, both socially and healthwise, a circular one. Children’s smoking behaviour is related to that of adults, especially to that of their parents; their health is affected by adult smoking; their behaviour is affected by their health; this is then carried forward into adulthood to affect the next generation of children. It is perhaps best described as ‘a cycle of deprivation’, or ‘family circle’, although the smokers involved would be unlikely to interpret it in that way. The circular nature of the problem makes it difficult to choose the best point at which to start an overview. However, a brief consideration of the historical aspects is helpful in setting the scene and leads naturally from the adult smoking to children’s smoking.

The development of smoking

Rogers and Shoemaker developed a theory of the communication of innovations, which can be applied to both the rise and fall of cigarette smoking in a country (Fig. 1). The behaviour, in this case cigarette smoking, is started by a few innovators and is then taken up by a
relatively small group of 'early adopters'. This group has a particular set of characteristics, including being better-educated, more affluent, perhaps in a decision-making role and socially advantaged. In most countries, and Britain was no exception when cigarette smoking was introduced, this group is usually the men in the higher socio-economic groups. It can be seen worldwide and is especially clearly illustrated in the US Surgeon General’s report. After the behaviour has become established in these early adopters, it is taken up by the 'early majority' and the 'late majority', which, for reasons of social status and norms, is usually the 'blue collar' men. In many countries, it is still socially unacceptable for women to smoke, but, as western habits spread by means of the media to these areas and emancipation of women is seen as desirable, women next become the adopters of cigarette smoking followed by the girls, both groups following the diffusion of innovations curve (Fig. 2). This situation is developing in China at present. In Britain, the USA, Canada, Australia, New Zealand and other industrialised countries, this process has gone the whole way. However, the reverse process also begins when the first messages about health risks are received. Again it is the 'white collar' men who act on it first and become non-smokers as they did in response to the report by the Royal College of Physicians in 1962. Boys, women and finally girls develop their own 'diffusion of innovations' curve in adopting non-smoking. Men and women with lower socio-economic status are again mainly in the 'late majority' group in taking up a new behaviour. Therefore in most westernised countries the point has been reached where smoking prevalence has fallen.
considerably among the more affluent men and women and also among boys. Girls' smoking prevalence is still high, as it is among the less affluent or less well-educated men and women\textsuperscript{6} (Table 1).

Children's smoking prevalence, especially that of girls, is, therefore, a major problem in Britain. What has happened, since the first national survey of children's smoking in 1966\textsuperscript{7}, is that girls have continued on their first cycle, i.e. adopting smoking, whilst boys have entered the second cycle, namely adopting non-smoking. The stage has now been reached in Britain where very few people take up smoking after the age of 18-years\textsuperscript{8}. It has become a children's habit. It must also not be forgotten that the children in the less affluent families are more likely than those from more affluent homes to have smoking parents. Children have long been known to be more likely to become smokers if their parents smoke\textsuperscript{9} and are also subjected to exposure to environmental tobacco smoke in the home. Thus, the 'family circle' mentioned earlier is focused on the less affluent groups. The *Health of the Nation* document\textsuperscript{10} sets out the targets for reducing lung cancer and also specifically for reducing the prevalence of smoking among 11 to 15-year-olds. The overall target of reducing smoking prevalence among 11 to 15-year-olds from 8\%, as it was in 1988, to 6\% in 1994 has not been reached\textsuperscript{11}. If Rogers and Shoemaker's theory is to be applied, the target of reducing regular smoking is probably not appropriate to this age group. Reduction of incidence rather than reduction of prevalence would be the best measure of progress. Much
Table 1  Smoking behaviour in 11 to 15-year-old school children by sex: England, 1982 to 1992

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys Regular smoker</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Girls Regular smoker</td>
<td>11</td>
<td>13</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Boys Occasional smoker</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Girls Occasional smoker</td>
<td>9</td>
<td>9</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Boys Used to smoke</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Girls Used to smoke</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Boys Tried smoking</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Girls Tried smoking</td>
<td>22</td>
<td>22</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Boys Never smoked</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Girls Never smoked</td>
<td>49</td>
<td>46</td>
<td>53</td>
<td>59</td>
<td>58</td>
<td>57</td>
</tr>
<tr>
<td>Base (=100%)</td>
<td>1514</td>
<td>1689</td>
<td>1508</td>
<td>1529</td>
<td>1478</td>
<td>1626</td>
</tr>
</tbody>
</table>


better would be to have set out to delay onset of the behaviour and this has, in fact, been achieved even in 15-year-olds, although, as might be expected if the theory holds, the delay and reduction has been greater in boys than in girls. Table 1 shows changes in smoking prevalence in the 11 to 15-year-old age group since 1982, when regular national surveys of smoking in this age group began.

The situation is quite different in countries where social norms and status for women and girls are less emancipated than in Britain. Relatively few women and girls have yet taken up the habit and the communication of innovations has still reached only the innovators and some early adopters (Table 2), whilst the curve for men and boys is at a later stage of development. However, the tobacco industry would have it otherwise and is aggressively marketing tobacco in order to move its adoption to the next phases. In these countries, there is a real opportunity to halt the diffusion process before it spreads to the other adopters. In this way, health activists could benefit from knowing about the experience in industrialised countries and could take action to prevent the process before it progresses further, thus reducing to a minimum the
Table 2  Data on smoking prevalence of 15-year-olds, drawn from six recent national studies and The WHO Cross National Study of Children’s Health Behaviour, 1986

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>Sample No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All countries</td>
<td>14.4</td>
<td>4.4</td>
<td>22.3</td>
<td>6.4</td>
<td>39.9</td>
<td>34.2</td>
<td>&gt;5754</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>—</td>
<td>—</td>
<td>25.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>11.8</td>
<td>6.5</td>
<td>—</td>
<td>10.3</td>
<td>43.3</td>
<td>28.2</td>
<td>476</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>16.6</td>
<td>5.0</td>
<td>—</td>
<td>5.1</td>
<td>32.7</td>
<td>40.6</td>
<td>603</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>13.1</td>
<td>7.1</td>
<td>—</td>
<td>11.8</td>
<td>39.1</td>
<td>28.9</td>
<td>381</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td>13.5</td>
<td>6.2</td>
<td>—</td>
<td>5.6</td>
<td>29.4</td>
<td>45.3</td>
<td>502</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada*</td>
<td>17.4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>29.1</td>
<td>6.3</td>
<td>—</td>
<td>6.3</td>
<td>39.9</td>
<td>18.4</td>
<td>539</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>20.1</td>
<td>7.4</td>
<td>—</td>
<td>10.1</td>
<td>36.8</td>
<td>25.6</td>
<td>543</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scotland</td>
<td>15.4</td>
<td>6.9</td>
<td>—</td>
<td>8.2</td>
<td>39.9</td>
<td>25.4</td>
<td>562</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>14.7</td>
<td>4.5</td>
<td>—</td>
<td>6.7</td>
<td>40.0</td>
<td>33.3</td>
<td>711</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>9.7</td>
<td>5.7</td>
<td>—</td>
<td>7.6</td>
<td>47.0</td>
<td>31.1</td>
<td>541</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>9.5</td>
<td>3.6</td>
<td>—</td>
<td>10.2</td>
<td>35.8</td>
<td>40.9</td>
<td>279</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>10.5</td>
<td>3.4</td>
<td>—</td>
<td>6.3</td>
<td>21.3</td>
<td>64.9</td>
<td>559</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wales</td>
<td>15.1</td>
<td>5.2</td>
<td>—</td>
<td>4.4</td>
<td>41.9</td>
<td>38.2</td>
<td>954</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wales &amp; Scotland</td>
<td>13.1</td>
<td>2.4</td>
<td>—</td>
<td>4.4</td>
<td>41.2</td>
<td>34.1</td>
<td>1104</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in percentages; *15- and 16-year-olds; *15- to 19-year-olds. The data have been collected from a variety of studies with differing methodologies. The WHO cross-national survey statistics are courtesy of Nutbeam, D. Planning for a Smoke-Free Generation. Smoke-Free Europe: p. 6. The table is reproduced from: Charlton A, Moyer C, Melia P. A Manual on Tobacco and Young People for the Industrialised World. Geneva: UICC, 1990; p. 31.

epidemic of smoking-related diseases which is bound to follow as it has done in the industrialised world.

**Smoking and the unborn child**

Adult smoking affects children even before they are born and perhaps even before they are conceived. It is now nearly 30 years since the first
evidence of low birth weight associated with smoking in pregnancy was published\textsuperscript{15} and, during that period, a tremendous body of research evidence has been amassed showing effects of maternal and paternal smoking on the unborn child. It is impossible in a short paper to cover the topic in detail. Many reviews of the effect of smoking on the fetus are available and the reader is referred to some of these\textsuperscript{8,16,17}. It is, however, essential to provide a brief overview here of such an important set of effects of smoking on children’s health.

Low birth weight is the term generally used in the context of smoking to mean small for gestational age. Babies who are small for gestational age are at greater risk of health problems in the neonatal and perinatal period and there is even some evidence to suggest that the effects of this disadvantage might be carried forward into childhood. Early studies rarely included any factors other than smoking in their analyses, and there was a time when the findings were questioned on the grounds that socio-economic status or other confounding factors could be operating. However, studies including socio-economic status, maternal age, weight, height and weight gain in pregnancy, sex and ethnicity of the baby have carried out multivariate analyses and have found that smoking has the strongest effect on birth weight\textsuperscript{18,19}.

Babies born to smoking mothers are, on average, 200 g lighter than those born to non-smoking mothers\textsuperscript{20}. The effect is dose-related. Mothers who smoked 10–20 cigarettes per day during pregnancy have had lower birth weight babies than those who smoke less\textsuperscript{21}. Recent techniques to assess the level of cotinine, a metabolite of nicotine in the maternal blood, have enabled this dose-response effect to be measured accurately and physiologically. One such study has shown that women with the highest levels of serum cotinine had babies whose birth weight was 441 g less than those with the lowest levels\textsuperscript{22}, this study also suggested a reduction of 12 g birth weight for every cigarette smoked per day.

The most marked effect on birth weight appears to be caused by maternal smoking during the second and third trimesters of pregnancy\textsuperscript{23}, which enables the mother to have a little leeway in stopping smoking when she knows she is pregnant. Unfortunately, pregnant women are a surprisingly difficult group with which to intervene. In spite of having so much reason to stop smoking, only a quarter succeed in stopping smoking at some time during pregnancy and about two-thirds of those who are successful take up smoking again after the birth\textsuperscript{24}. Paternal smoking is also associated with babies being small for gestational age\textsuperscript{25}.

Spontaneous abortion of the fetus is more frequent in smoking than in non-smoking mothers\textsuperscript{26}, as is perinatal mortality\textsuperscript{27}.

It is, of course, difficult to separate the effects of pre- and post-natal exposure to smoke in many cases, because the mothers who smoke in pregnancy are likely also to smoke in the home as their infant is growing.
Tobacco and health

up. Perhaps the most important of these dual effects is that of the sudden infant death syndrome (SIDS). A valuable analysis\textsuperscript{28} of the findings of ten recent major studies on this topic found that all except one showed an association between maternal smoking during pregnancy and increased incidence of SIDS. Most of the studies took other social factors into account, such as maternal age, parity, housing conditions, marital status, education and unemployment and found that smoking was still a significant factor. Sleeping position was not taken into account in these studies.

Other possible serious health risks in the life of a child, who was exposed to smoke during his or her fetal development, include cancers. A number of studies on maternal smoking during pregnancy and risk of childhood cancer have been carried out over the past 25 years, but their outcomes are still inconclusive. Because childhood cancers are relatively infrequent, the small numbers have caused problems, in general, with analysis and interpretation of results.

Out of three cohort studies, only one has found a significant link between maternal smoking during pregnancy and increased risk of childhood cancer. The earliest of these studies, in 1971, found little evidence of increased risk\textsuperscript{29}, and the most recently reported in 1992\textsuperscript{30}, found no increase in the overall cancer risk in children whose mothers smoked during pregnancy (relative risk 0.99; 95\% CI 0.78–1.27). This study was a survey of 497,051 children born in Sweden between 1982 and 1987. There were 198 solid tumours and 129 lymphatic/haematopoietic cancers. Risks for solid tumours were also not increased (relative risk 0.96; 95\% CI 0.70–1.32) but cancers of the lymphatic/haematopoietic system showed a relative risk of 1.04; 95\% CI 0.71–1.52. The risk did not increase with the number of cigarettes smoked each day by the mother. No significant site specific increase in risk was found for solid tumours or lymphatic/haematopoietic cancers. The third cohort study\textsuperscript{31} published in 1990 examined data from the British Birth Cohort (BCS70) where 33 children out of 16,193 born in one week in April 1970 developed cancers (2.04 per 1000 births). Here, logistic regression involving the whole cohort found an independent statistical association between childhood cancer and maternal smoking during pregnancy (OR 2.5).

Case control studies have also yielded equivocal results. In 1986, another Swedish study\textsuperscript{32} of 305 children with cancer and a control group of 340 children with diabetes mellitus found a 50\% increase in overall cancer risk for the children exposed to 10 or more cigarettes per day during pregnancy. They also found an increase for single sites, including a doubling of risk for Wilms’ tumour, Hodgkin’s lymphoma and acute lymphoblastic leukaemia. However, the reaction to this publication was swift, with a British Inter-Regional Epidemiological Study of Childhood
Cancers (IRESCC) study of 555 cases, each with two matched controls, showing no increased risk of cancers in children of mothers who smoked during pregnancy. The US Children’s Cancer Study Group (CCSG) also responded with a study showing that they found no significant increase.

In 1991, another case control study, in Denver, Colorado involved children aged 0–14 years, born from 1976–1983. There were 223 cases and 196 controls. However, the diagnostic subgroups were very small and the authors advised caution in interpreting the findings. Mother’s smoking in the first trimester, when adjusted for father’s education, was found to be associated with increased risk of cancers in general (OR 1.3, 95% CI 0.7–2.1), acute lymphocytic leukaemia (OR 1.9, 95% CI 0.9–4.1) and lymphomas (OR 2.3, 95% CI 0.8–7.1). When father’s smoking during his partner’s pregnancy was considered, and adjusted for his educational status, some increased risk was found for the same three cancer groups. An increased risk of brain cancer was also identified (OR 1.4; 95% CI 0.7–3.5), which is interesting in view of a later study which also found an increased risk related to paternal smoking.

All these studies advise caution in interpretation due to small numbers and numerous confounding factors and methodological limitations and variations. The situation with regard to maternal and passive smoking and childhood cancer is an important one which merits further investigation.

Returning to the premise of a ‘family circle’ in the children of smokers, the effects of exposure to smoke during fetal development can be summed up in two ways: the dramatic acute effects causing death of the child and the continuing chronic effects which can affect the child’s life in many ways in the future. To end this section, it is appropriate to review these less spectacular effects which can undermine a child’s social and academic development. They fall into three groups as follows: minor ailments; effects on growth; effects on academic achievement. With regard to the first of these, in utero exposure to smoke has been found to be strongly related to an increased incidence of respiratory illnesses in children, over and above the effects of exposure to passive smoking in the home. Growth is also less in children of smoking mothers, several studies having found that children of smokers are shorter and lighter in weight at the ages of 5 and 7-years, which is consistent with the development of low birth weight children in general. Small stature is likely to affect children’s self-esteem and impede their social development. Finally, there is evidence that babies born to smokers have a smaller head circumference, suggesting that exposure to smoke during fetal development might restrict brain growth. Further evidence for this is found in young adults in a national cohort study where lower academic achievement was linked to mother’s smoking during pregnancy even when other factors such as social class were taken into account. So the
child of a smoker starts life with several disadvantages, which can then be compounded if family smoking continues during his or her infancy and childhood.

**Family smoking and the health risks to children**

Children who are brought up in homes where the parents smoke have little or no choice with regard to their own exposure to smoke. Infants at home with their mother are in an especially vulnerable position. Early studies focused on infants and the frequency of respiratory disease, sometimes associated with admissions to hospital. A review of studies with large data sets carried out since the late 1970s was published in 1992. Whilst the sampling and methodology of the studies varied considerably, the outcomes were generally consistent in finding an increased risk of respiratory problems in children of smoking parents. However, an analysis of data from the British Birth Cohort Study (BCS70) in this same publication shed more light on the pre- and post-natal nature of the various symptoms. In mothers who had smoked in pregnancy, the history of wheezing and bronchitis in the children measured at either 5- or 10-years was significantly increased, as was snoring and habitual mouth-breathing at the age of 5-years. Children of multiparae had a more frequent history of pneumonia at the age of 5-years, and of cough and shortness of breath at the age of 10-years. The authors of this study also considered mothers who did not smoke in pregnancy, but smoked post-natally. In this case, the only respiratory symptoms which were significantly more frequent in their children compared with those of non-smokers were habitual snoring and mouth-breathing at 5-years, sore throats at 5-years and coughs at 10-years which were of borderline significance. When the same respiratory symptoms were studied in the children of smoking mothers who smoked throughout pregnancy, those who did not and non-smokers, only snoring and mouth-breathing was significantly higher in those who did not smoke in pregnancy. The authors concluded that maternal smoking in pregnancy was linked to an increase in the child's risk of wheezing, bronchitis and pneumonia and post-natal exposure to smoke to increased risk of habitual snoring and mouth-breathing and perhaps of chronic coughs. They also concluded that exposure to passive smoking post-natally has a more marked effect on problems of the upper respiratory tract than on lower respiratory problems.

This study has been considered more fully than others here, because it attempts to untangle the pre- and post-natal effects. There is, however, a considerable body of evidence which reinforces these findings and covers
a considerable number of other health risks in children who are exposed to passive smoking at home. The effect of exposure to environmental tobacco smoke in the home is particularly problematic for children with asthma, by increasing the frequency and severity of symptoms, thus compounding effects of in utero exposure. The incidence of middle ear effusion and sore throats, also greatly increased in children who are exposed to smoke in the home.

Passive smoking is, therefore, a cog in the 'family circle'. The children who are exposed to it are likely to suffer from more minor ailments than those who have smoke-free homes. Minor ailments cause absence from school, or underperformance. A study of 2,800 schoolchildren aged 12–13-years found that the risk of being absent from school on a randomly selected day was not only related to the children's own smoking behaviour, but the risk was increased by equal amounts if the mother also smoked. Motivation falls if the continuity of learning is frequently broken. It becomes difficult to keep up with the rest of the class, self-esteem or self-perception falls in this domain. It is well-known that those children who underachieve, who are 'fed up' with school and who place little value on academic progress are the most likely to take up smoking. A recent study showed that low self-perception in the scholastic achievement domain in boys and girls, measured by Harter's Self-Perception Profile for Children, was most significantly related to being a smoker. Another link is then forged in the chain from adult to child to adult. Not only has the children's health been harmed, they are now on their way to damaging their own health even further.

In fact, the same three disadvantages of minor ailments, growth and probably academic development, are compounded by exposure to environmental tobacco smoke during childhood. These children are also at the greatest risk of becoming smokers themselves. The question of lung cancer in adults who were exposed to environmental tobacco smoke in their homes during childhood is a difficult one, due to the very long latent period between exposure and appearance of lesions and symptoms. Several studies have attempted to tease out the answer. The earliest reported case-control study on this topic involving 1338 lung cancer patients and 1393 comparison subjects found that, when variables indicative of active smoking were controlled for in a logistic regression analysis, exposure to maternal smoke was associated with an increased risk of lung cancer in smokers. The relative risk for both sexes was 1.36 (p<0.02) and for males was 1.5 (p<0.01). No increased risk was found for females or for subjects whose father smoked. The authors emphasised the preliminary nature of these findings and the possibility of confounding factors which were not controlled for. Two years later a study of 518 patients from a hospital-based tumour registry found that the overall risk of cancers rose by 60% for those exposed in childhood only, by 50%
for those exposed in adulthood only, but more than doubled (OR 2.7) for those exposed in both childhood and adulthood. Trends were similar for smokers (who had smoked at least one cigarette for a period of at least six months) and non-smokers.

A more recent study of lung cancer patients, showed that exposure to 25 or more ‘smoker years’, e.g. living with two smokers for 12.5 years during childhood and adolescence appeared to double the risk of lung cancer in those patients who have never smoked. More investigation on the possibly increased risk of lung cancer in people exposed to environmental tobacco smoke as children is needed.

The health risks of a child’s own smoking

There is always a tendency to consider only the serious long-term risks to health which are posed by personal smoking. However, for children, the immediate or short-term risks are not only very relevant in practical terms, they are also much more meaningful as a possible deterrent. Such risks as lung cancer and heart diseases which usually affect older people seem too far ahead to be of any relevance to a young smoker. Immediate discomfort can far outweigh the extension of life even by a few years. After all, when one is really old, what is the benefit of living to be even older, they think. It cannot be any fun.

Coughs and respiratory problems do start to occur immediately. A survey of 16,000 young people in the UK in the 1980s found that, even from the age of 10-years, young smokers of one cigarette per week or more were more likely than non-smokers to report frequent coughs. Whilst the incidence of frequent coughs fell steadily overall as the children became older, the increased risk among smokers remained high (Fig. 3). As long ago as the 1970s, Bewley et al. showed that the risk of respiratory symptoms in young smokers in the 10- to 12-year-old age group was double that of non-smokers. In both these studies, young smokers were defined as smoking at least one cigarette per week. Numerous other studies have shown increased risk of cough, wheeze, shortness of breath and increase of sputum. The increase in risk appears to be the same whether low or middle tar cigarettes are smoked.

Lung function can also be affected in young smokers. A study of 669 young people, aged 5- to 19-years at the start, who were followed up annually for changes in FEV in one second (FEV₁) and FEF₂₅−₇₅ (forced expiratory flow during the middle half of vital capacity), found significant decreases in both measures associated with smoking. When previous FEV₁ and FEF₂₅−₇₅, age, sex, height and mother’s smoking were controlled for, personal smoking was associated with significant
Fig. 3 Self-reported frequent coughs in 10- to 18-year-olds in never-smokers and in regular smokers of one or more cigarettes per week.


- Decreases in FEV₁ (p<0.001) and FEF2⁵⁻⁷⁵ (p=0.033). On this basis, the authors estimated that starting to smoke at the age of 15 would reduce FEV₁ to 92% and FEF2⁵⁻⁷⁵ to 90% of the expected by the age of 20. Very interestingly, one study has found that children who take up smoking appear to have higher levels of lung function at that stage, but 5 years of smoking reduces it to the same level as that of non-smokers⁵⁹. However, there is evidence, in a study of 10 young doctors who smoked, that after 3 weeks of abstinence from smoking, peak expiratory flow (PEF) was significantly increased⁶⁰. Similar findings occurred among 195 boys during 8 weeks at a detention centre where they were not allowed to smoke⁶¹, all except the heaviest smokers having near normal PEF at the end of the 8 weeks. It does, therefore, appear that the reduction in PEF can be reversed by quitting smoking.

- Fitness levels are also immediately affected due to the replacement of oxygen by carbon monoxide in the haemoglobin. Addiction is also an important element in the immediate effects of smoking. Young people tend either to dismiss it on the grounds that it takes a long time to develop, will not happen to them and that they can easily give up smoking whenever they want to, or they actually like the idea of being addicted. Research has shown that the addiction process quickly takes hold. Much evidence of addiction in young people is provided by the research carried out by McNeill, in two valuable studies: one showed that young smokers, deprived of cigarettes, experience withdrawal symptoms
associated with addiction to nicotine\textsuperscript{62} and the second showing that inhalation of smoke occurs early in a smoker's experience, thus emphasising the importance of the first few cigarettes\textsuperscript{63}. These findings confirm that addiction can be established quickly and at an early age. A national survey in the UK found that 65\% of 16- to 19-year-old smokers had made at least one attempt to stop smoking\textsuperscript{64} and half of these young people had made more than one attempt and failed. Another study found that three-quarters of smokers aged 16- to 19-years had tried to stop, 4\% of them had first tried, unsuccessfully, at the age of 12 years\textsuperscript{65}.

Blood pressure presents an interesting picture with regard to young smokers. There is a considerable body of research evidence which indicates that adult smokers, including young smokers, have lower mean blood pressure and pulse rate than non-smokers\textsuperscript{66–72}, but smoking a cigarette raises the heart rate within 1 min, with perhaps as much as a 30\% increase in 10 min\textsuperscript{73}. Blood pressure also increases sharply by 7–10\% due to peripheral vasoconstriction and changes in the regional blood flow. Recent research raises the question as to whether or not low blood pressure might precede the uptake of smoking in children, but this issue requires further investigation and interpretation\textsuperscript{74}.

There are many other immediate or short-term effects of active smoking on children including increased risk of leukoplakia\textsuperscript{75}, greater susceptibility to infection due to decreased immunity\textsuperscript{76}, damage to the cilia lining the trachea, shaky hands and increased pulse rate, all of which to a greater or lesser extent are experienced by the child. However, the basis for life-threatening diseases later in life is already being laid down in young smokers. There is evidence that smoking started before the age of 15-years greatly increases the risk of lung cancer in later life\textsuperscript{77,78}. The forerunners of cardio-vascular diseases can already be observed in increased likelihood of the blood to clot, changes in blood lipids, and evidence of atherosclerosis\textsuperscript{8}.

The health effects as well as the family norms have conspired to make the ‘at risk’ children more likely to be smokers. They leave school as early as possible, having failed to achieve their maximum potential, and they are likely to have early pregnancies. There is evidence that younger women with a lower educational attainment, working in unskilled jobs are most likely to smoke during pregnancy, as are their male partners. Thus the cycle is continued to the next generation of children. The ‘family circle’ is complete.

Children of smoking mothers, especially those who smoke during pregnancy, are more likely than children of non-smokers to have health problems, which can cause them to miss time from school and fall behind with their work. Children who feel they are not achieving academically are at increased risk of taking up smoking. They are also more likely to take up smoking due to the norms of their family.
Prevention issues

How can this family circle be broken? Since the health risks of smoking were first published 40 years ago, this problem has been considered. The early attempts were largely academic in approach and often school-based. They were, not unexpectedly, largely unsuccessful on the basis that it is the least academically inclined young people who are most likely to take up smoking and to be the late majority or even the laggards in the communication of innovations process to adopt non-smoking. School-based education has not been entirely unsuccessful and sets of guidelines based on research outcomes have been developed. Social skills and short-term, rather than long-term, health risks form the best content; peer-teaching, parental involvement for younger children and sufficient time allocation (10 sessions in the critical 2-year period following the peak initiation age is suggested) have all been shown to increase effectiveness. However, the best which can be achieved in this way appears to be a delay in onset rather than a decrease in prevalence in regular smokers. This reservation has serious implications for the target set in The Health of the Nation, as was mentioned earlier in this paper. Perhaps the most serious shortfall in school-based education is that it fails to reach the ‘drop outs’ as the early school-leavers are called in the US. As has been discussed, these young people are most at risk and are most likely to form ‘family circles’ of the type discussed in this paper. They must be reached in other less academic ways. Many are anti-establishment. Having failed to attain the targets which are usually set by the establishment, they reject these norms and rebel against them. Rebelliousness is a major factor in the uptake of smoking by young people. These young people are, therefore, unlikely to attend youth clubs because these are also establishment-based. They are unlikely to join Smokebuster clubs or similar out-of-school organised activities. The points at which the circle can be broken need more practical action.

If the ‘family circle’ of smoking is to be broken, the time for information, education and advice is past. What is now needed is positive action to help. In summary, some suggested actions for consideration which arise out of this review of children’s health and smoking are tentatively presented as follows:

1. Prophylactic medical help for the ‘at risk’ infants, children and young people in the form of dietary supplements such as vitamins C and D, and provision of medication and immunization for children identified as being ‘at risk’ as a result of screening at post-natal clinics, and by midwives, community nurses and school nurses. Children’s health should not be penalized because their parents smoke. Help now is
likely to prevent them from taking up smoking later and could prevent the health problems from arising.

2. Pre-pregnancy provision of nicotine replacement therapy at preparation for parenthood classes, provided that such a therapy can be developed and recommended for safe use with the appropriate age group.

3. Family approaches through ante- and post-natal clinics, day care centres, schools and other appropriate channels to raise self-esteem, to strengthen coping, to identify why smoking outweighs family and personal health, and to develop shared methods of overcoming these problems or needs. Ownership of the programmes by the families themselves is essential. Programmes should not be imposed from outside by non-smoking health educators who think they know how the families feel. If social help is needed, it must be provided.

4. Government action is also needed to ban cigarette advertising and to create a smoke-free norm.

Action, not leaflets, is needed to break the 'family circle' of smoking. As a recent paper emphasises, the lifestyle of smokers may differ widely from that of non-smokers, smoking is only one part of this lifestyle and health and development problems in the children may be influenced by this complex interaction\textsuperscript{83}. Women who smoke need help in coping with the stresses of their lives.

**Acknowledgement**

The author wishes to thank the Cancer Research Campaign for funding her research.

**References**


17 Charlton A. Children and passive smoking: a review. *J Fam Pract* 1994; 38: 267-77


46 Charlton A, Blair V. Absence from school related to children’s and parental smoking habits. *BMJ* 1989; 298: 90–2
54 Charlton A. Children's coughs related to parental smoking. *BMJ* 1984; 288: 1647–9
61 Backhouse CI. Peak flow in youths with varying cigarette habits. *BMJ* 1975; 1: 360–2
65 Charlton A. Smoking cessation in schools and colleges. *J Smoking Rel Disorders* 1995; 5: 289–94
74 Charlton A, While D. Blood pressure and smoking: observations on a national cohort. *Arch Dis Childhood* 1995; in press
75 Von Wyk CW. An oral pathology profile of a group of juvenile delinquents. *J Forensic Odontostomatol* 1983; 1: 3–10