

# Smoking and reproductive life

The impact of smoking on sexual, reproductive and child health



**British Medical Association  
Board of Science and Education  
& Tobacco Control Resource Centre**

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**BMA** 

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reproductive and child health

February 2004

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A joint publication from the BMA Board of Science and Education and the Tobacco Control Resource Centre.

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British Library Cataloguing-in-Publication Data.

A catalogue record for this book is available from the British Library.

ISBN: 0 7279 1856 7

Cover photograph: Getty Images

Figure 1: Robert Britton Illustration © BMA Tobacco Control Resource Centre

Printed by the BMA publications unit

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Approval for publication as a BMA policy report was recommended by BMA Board of Professional Activities on 19 November 2003.

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## Acknowledgements

The Association is very grateful for the help provided by the BMA committees and many outside experts and organisations. We would particularly like to thank:

- Professor Hilary Critchley, Obstetrics and Gynaecology, Reproductive and Developmental Sciences, Centre for Reproductive Biology, Edinburgh.
- Dr Amanda Amos, Reader in Health Promotion, Public Health Sciences, Division of Community Health Sciences, University of Edinburgh Medical School, Teviot Place, Edinburgh.
- Professor Jonathan M Samet MD MS, Chairman, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA.

The BMA Tobacco Control Resource Centre receives financial support from the European Commission.

## Foreword

This report presents an overview of the impact of smoking on reproductive life and health in the UK today. The picture that emerges is disturbing. Smoking harms sexual and reproductive health in both men and women. Its damaging effects are seen throughout reproductive life – from puberty, through young adulthood and into middle age. Smoking can compromise the capacity to have a family, and parental smoking can have long-term and serious consequences for child health. Exposure to second-hand smoke is a risk during pregnancy, and harms infants and children.

The good news is that giving up smoking reduces or eliminates many of the risks to reproductive life and health. Tackling the burden of smoking on reproductive life requires strategies to reduce smoking among younger adults and to protect all against second-hand smoke. Since the early 1970s, smoking rates have fallen. But over the past decade, the overall prevalence of smoking has remained worryingly stagnant, while rates among young adults, especially young women, have risen.

Just as smoking accounts for one half of the difference in life expectancy between social classes I and V, the burden of smoking on reproductive life falls most heavily on the least privileged. Smoking rates increase with every marker of social disadvantage, as does smoking-related ill-health. Exposure to second-hand smoke is also highest among the most vulnerable: those in manual and service groups are most likely to be exposed to second-hand smoke at home and at work. Babies and children born into these groups are most likely to suffer the longer-term health effects of parental smoking.

Recent years have seen some significant advances. The elimination of tobacco advertising and promotion will certainly be beneficial. The establishment of smokers' clinics offers life-saving treatment to the many smokers who wish to stop. The government's recognition of smoking as a key factor in health inequalities and poverty is welcome. But if we are to break the lethal legacy of smoking-related health inequalities, there can be no room for complacency. No proven strategy should be left unused.

Smoke-free public places both protect non-smokers and support smokers who wish to stop. But the benefits can be felt, not just in the public arena, but also in homes across the country. Smoke-free public places cut smoking rates across most population groups, including young adults. When fewer young adults smoke, children's exposure to second-hand smoke in the home decreases. Smoke-free public places also reinforce the message that second-hand smoke is harmful and provide encouragement for parents to restrict smoking in their homes. Finally, smoke-free public places and smoke-free homes reduce the risk of young people taking up smoking. This could be particularly important in breaking the cycle of tobacco dependence in communities where smoking is still the norm, rather than the exception.

There is an urgent need for better recognition of the impact of smoking on sexual, reproductive and child health and of the benefits of giving up smoking. Continued government action is essential. We hope that this report will provide both a useful summary and serve as renewed impetus for progress.



Professor Sir David Carter  
Chairman, Board of Science and Education  
February 2004

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## Introduction

Reproductive health is defined by the World Health Organisation (WHO) as:

*'a state of physical, mental, and social well-being in all matters relating to the reproductive system at all stages of life. Reproductive health implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce ...'*

WHO's reproductive health programme includes strategies to promote the health and wellbeing of the mother and infant.

This report presents the first focused overview of the impact of smoking on sexual, reproductive and child health in the United Kingdom (UK). It considers active and passive smoking by both men and women, and summarises the impact on sexual health, conception and pregnancy, as well as effects on the reproductive system. The impact of smoking on infant and child health is also considered.

The benefits of smoking cessation are presented. The current situation in the UK with regard to both active and passive smoking throughout the life-course is outlined, and the potential impact of smoking prevention and cessation on alleviating the burden of illness highlighted.

The report frames smoking as an important consideration in sexual, reproductive and child health. It makes recommendations to reduce the burden of sexual, reproductive and childhood ill health caused by tobacco, including recommendations for research, healthcare professionals and public policy.

## Smoking harms reproductive health

A series of expert scientific reports has reviewed the available evidence and noted the harmful impact of smoking on reproductive and infant health. These reports highlight the link between smoking and reproductive health problems in both men and women. The conditions and diseases associated with smoking can cause problems at different life stages, from puberty, through middle-age, and beyond. Moreover, smoking compromises fertility, pregnancy outcomes and infant health. Significant conclusions include:

1980 – US Surgeon General concludes that smoking during pregnancy is a cause of **low birth-weight**<sup>1</sup>

1983 – UK Independent Scientific Committee on Smoking and Health concludes that smoking during pregnancy **retards foetal growth**<sup>2</sup>

1988 – UK Independent Scientific Committee on Smoking and Health identifies exposure to other people's tobacco smoke as **a risk for pregnant women**<sup>3</sup>

1990 – The US Surgeon General notes that men who smoke have **altered levels of male sex hormones**<sup>4</sup>

1992 – The Royal College of Physicians concludes that smoking during pregnancy increases the risk of **miscarriage, low birth-weight and perinatal death**<sup>5</sup>

1998 – The UK Scientific Committee on Tobacco and Health concludes that passive smoking causes **childhood respiratory disease** and is causally associated with **cot death**<sup>6</sup>

1999 – WHO expert consultation on environmental tobacco smoke and child health concludes that passive smoking causes **respiratory disease** and **middle-ear infection**, and **reduces lung growth and function in children**<sup>7</sup>

1999 – The British Medical Association states that smoking is a cause of **male sexual impotence**<sup>8</sup>

2000 – The UK Confidential Enquiry into Stillbirths and Deaths in Infancy identifies exposure to second-hand smoke during infancy as a cause of **cot death**<sup>9</sup>

2001 – US Surgeon General's report on smoking and women's health identifies smoking as a cause of **infertility** and **early menopause** in women<sup>10</sup>

2002 – The WHO International Agency for Research on Cancer (IARC) concludes that smoking is a cause of **invasive cervical cancer**.<sup>11</sup>

In assessing exposure to tobacco smoke as a cause of a disease or condition in humans, certain key questions are considered.

- Do well-designed epidemiological studies consistently show an association between the exposure and the effect?
- Does a greater level of exposure increase the risk?
- Does the risk decrease when the exposure stops?
- Is there a plausible biological mechanism by which the exposure could cause the effect?
- How strong is the association between the exposure and the outcome?
- How precisely has the exposure been measured?
- Are there supporting data from experimental evidence in human and animal studies?

These tests draw on the Bradford-Hill criteria<sup>12</sup> for causality, outlined in **appendix A**. Evaluation of an exposure as a cause is based not on any single test, but on the balance of all available evidence. No single criterion is essential, except that the exposure precedes the effect. Identifying an exposure as a cause does not mean that it is the sole cause of the disease or condition. Nor does it imply that the exposure is sufficient to cause the disease – it may act in combination with other factors.<sup>13</sup>

The strength of evidence on the harmful effects of smoking on reproductive health varies. In this report, the evidence for each effect is described as conclusive, substantial or suggestive. These conclusions draw largely on existing expert evaluations – in particular those of the US Surgeon General, the UK Scientific Committee on Tobacco or Health, WHO and IARC.

For certain effects – for example, smoking during pregnancy as a cause of low birth-weight – the evidence is *conclusive*, or beyond reasonable doubt: extensive, well-conducted epidemiological studies have shown a consistent association and there is a plausible mechanism by which the effect could be mediated. The effect increases with the number of cigarettes smoked, and stopping smoking reduces it. In this instance, smoking is said to be a *cause* of the outcome.

For other effects, the evidence is judged *substantial*. An example is the association between smoking and ectopic pregnancy. Several well-designed studies have shown that smokers have an increased risk of ectopic pregnancy, a risk which increases with the number of cigarettes smoked, and declines when women stop smoking. Plausible biological mechanisms exist, but pathways have not yet been elucidated. In this instance, there is said to be an *association* between smoking and the outcome.

Finally, for certain outcomes, the evidence for an effect of smoking is *suggestive*. In these cases, the evidence for an association may be limited, or the results of studies may not always be consistent. However, at least one good-quality study has found an effect, a plausible mechanism can be identified, and the association is judged to warrant further investigation. An example is the link between smoking during pregnancy and certain foetal abnormalities, such as cleft lip and plate, and limb reduction.

The major effects of smoking that compromise sexual and reproductive health in men and women are summarised in **table 1**. The effect of smoking on child health is also presented.

**Table 1: Major effects of smoking on sexual, reproductive and child health**

Affected	There is conclusive evidence that smoking causes	There is substantial evidence that smoking causes	There is suggestive evidence that smoking causes
Male sexual health		<ul style="list-style-type: none"> <li>• Male sexual impotence</li> </ul>	
Female sexual health	<ul style="list-style-type: none"> <li>• Increased risk of coronary heart disease with combined oral contraceptive pill</li> </ul>		<ul style="list-style-type: none"> <li>• Increased risk of stroke with combined oral contraceptive pill</li> <li>• Increased risk of contraceptive failure with combined oral contraceptive pill</li> <li>• Painful periods</li> <li>• Missed periods</li> <li>• Irregular periods</li> </ul>
Male fertility	<ul style="list-style-type: none"> <li>• Sperm damage</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced semen quality</li> <li>• Reduced response to fertility treatment</li> </ul>	
Female fertility	<ul style="list-style-type: none"> <li>• Delayed conception</li> <li>• Primary infertility</li> <li>• Secondary infertility</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced response to fertility treatment</li> </ul>	
Other reproductive health effects	<ul style="list-style-type: none"> <li>• Early menopause</li> <li>• Pre-cancerous changes of the cervix (abnormal cervical smears)</li> <li>• Invasive cervical cancer</li> </ul>	<ul style="list-style-type: none"> <li>• 'Male' body shape (women)</li> </ul>	<ul style="list-style-type: none"> <li>• More menopausal symptoms</li> <li>• More severe menopausal symptoms</li> </ul>
Pregnancy	<ul style="list-style-type: none"> <li>• Placental complications</li> <li>• Premature rupture of the membranes</li> <li>• Premature baby</li> <li>• Low birth-weight baby</li> <li>• Perinatal death</li> </ul>	<ul style="list-style-type: none"> <li>• Ectopic pregnancy</li> <li>• Miscarriage</li> </ul>	<ul style="list-style-type: none"> <li>• Foetal malformation</li> </ul>
Breastfeeding		<ul style="list-style-type: none"> <li>• Less likely to breastfeed</li> <li>• Breastfeeds for a shorter time</li> </ul>	
<b>Second-hand smoke</b>			
Men			<ul style="list-style-type: none"> <li>• Male sexual impotence</li> </ul>
Women (in pregnancy)		<ul style="list-style-type: none"> <li>• Reduced foetal growth (low birth-weight baby)</li> <li>• Premature birth</li> </ul>	
Children	<ul style="list-style-type: none"> <li>• Cot death</li> <li>• Middle-ear disease (glue ear)</li> <li>• Respiratory illnesses</li> <li>• Development of asthma in those previously unaffected</li> <li>• Asthma attacks in those already affected</li> </ul>		<ul style="list-style-type: none"> <li>• Behavioural problems</li> <li>• Impaired growth and development</li> </ul>

## Smoking and reproductive life: the health effects

This section presents current knowledge on the effects of smoking on sexual, reproductive and child health, together with the mechanisms by which the effects may be mediated. For an overview, see **figure 1** (opposite).

### *Male sexual impotence*

Male sexual impotence, or erectile dysfunction, is the consistent inability to achieve or sustain erection of the penis. The condition is common, affecting one in ten men aged 21–70 years at any given time, and is more common among older men. In the UK, around 2.3 million men suffer from impotence.<sup>14</sup>

Impotence can have a serious impact on men's ability to enjoy a full sexual life, and compromises their ability to have a child. It also affects sexual partners: partners of men who have erectile dysfunction can suffer loss of self-esteem, depression and anxiety. Men with impotence may suffer psychologically as a result: two-thirds (65%) of men with erectile dysfunction feel worried or anxious about their condition, and more than half (56%) say it makes them feel depressed.<sup>14</sup>

A growing body of evidence suggests that smoking may cause male sexual impotence.<sup>15</sup> Certain studies suggest that smokers are at least 50 per cent more likely to suffer from erectile dysfunction.<sup>16</sup> It is estimated that in the UK, 120,000 men aged 30–50 years are impotent because of smoking.<sup>8</sup> The effect is seen in men of all ages.<sup>17</sup> One study of almost 4,500 men aged 31–49 years found that in smokers, the risk of impotence was 1.5 times that in non-smokers.<sup>18</sup> Another study of men aged 40–70 years found that men who smoked were twice as likely as non-smokers to develop moderate or severe impotence.<sup>19</sup>

The effects of smoking on erectile dysfunction are thought to be mediated largely through damage to the circulatory system (**box 1**). Impotence may be a marker for more serious underlying health problems: damage to the small blood vessels of the penis can be seen as an early indication of smoking-related damage to the circulatory system that may ultimately lead to a heart attack.

In addition to being a cause of impotence, smoking may amplify the effects of other causes of the condition. Physical causes of impotence that interact with smoking include diabetes, coronary artery disease and high blood pressure. Smoking also interacts with certain drugs, such as the beta-blockers used for treating high blood pressure, to increase the risk of impotence.<sup>20</sup>

Impotence affects more than four out of 10 men with diabetes. Among diabetic men, smoking is associated with an increased risk of impotence. A study of almost 10,000 diabetic men concluded that smokers were significantly more likely to be impotent. Smoking more cigarettes, and smoking for a longer time, increased the risk.<sup>21</sup>

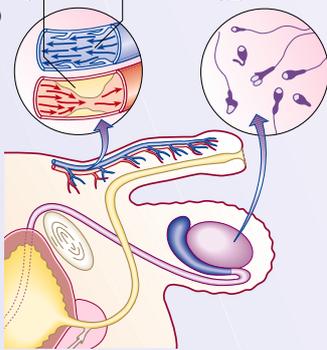
There is limited evidence to suggest that passive smoking may also be associated with an increased risk of impotence. For example, one study found that non-smoking men exposed to second-hand smoke were significantly more likely to become impotent.<sup>19</sup> The association seems plausible, given that passive smoking is a proven cause of cardiovascular disease, with significant effects seen even at low levels of exposure.<sup>22</sup>

# SMOKING AND REPRODUCTIVE LIFE

The impact of smoking on sexual, reproductive and child health

## 1 MALE SEXUAL HEALTH

Male sexual impotence  
 Fatty deposits (atherosclerosis) and constriction (vasospasm) → Reduced blood flow  
 Damage to valves (venous dilatation) → Blood escapes too quickly

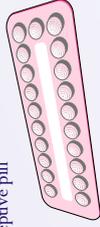


Alterations in sex hormone metabolism  
 Reduced semen quality  
 DNA damage  
 Lower sperm count  
 Lower semen quality

**PASSIVE SMOKING**  
 Male sexual impotence

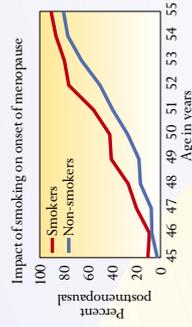
## 2 FEMALE SEXUAL HEALTH

Increased risk of heart disease and stroke with the combined contraceptive pill  
 Increased failure of the combined contraceptive pill  
 Alterations in sex hormone metabolism  
 Painful, irregular or missed periods



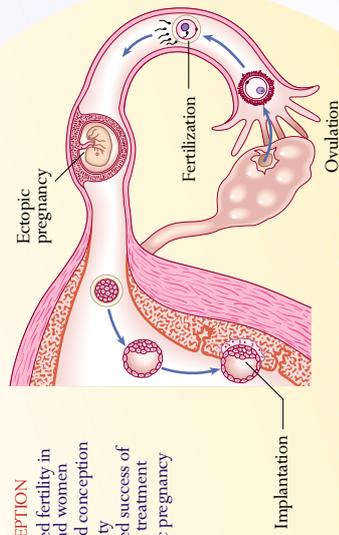
## 3 OTHER REPRODUCTIVE HEALTH EFFECTS

Early menopause  
 More severe menopausal symptoms  
 Malignant cancer of the cervix  
 Abnormal cervical smears  
 'Male' body shape



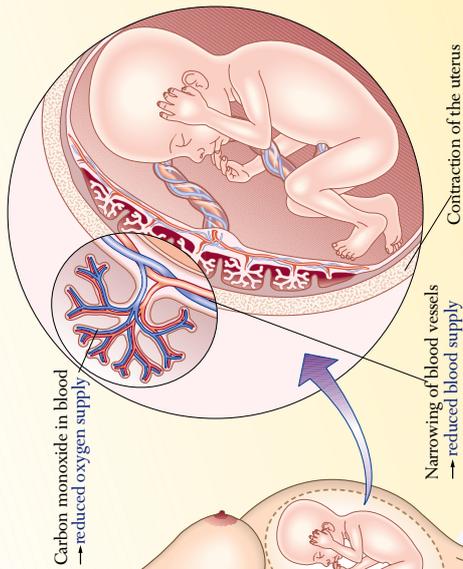
## 4 CONCEPTION

Reduced fertility in men and women  
 Delayed conception  
 Infertility  
 Reduced success of fertility treatment  
 Ectopic pregnancy



## 5 PREGNANCY

Increased risk of foetal malformation  
 Slower foetal growth  
 Miscarriage  
 Premature birth  
 Placental complications  
 Placental separation (placenta abruptio)  
 Placental obstruction (placenta praevia)



Carbon monoxide in blood → reduced oxygen supply

Narrowing of blood vessels → reduced blood supply

## 6 NEWBORN

Stillbirth  
 Low birth-weight baby  
 Death of the newborn  
 Impaired lung function  
 Respiratory illnesses  
 Cot death (first year of life)



## 7 NURSING MOTHER

Reduced milk supply  
 Reduced milk quality  
 Less likely to breastfeed  
 Breastfeeds for a shorter time

**PASSIVE SMOKING**  
 Breastfeeds for a shorter time

### Box 1: Smoking and male sexual impotence: mechanisms

Circulatory and vascular problems are the most common cause of impotence. Achieving and sustaining an erection depends on the balance between blood flow to and from the penis. Smoking-related impotence may result from damage to the circulatory system caused by exposure to the many toxins, including carbon monoxide, found in cigarette smoke. Smoking may inhibit erectile function in three ways.<sup>23</sup>

**Atherosclerosis** – arteries are narrowed by fatty deposits, decreasing the flow of blood to the penis. Smoking is closely associated with atherosclerosis of the arteries in the penis, and of the main arteries that supply it.

**Acute vasospasm** – arteries constrict, restricting the flow of blood to the penis.

**Venous dilatation** – the valve mechanism that normally traps blood in the penis is damaged, allowing blood to flow out of the penis too rapidly.

Stopping smoking appears to reduce the risk of impotence.<sup>20</sup> Among ex-smokers, the risk of impotence falls over time.<sup>21</sup> In younger men, sexual potency may improve rapidly after quitting smoking.<sup>24</sup> Because smoking exacerbates the effect of certain other conditions that cause impotence, even men with other risk factors – such as diabetes – can benefit from stopping.<sup>21</sup>

### Key messages: Smoking and male sexual impotence

- *Smoking may cause male sexual impotence.*
- *Smoking may amplify the effects of other causes of sexual impotence.*
- *Stopping smoking appears to reduce the risk of impotence and can improve sexual potency.*
- *There is limited evidence to suggest that passive smoking may increase the risk of impotence.*

## Menstruation

Menstrual problems can be difficult to describe and study, and there is no generally accepted definition of menstrual problems. Nevertheless, a limited number of studies have suggested that smoking may affect the menstrual cycle.

Certain studies suggest that women who smoke seem to be more likely than non-smoking women to have painful periods (dysmenorrhea). These studies suggest that smokers are 50 per cent more likely to report having painful periods than non-smokers.<sup>10</sup> The more cigarettes smoked, the greater the risk of period pain. One study found that women who smoked 10 or more cigarettes daily were almost twice (1.9) as likely to have painful periods as non-smokers. For women who had smoked for nine years or longer, the risk was almost three and a half (3.4) times greater.<sup>25</sup> Smoking has also been reported to affect the duration of painful periods. On average, women who smoke report that they have around a half-day more pain during their period than non-smokers.<sup>26</sup>

Any increased risk of painful periods in smokers seems to be partially reversible. Most studies have found that while period pain is less common among ex-smokers than among current smokers, it is more common than among women who have never smoked.<sup>10</sup>

Stopping smoking appears to reduce the risk of invasive cervical cancer. An intervention study among women who had early precancerous changes (lesions) of the cervix found that stopping smoking reduced the size of the lesion.<sup>43</sup> By contrast, the success rate of treatment for precancerous lesions is reduced some 2.5 fold in women who continue to smoke.<sup>44</sup>

**Key messages: Smoking and cervical cancer**

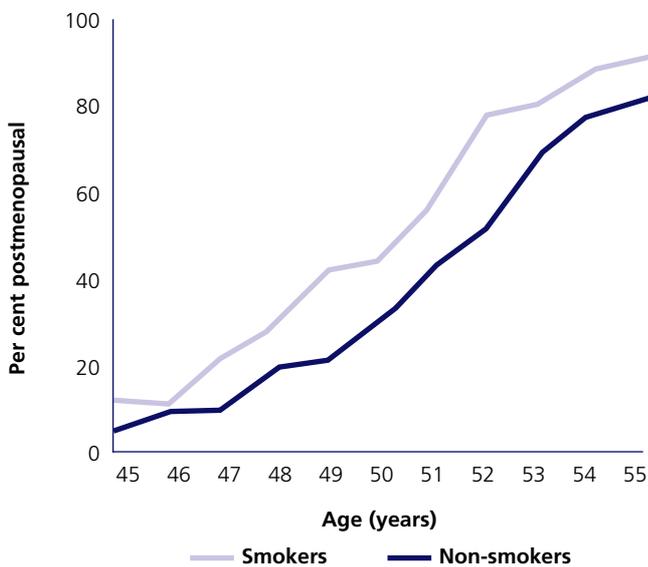
- *Women who smoke are more likely to have pre-cancerous changes of the cervix.*
- *Smoking is a cause of malignant cancer of the cervix.*

## Menopause

The age at which women naturally experience menopause varies.<sup>45</sup> On average, women who smoke reach menopause two years earlier than non-smoking women (figure 3).<sup>10</sup>

The risk of early menopause is particularly high among women who smoke – one large US study found that women aged 40–44 years who smoked were twice (2.1) as likely to have gone through menopause as their non-smoking peers.<sup>46</sup> The more cigarettes smoked, the greater the risk. For example, a study of Scottish women in their forties found that the risk of early menopause was almost trebled (2.7) for women who had smoked a pack of cigarettes a day for 20 years.<sup>47</sup>

**Figure 3: Age at menopause: smokers and non-smokers**



Stopping smoking may lower the risk of early menopause. While current smokers’ risk of early menopause is twice that of non-smokers, in ex-smokers the risk is higher by just one-third.<sup>34</sup> Former smokers reach menopause later than smokers, but earlier than women who have never smoked.<sup>48</sup>

A limited number of studies suggest that women who smoke are more likely than non-smokers to experience certain symptoms of menopause, including hot flushes, sweats and insomnia.<sup>49</sup> For example, one study found that women who smoke are twice as likely as those who have never smoked to have more frequent and more

Women who smoke appear to be more likely to have irregular periods (menstrual irregularity). Smokers also seem to have shorter menstrual cycles, on average, than non-smokers.<sup>10</sup> Among women who stop smoking, the risk of irregular periods returns to that seen in non-smokers.<sup>27</sup>

There is also limited evidence to suggest that smoking is associated with missed periods in women who have previously menstruated (secondary amenorrhoea). One study found that high-school girls who smoked were twice as likely as non-smokers to miss three or more consecutive menstrual periods.<sup>28</sup>

The pathways through which any impact of smoking on the menstrual cycle might be mediated are unclear. One possibility is that changes in body weight may be involved. Another is that smoking may lead to alterations in sex hormone metabolism (**box 2**).

#### **Key messages: Smoking and menstruation**

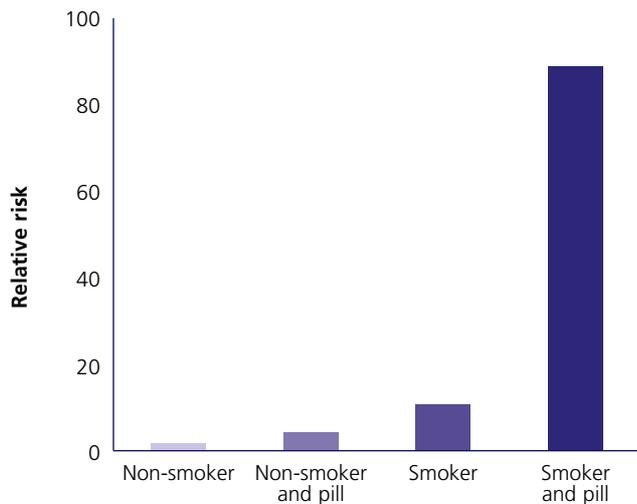
- *There is limited evidence that women who smoke may be more likely to have painful periods or irregular periods.*
- *There is limited evidence to suggest that smoking is associated with missed periods in women who have previously menstruated.*
- *Stopping smoking appears to reduce any increased risk of menstrual problems.*

## ***Oral contraceptives and smoking***

Smoking is an important cause of both coronary heart disease and stroke. Moreover, smoking interacts with oral contraceptives containing oestrogen ('the combined pill') to affect the risk of both diseases. Smoking and combined oral contraceptives act synergistically, so that the combined effects of smoking and using the pill are greater than would be expected on the basis of the risk posed by each alone.

Women who use combined oral contraceptives are at increased risk of heart disease. Because the risk of heart disease in young women is low, the benefits of using the pill generally outweigh the risks for young women who do not smoke. Among pill-users who smoke, however, the risk of having a heart attack is some 20 times higher (**figure 2**).<sup>29</sup>

**Figure 2: Smoking, the combined contraceptive pill and risk of coronary heart disease**



Some evidence suggests that smokers who use combined oral contraceptives may be more likely to have a stroke than non-smoking women on the pill. The increased risk seems largely the result of the combined effects of smoking and the pill. For example, one large study found that the risk of stroke in smokers taking the pill was more than seven (7.2) times that seen in non-smokers.<sup>29</sup>

Failure of the contraceptive pill is rare. Some evidence suggests, however, that smoking may increase the risk of failure of combined oral contraceptive pills. One study examined risk factors for pill failure among women who had an unwanted pregnancy while using either the combined oral contraceptive pill or the progesterone-only pill. After accounting for other known risk factors for pill failure, women who smoked were twice as likely as non-smokers to become pregnant while taking the combined pill, but not the progesterone-only pill.<sup>30</sup>

Failure of oral contraceptives containing oestrogen might plausibly result from alterations in the metabolism of artificial oestrogens in women who smoke. While levels of endogenous oestrogens do not appear to differ in smokers and non-smokers (**box 2**), oral oestrogens are broken down more quickly in smokers, and blood levels of active oestrogens are lower.<sup>30</sup>

#### **Key messages: Smoking and oral contraceptives**

- *Smoking greatly increases the risk of heart disease among women who use the combined oral contraceptive pill.*
- *Smoking may increase the risk of stroke among women who use the combined oral contraceptive pill.*
- *There is evidence to suggest that smoking may increase the risk of failure of the combined oral contraceptive pill.*

## Box 2: Smoking and sex hormones

Evidence from various types of study suggests that smoking may alter the metabolism of sex hormones in both men and women. While this could offer a plausible explanation for many of the effects of smoking on reproductive health, the precise nature and consequences of any changes in sex hormone metabolism remain to be identified.

Population-based studies have found that in women, smoking increases the risk of certain conditions that are associated with oestrogen-deficiency; for example, early menopause. Moreover, women who smoke have been found to have a lower risk of certain oestrogen-dependent diseases, such as endometrial cancer. As a result of these findings, smoking has been characterised as having an 'anti-oestrogenic' effect in women.<sup>31</sup>

The precise pathways that underlie this 'anti-oestrogenic' effect are unknown. Smoking does not materially affect the levels of naturally occurring oestrogens in the blood. However, it may alter oestrogen metabolism so as to favour the production of less active forms that are more rapidly cleared from the blood,<sup>32</sup> or increase the production of male sex hormones (androgens).<sup>33</sup> The finding that women who smoke tend to develop a male-like body shape lends support to this possibility.<sup>10</sup> Patterns of fat distribution in men and women are partly determined by sex hormones. Female sex hormones typically encourage fatty deposits in the hips, whereas male hormones typically favour fat build up in the abdomen. Women who develop a male-like pattern of body fat have been found to have higher levels of the male sex hormone, testosterone.

Some evidence suggests that smoking can also alter the metabolism of the gonadotrophins. These hormones trigger the production of oestrogen and progesterone, regulating processes essential for ovulation, implantation of the embryo, and the establishment and maintenance of pregnancy. Nicotine has been found to alter the release of gonadotrophins, which could in turn affect ovarian function.<sup>34</sup> Components of cigarette smoke are toxic to ovaries in animals;<sup>35</sup> moreover, they compromise formation of the corpus luteum, which produces progesterone.

Smoking also appears to affect the metabolism of male sex hormones: men who smoke have been found to have altered levels of androgens.<sup>4</sup> Studies in animals have found that tobacco smoke is toxic to the testis.<sup>36</sup>

## *Cervical cancer*

Cervical cancer is the leading cause of cancer death in women worldwide, with more than half a million new cases diagnosed each year.<sup>37</sup> Infection with certain types of human papilloma virus (HPV) is the major cause of cancer of the cervix (neck of the womb).<sup>38</sup> Nevertheless, in only a fraction of women will infection with HPV progress to give rise to certain precancerous changes, and eventually cervical cancer. Studies among women who are infected with HPV have found that women who smoke are at higher risk of developing preinvasive and invasive cervical cancer. Typically, smoking increases the risk of invasive cervical cancer some two-to-three fold.<sup>39</sup> In 2002, the WHO IARC reviewed the large number of studies available and concluded that smoking is a cause of invasive (malignant) cervical cancer.<sup>11</sup>

Several types of studies point to pathways that may be involved in this effect. Nicotine and tobacco-specific carcinogens have been detected in the cervical mucus of smokers.<sup>40</sup> Cigarette condensate increases the frequency of malignant transformation in cultured cervical cells infected with HPV.<sup>41</sup> There is also some evidence that smoking may result in a reduced immune response in the cervix.<sup>42</sup>

severe hot flushes.<sup>50</sup> There is also some evidence that women who smoke are more likely to have hot flushes after surgical removal of the womb (hysterectomy) and ovaries (oophrectomy).<sup>51</sup>

#### **Key messages: Smoking and menopause**

- *On average, smokers undergo menopause two years earlier than non-smokers.*
- *Some studies suggest that smokers may also have more severe and more frequent menopausal symptoms, including hot flushes and sweats.*
- *Stopping smoking reduces the risk of early menopause.*

## ***Smoking and other reproductive health effects in women***

Other reproductive conditions and illnesses that have been linked to smoking in women include breast cancer, uterine fibroids, endometriosis and endometrial cancer.

Although in certain studies, smoking has been implicated as a risk factor for breast cancer in women, a recent review of all the available evidence by the WHO IARC concluded that tobacco smoking does not cause breast cancer, nor does it protect against it.<sup>11</sup>

Uterine fibroids are benign growths of the muscle wall of the uterus. These growths are thought to be oestrogen-dependant. While certain studies suggest that the risk of fibroids may be decreased among women who smoke, a recent expert review judged the evidence to be inconclusive.<sup>10</sup>

Endometriosis is a condition in which endometrial material, which normally lines the womb, grows outside the uterus. It is associated with pain during menstruation and, in severe cases, with infertility. Certain studies have linked smoking to a decreased risk for endometriosis; however, a recent expert review judged that the evidence was not conclusive.<sup>10</sup>

In its 1998 report, the UK Scientific Committee on Smoking or Health concluded that the risk of endometrial cancer actually decreased in women who smoked. The report also emphasised that the number of deaths from endometrial cancer averted because of smoking totalled 100 at most, while there are almost 40,000 smoking-related deaths among women every year in the UK.<sup>52</sup> In its recent evaluation,<sup>11</sup> the WHO IARC concluded that cigarette smoking is associated with a 20–50 per cent decrease in the risk of endometrial cancer. This effect is predominantly seen in post-menopausal women.

## ***Smoking and fertility***

It is estimated that around one in six couples in the UK experiences problems in conceiving at some time. Several types of study provide information on the effects of smoking on fertility. Semen analysis can reveal abnormalities. Surveys of pregnant women can investigate the time taken to conceive. Studies of couples can compare those who conceive with those who do not. Finally, investigation of couples having fertility treatments can help to characterise differences in the quality of egg and sperm, fertilisation, implantation and early loss of embryos.

Smoking reduces fertility in both men and women. The fertility problems observed in smokers may result at least in part from alterations in sex hormone metabolism (**box 2**). Other effects may also contribute. Substances present in cigarette smoke have been found to be toxic to the testes and ovaries. Animal studies

have also found adverse effects of nicotine and cigarette smoke on the interaction of egg and sperm and the implantation of the fertilised egg.<sup>36</sup>

### **Semen quality and sperm damage**

Smoking reduces the quality of semen: men who smoke have a lower sperm count than non-smokers, and their semen contains a higher proportion of malformed sperm.<sup>53</sup> By-products of nicotine present in the semen of smokers have been found to reduce the motility of sperm,<sup>54</sup> and to affect their normal swimming patterns.<sup>55</sup>

Genetic material in sperm cells is damaged by smoking. For example, benzo[a]pyrene, one of the carcinogenic components of tobacco smoke, has been found to bind to DNA in sperm, inducing mutations. This damage can persist in embryos.<sup>56</sup>

### **Delayed conception**

Of couples having regular, unprotected sex, eight out of 10 will conceive within 12 months, and nine out of 10 within 18 months.<sup>57</sup>

Women who smoke take longer to conceive. Among smokers, the chances of conceiving are decreased by 10–40 per cent per cycle. The greater the number of cigarettes smoked, the longer a woman is likely to take to achieve pregnancy.<sup>58</sup> However, even relatively low levels of smoking can have a substantial impact. A study of almost 11,000 women in Denmark found that women who smoked between five and nine cigarettes a day were 1.8 times more likely than non-smokers to wait longer than 12 months to conceive.<sup>59</sup>

### **Infertility**

Infertility is usually defined as not having conceived after 12 months of unprotected sex. Smoking increases the risk of infertility: women who smoke are twice as likely to be infertile as non-smokers.<sup>10</sup> This is true for both women attempting to become pregnant for the first time (primary infertility) and women who have previously been pregnant (secondary infertility).

Studies that have assessed the risks of different types of infertility have found some evidence that smokers are at particular risk of tubal infertility, in which the underlying problem is thought to involve the function of the fallopian tubes.<sup>10,60</sup> For example, one study found that women with primary tubal infertility were almost three times (2.7) as likely to be smokers as were fertile women.<sup>61</sup>

### **Reduced response to fertility treatment**

Studies of couples who have used assisted reproduction techniques, such as *in vitro* fertilisation, have suggested a poorer response to techniques among smokers.

In ovarian stimulation, hormones are administered with the aim of increasing egg production. During this treatment, women who smoke have been found to have lower levels of the active form of the sex hormone oestrogen both in their blood and in the ovary during maturation of the egg.<sup>62</sup> Women who smoke tend to produce fewer eggs in response to fertility treatment. The more cigarettes smoked, the fewer eggs produced.<sup>63</sup>

Smoking may also reduce the likelihood of fertilisation, implantation and successful pregnancy resulting from assisted reproduction techniques.<sup>10</sup> One recent report found that women who smoked were significantly more likely than non-smokers to suffer early pregnancy loss after embryo transfer.<sup>64</sup>

Recent studies have looked at the effect of male smoking on assisted reproduction techniques.<sup>65</sup> One study of heterosexual couples reported that smoking reduced the success of both *in vitro* fertilisation (IVF) and intracytoplasmic sperm injection (ICSI). For example, while 38 per cent of women with non-smoking partners became pregnant during ICSI treatment, the rate fell to just 22 per cent among women whose partners smoked.<sup>66</sup>

There is some evidence that past smoking may also affect the outcome of fertility treatment. One study examined the effect of current and past smoking by either men or women on the success of fertility treatment. Among couples where either or both partners had ever smoked, the risk of not achieving a pregnancy was 2.41 times higher than in couples in which neither partner had ever smoked. The longer that couples had smoked, the poorer the outcome. In couples in which either partner had smoked for more than five years, the risk of not achieving a pregnancy was 4.27 times greater than for lifetime non-smokers. Women who smoked produced 40 per cent fewer eggs than non-smokers, and among men who smoked, IVF was 46 per cent less likely to succeed.<sup>65</sup>

### **Fertility and stopping smoking**

The effect of smoking on fertility appears to be reversible: most studies show that women who have stopped smoking take no longer to become pregnant than women who have never smoked. Stopping smoking also improves sperm count and quality in men.

#### **Key messages: Smoking and fertility**

- *Men who smoke have a lower sperm count and a higher proportion of malformed sperm.*
- *Women who smoke take longer to conceive.*
- *Women who smoke are twice as likely to be infertile as non-smokers.*
- *Men and women who smoke have a poorer response to fertility treatment.*
- *Women who have stopped smoking take no longer to become pregnant than women who have never smoked.*
- *Stopping smoking improves sperm count and quality.*

### ***Smoking in pregnancy***

Smoking during pregnancy is an important cause of ill-health for both mother and foetus. Besides increasing the mother's risk for potentially serious complications, smoking during pregnancy is the largest preventable cause of foetal and infant ill health and death.<sup>67</sup> Major mechanisms through which the effects of smoking during pregnancy may be mediated are presented in **box 3**.

#### **Ectopic pregnancy**

Ectopic pregnancy occurs when the fertilised egg implants and begins to grow outside the uterus, usually in the fallopian tube. Surgery is needed to remove the embryo and to repair or remove the damaged tube.

Ectopic pregnancy is rare, occurring in 2–15 of every 1,000 pregnancies. It is seldom fatal – in 1997–99, it is estimated that just four in 10,000 ectopic pregnancies led to the mother's death.<sup>68</sup> Nevertheless, ectopic pregnancy has emerged as a leading cause of death for women during the first three months of pregnancy. It can also compromise future fertility.

Smoking is associated with an increased risk of ectopic pregnancy.<sup>69</sup> This association remains after adjustment for other predisposing factors, such as sexually transmitted infections and pelvic inflammatory disease.<sup>10</sup> Typically, studies have found that in women who smoke, the risk of ectopic pregnancy is increased 1.5–2.5 times. The risk is significant even when relatively few cigarettes are smoked: one study found that among women smoking one to five cigarettes a day, the risk of ectopic pregnancy was 60 per cent higher than in non-smokers.<sup>70</sup>

Animal studies have found adverse effects of cigarette smoke on the functioning of the fallopian tubes:<sup>36</sup> cigarette smoke suppresses the normal rhythmic movement of the cilia, the small hairs that line the fallopian tubes and waft the egg towards the womb. It has been suggested that impaired tubal transport and a delay in the ovum reaching the uterus might be involved in the increased risk of ectopic pregnancy in smokers.<sup>71</sup>

## Miscarriage

Definitions of miscarriage vary. In the UK, miscarriage is currently defined as loss of the pregnancy before 24 weeks' gestation; in older studies, it has been defined as loss before 28 weeks of pregnancy.

There is substantial evidence that smoking increases the risk of miscarriage: the Royal College of Physicians<sup>72</sup> has estimated that the risk is increased by 25 per cent. For example, one study of almost 60,000 women in Canada found a clear dose response, with the risk of miscarriage increasing with the number of cigarettes smoked. An increased risk was seen even among women smoking nine cigarettes or fewer daily.<sup>73</sup>

The increased rate of miscarriage seen in women who smoke does not appear to reflect increased loss of abnormal embryos. One study found that smoking did not affect the loss of embryos with chromosomal abnormalities, but significantly increased the rate at which normal foetuses were lost.<sup>74</sup>

## Reduced foetal growth and low birth-weight

On average, smokers have babies that are 200–250g lighter than those of non-smokers. The greater the number of cigarettes smoked during pregnancy, the less well the foetus grows and develops. This reduced foetal growth can result in a baby being born which is smaller and less mature than would be expected for its age, or 'small for gestational age'.

Low birth-weight is defined by the WHO as a birth-weight below 2,500g. Low birth-weight can result from the foetus failing to grow as normal (reduced foetal growth) and/or from the baby being born prematurely. Around 7.5 per cent of all babies born in England and Wales fall into this category. However, while 5.4 per cent of babies born into professional social classes are classified as low birth-weight, the rates are much higher (9.3%) among babies whose birth is registered by the mother alone.<sup>75</sup>

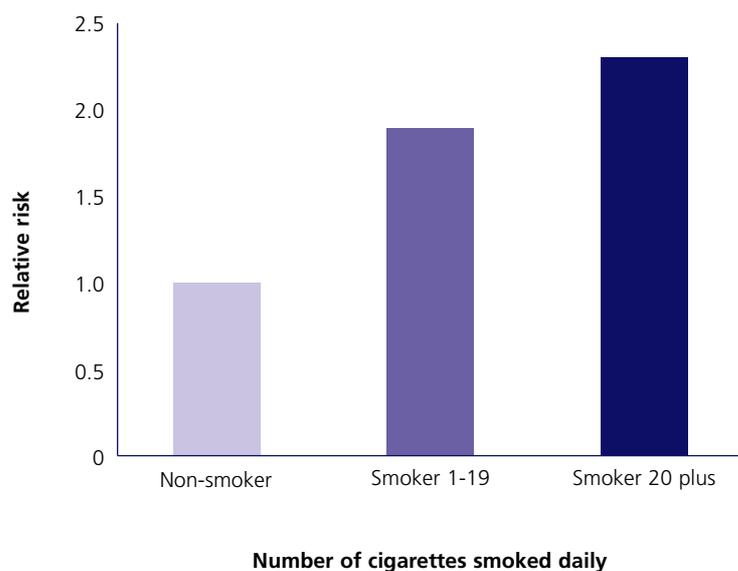
The risk of having a low birth-weight baby increases with the amount smoked. Low birth-weight babies are at increased risk of illness. Moreover, there is a close association between low birth-weight and death in infancy.<sup>76</sup> Women who smoke during pregnancy are three times more likely to have a low birth-weight baby.<sup>77</sup> Smoking is a more important determinant of birth-weight and growth of the foetus than the mother's height, weight, number of previous pregnancies and their outcomes, or the sex of the baby.<sup>78</sup>

## Perinatal death

Perinatal death encompasses both stillbirth – loss of the foetus after the 24th week of pregnancy – and neonatal death – death of the newborn during the first four weeks of life. It is estimated that about one-third of all perinatal deaths in the UK are caused by smoking.<sup>67</sup> The greater the number of cigarettes smoked during pregnancy, the greater the risk of perinatal death (**figure 4**).<sup>79</sup>

Smokers are more likely to lose their baby through stillbirth. One study of more than 600,000 pregnancies in Sweden found that the risk of stillbirth was increased 40 per cent in smokers compared to non-smokers.<sup>80</sup> Moreover, babies born to mothers who smoke are around 40 per cent more likely to die within the first four weeks of life than babies born to non-smokers.<sup>81</sup>

**Figure 4: Smoking in pregnancy and relative risk of perinatal death**



### Placental complications

Women who smoke during pregnancy are at risk of certain complications of pregnancy that affect the placenta, which supplies oxygen and nourishment to the developing foetus. Placental complications are an important cause of illness and death in mother and baby, and contribute to perinatal mortality.

Premature separation of the placenta from the wall of the uterus (placental abruption or *placenta abruptio*) is one of the main causes of perinatal death. Smoking increases the risk of placental abruption 1.4 to 2.4-fold, the risk increasing with cigarette consumption.<sup>82</sup>

*Placenta praevia* occurs when the placenta obstructs the opening at the neck of the womb. The result is an increased risk of maternal bleeding and of premature birth, which can be dangerous for both mother and child. Smoking increases the risk of *placenta praevia* 1.5–3.0 times, and the risk increases with cigarette consumption.<sup>82</sup>

### Premature birth

Women who smoke are at increased risk of having a premature baby. The risk is some 1.5–2.0 times higher than that of non-smokers. Premature babies (those born before 37 weeks of pregnancy) are at greater risk of illness and death. One trigger for labour is rupture of the membranes that surround the foetus in the womb. Smokers have a two-to-three fold increased risk of the membranes breaking prematurely before 37 weeks of pregnancy.<sup>10</sup>

### Pre-eclampsia

Pre-eclampsia is a condition that arises in some women during pregnancy, characterised by high blood pressure, with swelling and protein in the urine. Pre-eclampsia can result in restricted growth of the foetus and premature birth, and in severe cases, may be fatal for the mother.<sup>83</sup>

Smoking is consistently associated with a 30–50 per cent reduction in the risk of pre-eclampsia.<sup>10</sup> The mechanisms underlying this effect are not known.<sup>84</sup> Nevertheless, the US Surgeon General has noted that this apparently beneficial effect is greatly outweighed by the harmful effects of smoking during pregnancy.<sup>10</sup> Moreover, if pre-eclampsia does develop, the pregnant smoker is at much greater risk of serious

complications than the pregnant non-smoker. Among smokers who develop pre-eclampsia, risks of placental abruption, foetal growth restriction, and perinatal death are extremely high.<sup>85</sup>

### **Foetal malformation**

In certain studies, smoking during pregnancy has been associated with an increased risk of foetal malformation (birth defects). A recent expert review concluded that while smoking during pregnancy does not increase the overall risk of foetal malformation, it may nonetheless be related to a modest increase in risk for certain malformations.<sup>10</sup> For example, smoking has been associated with an increased risk of oral clefts<sup>86</sup> (cleft lip and cleft palate, 30% increased risk), limb reduction<sup>87</sup> (absent or shortened limb, 30% increased risk) and urogenital<sup>88</sup> (20% increased risk) abnormalities.

Any increased risk for foetal malformation from smoking is likely to arise in the first few months of pregnancy. These effects might be the result of a lack of oxygen in the foetus resulting in disruption of the vascular system (**box 3**). The review noted that the association between smoking and limb reduction seems particularly plausible, as these malformations are thought to result from vascular disruption.<sup>89</sup> Other toxic or mutagenic effects of tobacco smoke might also play a role.

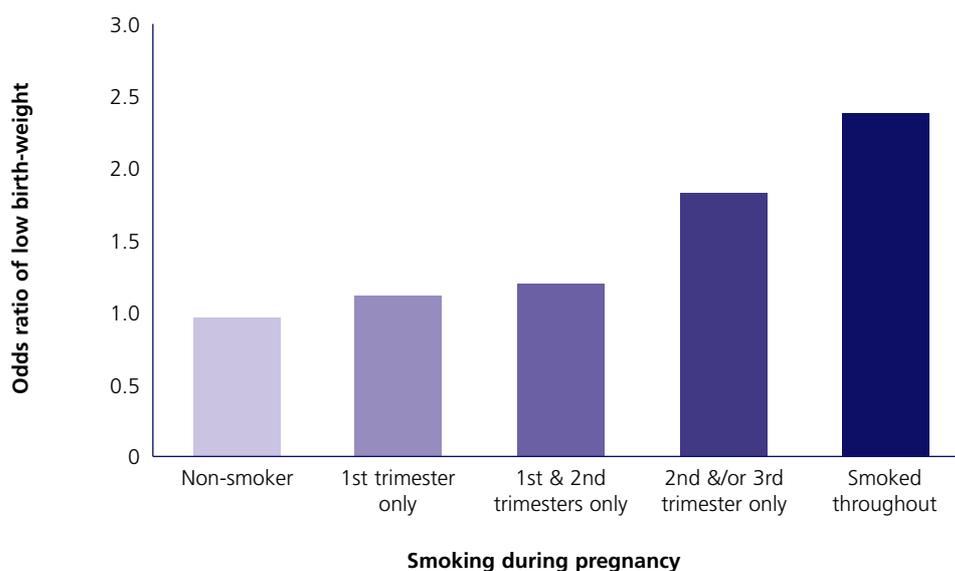
### **Pregnancy and stopping smoking**

Stopping smoking reduces the risk of many of the adverse effects of smoking on pregnancy. Former smokers appear to have the same risk of ectopic pregnancy as women who have never smoked.<sup>10</sup> Women who stop smoking during pregnancy have a lower risk of placental complications than those who continue to smoke. Stopping smoking during the first three months of pregnancy appears to avert some of the increased risk of placental abruption<sup>82</sup> and *placenta praevia*.<sup>90</sup>

Stopping smoking also appears to reduce the risk of premature birth to that seen in non-smokers.<sup>91</sup> One randomised trial showed that women who stopped smoking during the first three months of pregnancy delivered their babies on average a week later than those who continued to smoke.<sup>92</sup> Smoking fewer cigarettes had no beneficial effect.

Stopping smoking greatly reduces the risk of low birth-weight and perinatal death. In one typical study, the average birth-weight and perinatal death rate among babies whose mothers had stopped smoking during the first three months of pregnancy were almost identical to those among infants whose mothers had not smoked at all. Stopping smoking during pregnancy also reduced the risk of the baby being ill: while 8.8 per cent of infants whose mothers stopped smoking needed hospital care in the first month of life, compared with 11.4 per cent of infants whose mothers continued to smoke.<sup>81</sup>

**Figure 5: Effect of stopping smoking during pregnancy on the risk of low birth-weight**



Randomised clinical trials of smoking cessation interventions have also demonstrated the benefits of smoking stopping on birth-weight.<sup>93</sup> Most studies suggest that smoking in the last three months of pregnancy – a period of rapid foetal growth – is a particular risk for low birth-weight (**figure 5**).<sup>94</sup>

Certain studies have suggested that reducing the amount smoked may reduce the risk of low birth-weight.<sup>95</sup> However, more recent research has found that pregnant women who report cutting down on the number of cigarettes smoked are not at reduced risk of having a smaller baby.<sup>96</sup> Nor is smoking ‘low-tar’ or ‘low nicotine’ cigarettes (often known as ‘light’ or ‘mild’ cigarettes) of any benefit.<sup>96</sup>

### Box 3: Smoking and pregnancy: mechanisms

Although the precise mechanisms that underlie the various effects of smoking on pregnancy are not completely understood, several major processes have been implicated.

Various components of tobacco smoke have been implicated in processes that could result in **reduced foetal growth** and **low birth-weight**. Nicotine induces vasoconstriction, or narrowing of the blood vessels. This may affect the function of the placenta, restricting blood flow and reducing the supply of nutrients and oxygen to the foetus. Carbon monoxide in tobacco smoke inhaled by the mother displaces oxygen in the circulation, reducing the amount available to the foetus.<sup>97</sup> Smoking has been found to disrupt the growth and proliferation of blood vessels. This process – known as vascularisation – plays an important part in the establishment and maintenance of the placenta, as well as in growth and development of the embryo itself.<sup>98</sup>

Constriction of blood vessels and the high blood level of carbon monoxide induced by smoking might induce hypoxia (lack of oxygen). Hypoxia has been implicated in premature placental separation<sup>99</sup> (**placental abruption**). Hypoxia can also result in the enlargement of the placenta, which may cause it to extend over the cervix,<sup>90</sup> as seen in **placenta praevia**. Much of the increased risk of **stillbirth** is thought to be accounted for by growth retardation and placental complications.<sup>100</sup>

A growing body of experimental evidence suggests that smoking during pregnancy may affect the normal development of the brain systems that regulate the uptake of oxygen and heart function.<sup>101</sup> It has been suggested that this could contribute to foetal hypoxia and growth retardation. Such a mechanism might also contribute to **stillbirth, neonatal death** and **cot death**<sup>102</sup> (see also **box 4**).

Vasoconstriction may also explain the increased risk of **premature rupture of the membranes** and **premature birth** associated with smoking: it has been proposed that it could lead to mechanical stress that could disrupt the integrity of the membranes<sup>103</sup> or otherwise trigger delivery.<sup>104</sup> Other mechanisms implicated in premature birth include the possibility that smoking may cause higher levels of circulating catecholamines that could precipitate labour.<sup>1</sup>

### Key messages: Smoking during pregnancy

- *Women who smoke are at increased risk of ectopic pregnancy.*
- *Women who smoke during pregnancy may be at increased risk of having a miscarriage.*
- *Women who smoke are three times more likely to have a low birth-weight baby.*
- *Women who smoke during pregnancy are more likely to suffer a stillbirth.*
- *Babies born to women who smoke during pregnancy are more likely to die during the first four weeks of life.*
- *Women who smoke during pregnancy are at increased risk of certain complications of the placenta.*
- *Women who smoke during pregnancy may be at increased risk of giving birth prematurely.*
- *Smoking during pregnancy may increase the risk of certain foetal malformations.*
- *Stopping smoking before pregnancy avoids these risks.*
- *Stopping smoking in the first three months of pregnancy greatly reduces the risk of low birth-weight.*
- *Stopping smoking at any stage during pregnancy brings proportional health benefits.*

## Passive smoking during pregnancy

Non-smoking women exposed to other people's tobacco smoke during pregnancy have lighter babies. Babies born to non-smoking women whose partners smoked weighed less than babies born to non-smoking couples.<sup>105</sup> Moreover, women exposed to second-hand smoke in the workplace are also affected.<sup>106</sup> Even relatively low-level exposure to tobacco smoke has a significant effect – exposure to second-hand smoke equivalent to one per cent of the dose inhaled by a smoker results in decreases in birth weight of 10 per cent of that seen in active smokers.<sup>78</sup> The greater the amount of exposure, the greater the effect: in one UK study, babies born to women with the heaviest exposure to second-hand smoke were more than 70g lighter than those in the least exposed group.<sup>107</sup> A recent review of the evidence concluded that on average, infants born to women exposed to second-hand smoke during pregnancy are 40–50g lighter than those born to women who are not exposed.<sup>10</sup>

The reduction in birth-weight caused by passive smoking in pregnancy, while not of itself a risk for most babies, could compound health problems for those with additional health problems or risk factors. Pregnant women exposed to other people's tobacco smoke are about 20 per cent more likely to have a low birth-weight baby.<sup>107</sup> There is some evidence to suggest that women who are exposed to second-hand smoke during their pregnancy are at increased risk of giving birth prematurely.<sup>108</sup> For example, one study found that mothers exposed daily to second-hand smoke had a 23 per cent increased risk of giving birth prematurely.

### Key messages: Passive smoking and pregnancy

- *Babies born to women exposed to second-hand smoke in the home or at work are lighter than those born to women who are not exposed.*
- *Women exposed to second-hand smoke during pregnancy are at increased risk of having a low birth-weight baby.*
- *Women exposed to second-hand smoke during pregnancy may be at increased risk of giving birth prematurely.*

## Smoking and breastfeeding

Breastfeeding has important health benefits for both infant and mother. Mothers who smoke are less likely to start breastfeeding their babies than non-smoking mothers,<sup>109</sup> and tend to breastfeed for a shorter time. The more cigarettes smoked, the sooner the baby is weaned. These associations remain after adjustment for social class.<sup>110</sup>

In breastfeeding mothers who smoke, milk output is reduced by more than 250 ml/day<sup>111</sup> compared with non-smoking mothers. The composition of milk can also be affected: one study found that milk from mothers who smoked contained lower levels of lipids than milk from non-smokers.<sup>112</sup>

Passive smoking also appears to influence breastfeeding. Non-smoking women exposed to other people's tobacco smoke stop breastfeeding sooner than those who are not exposed.<sup>113</sup>

The effect of smoking on breastfeeding may be mediated by nicotine regulation of the hormone prolactin. Prolactin is essential for the initiation and maintenance of milk production by the mother. Breastfeeding women who smoke have lower levels of prolactin than those who do not smoke.<sup>114</sup> Nicotine has been shown to inhibit the production of prolactin.<sup>115</sup> It seems plausible that in mothers who smoke, prolactin production might be reduced, resulting in poorer milk supply and an increased likelihood of giving up breastfeeding earlier.

### Key messages: Smoking and breastfeeding

- Mothers who smoke are less likely to start breastfeeding their babies.
- Mothers who smoke breastfeed their babies for a shorter time.
- Mothers who smoke produce less milk.
- Mothers who smoke produce poorer quality milk.
- Women exposed to second-hand smoke breastfeed their babies for a shorter time.

## Smoking and child health

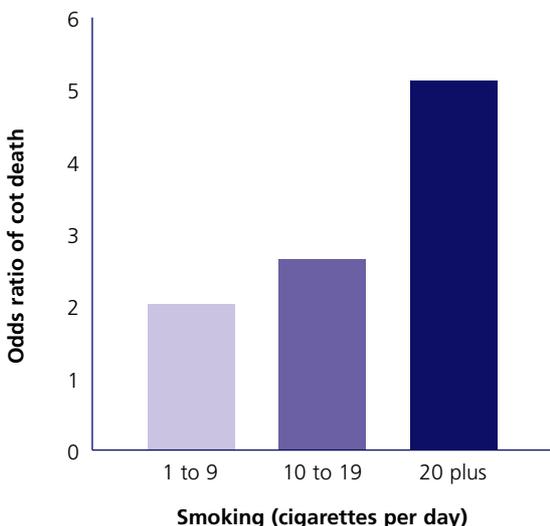
Damage to the foetus caused by smoking during pregnancy may have important consequences for the baby after birth. Moreover, exposure to second-hand smoke after birth brings additional risks in both infancy and childhood.

### Cot death

Cot death – or sudden infant death syndrome (SIDS) – is the sudden unexplained death of an infant in the first year of life. In the UK, cot death is the leading cause of death among infants aged one to 12 months. Cot death occurs most often among babies aged between two and four months, often during sleep.

Smoking during pregnancy has been identified as a cause of cot death.<sup>52</sup> The risk of cot death is approximately trebled in infants whose mothers smoke both during and after pregnancy. The more cigarettes smoked, the greater the risk.<sup>10</sup>

**Figure 6: Household smoking and cot death**



Exposure of the baby to second-hand smoke after birth is also a hazard. For example, one study of babies whose mothers did not smoke during pregnancy, but smoked after birth, found that they were twice as likely to suffer cot death as those whose mothers did not smoke.<sup>116</sup> Moreover, studies of families where fathers smoke, but the mother does not, have also reported an increased risk.<sup>117</sup> The UK Confidential Inquiry into Stillbirths and Death in Infancy<sup>9</sup> estimated that in families where only the father smoked, the

risk of cot death was increased 2.5 times; where both parents smoked, it was increased almost four times (odds ratio: 3.79). The greater the number of cigarettes smoked in a household, the greater the risk of cot death (**figure 6**).<sup>118</sup>

The pathways by which smoking might contribute to cot death are presented in **box 4**.

#### **Box 4: Smoking and cot death: mechanisms**

Definitions of sudden infant death syndrome have varied over the years, and research into its causes continues. The mechanisms underlying the syndrome are unclear. However, it has been proposed that problems with the regulation of the heartbeat and of breathing may be involved. The hypothesis is that as the result of an underlying developmental defect in one or both of these processes, affected babies have an impaired response to acute lack of oxygen. The triggering event might be hypoxic stress, induced for example by obstruction of the airways or a period of apnea, in which breathing spontaneously pauses.<sup>119</sup>

The pathways through which smoking increases the risk of cot death have not been elucidated, however, several possibilities have been proposed. Smoking during pregnancy increases the risk of premature birth and retards foetal development; this may in turn increase the risk of the baby being born before the brain systems that regulate the uptake of oxygen and heart function have developed. There is evidence that exposure of the foetus to nicotine may also interfere with the normal development of these systems<sup>120</sup> (see also **box 3**). As a result, the response to lack of oxygen appears to be dampened down.

Studies in animals have found that nicotine exposure during pregnancy compromises the response to hypoxia.<sup>121</sup> Moreover, there is some evidence that babies born to mothers who smoked during pregnancy are less easily roused from deep sleep than those born to non-smoking mothers, suggesting that their response to sudden stress may be impaired.<sup>122</sup>

Apnea is more common in premature babies. Moreover, it can also be triggered by infections and respiratory disorders, the risk of which is increased by exposure to second-hand smoke. Exposure to nicotine and to carbon monoxide in second-hand smoke may also play a role. An increased level of inflammatory responses to infection has also been implicated.<sup>123</sup>

### **Lung function**

Impaired development and growth of the lungs has been implicated as a risk factor for chronic obstructive pulmonary disease (COPD), in adult life.<sup>124</sup> COPD is characterised by a reduced lung capacity, and symptoms include coughing, wheeze and phlegm production. Smoking by the mother during pregnancy may result in impairments in lung development that persist into adult life. Smoking during pregnancy adversely affects lung function in healthy newborn babies.<sup>125</sup> Infants born to mothers who smoke have been found to have poorer lung function than those born to non-smoking women. This reduction persists into childhood.<sup>126</sup> Exposure to second-hand smoke during infancy and childhood has also been associated with slower rates of growth in lung function.<sup>127</sup>

### **Respiratory illnesses**

Second-hand smoke can cause asthma in children, and increases the severity of the condition in those who are already affected.<sup>128</sup> Children exposed to second-hand smoke also have an increased risk of respiratory symptoms, such as breathlessness, phlegm, coughing and wheezing.<sup>7,129</sup> Moreover, parental smoking is an important cause of lower respiratory tract illnesses in infants and children, including croup, bronchitis, bronchiolitis and pneumonia.<sup>7</sup>

## Middle-ear disease

The incidence of middle-ear disease, including recurrent ear infections, is increased among children exposed to second-hand smoke.<sup>128, 130</sup>

## Cancer

There is limited evidence to suggest that parental smoking may be linked to an increased risk of childhood cancer.<sup>7</sup> Smoking by the father has been associated with an increased risk of lymphoma and brain tumours,<sup>131</sup> while maternal smoking has been linked to slightly increased risk for all childhood cancer (relative risk 1.11) and leukaemia (relative risk 1.14). While certain studies have reported that children exposed to second-hand smoke during childhood have an increased risk of cancer during adulthood, a recent evaluation judged the evidence to be inconclusive.<sup>130</sup>

## Impaired growth and development

Reduced growth of the foetus can have long-term consequences. Low birth-weight has also been associated with an increased risk of cardiovascular disease, diabetes and obesity in adulthood. Babies born to mothers who smoked during pregnancy have been found to be smaller and lighter as children.<sup>132</sup> A dose-dependent association between childhood obesity and maternal smoking during pregnancy<sup>133</sup> has also been reported.

## Behavioural problems

Certain studies have reported an impact of smoking during pregnancy on various aspects of infant and child behaviour. Such studies can be difficult to interpret. Nevertheless, certain interesting findings warrant note.

It has been reported that babies born to mothers who smoke during pregnancy may have more bouts of unexplained crying (infant colic).<sup>134</sup> A recent report suggested that newborns of mothers who smoke may suffer nicotine withdrawal symptoms.<sup>135</sup>

A number of studies have found that, compared to children of non-smokers, children of smokers have a poorer performance at school. They also have lower scores on tests of cognitive function, including language, and are more likely to have certain behavioural problems, including hyperactivity and shorter attention spans. In most of these studies, sociodemographic characteristics have been controlled for; some have also demonstrated dose-response effects, with greater levels of impairment with greater levels of exposure.<sup>7</sup>

### Key messages: Smoking, infant and child health

- *Babies born to mothers who smoke are at increased risk of cot death.*
- *Babies born to mothers who smoke have poorer lung function.*
- *Second-hand smoke can cause asthma in children and increase the severity of attacks in those already affected.*
- *Children exposed to second-hand smoke are more likely to develop middle-ear diseases.*
- *Babies born to mothers who smoked during pregnancy are smaller and lighter as children.*
- *There is limited evidence to suggest that babies born to mothers who smoke during pregnancy may suffer nicotine withdrawal symptoms.*

## Smoking and reproductive life in the UK – a profile

This section presents a profile of smoking in the UK, with regard to sexual, reproductive and child health. The available evidence on the impact of smoking is outlined, together with information on public awareness of these health problems. Data on smoking are presented, with special reference to the prevalence and determinants of smoking among younger adults and pregnant women. The situation with regard to exposure to second-hand smoke is described. Current government policies and targets are outlined.

The impact of smoking on reproductive and child health worldwide is also of growing concern. **Box 6** describes trends in tobacco consumption in developing countries.

### **Box 6: Smoking and reproductive life – a global perspective**

While in certain Western countries, the prevalence of smoking among men is falling, in most developing countries, smoking rates are rising among both sexes. In developed and developing regions alike, tobacco use is increasing rapidly among women, especially among women aged 15–25 years. It is estimated that worldwide, the number of women smokers will triple over the next generation.

Smoking among men and women of reproductive age is of particular concern. It is estimated that in 1995, some 12 million women worldwide smoked during their pregnancy. A further 1–2 million women are estimated to have stopped smoking soon after becoming aware of their pregnancy. An additional 50 million pregnant women were exposed to second-hand smoke during their pregnancy.<sup>78</sup>

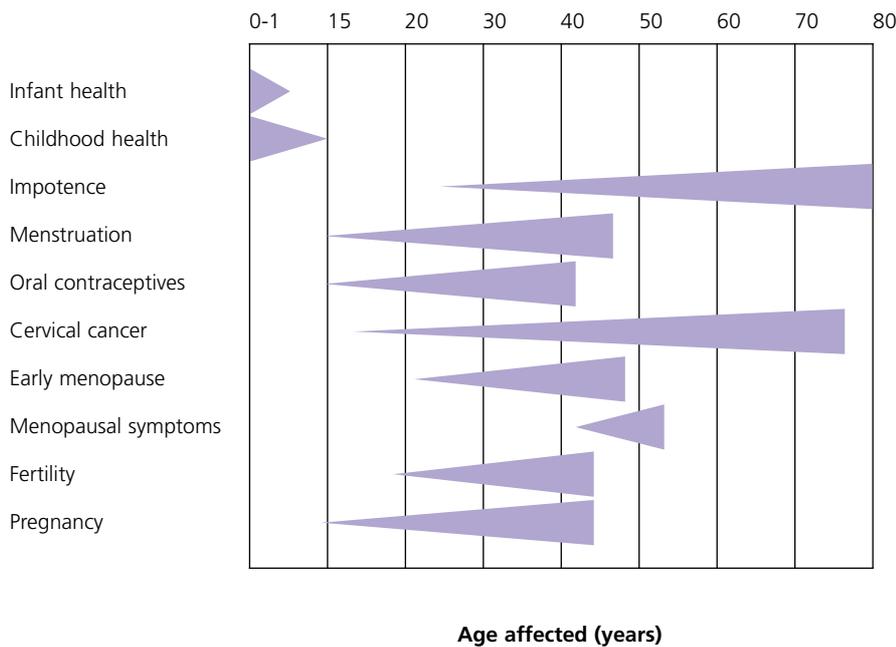
An expert group convened by WHO<sup>7</sup> concluded that approximately 700 million, or almost half, of the world's children are exposed to tobacco smoke.

## *Population impact and public awareness*

**Figure 7** presents a summary of the effects of smoking on sexual, reproductive and child health, together with the age groups most affected.

Much of the burden of illness and death caused by smoking is seen in middle age, and smokers who stop before age 35 avoid most of their excess risk of death.<sup>136</sup> In contrast, a substantial proportion of the burden of smoking on reproductive life occurs relatively early in life.

**Figure 7: Smoking and reproductive life: selected health effects and major age groups affected**



### The population impact of smoking on reproductive health

Estimates of the proportion of various reproductive health problems that can be attributed to smoking are presented in **table 2**. Certain outcomes – including low birth-weight and the effect of parental smoking on child health<sup>137</sup> – have been relatively well characterised. However, for other effects, UK-based estimates are not currently available.

Estimates of the total costs of smoking-related reproductive ill health in the UK have not been made. However, smoking-related illnesses have been estimated to cost the NHS at least £1.5 billion each year. In England alone, it has been estimated that annually, around 284,000 admissions to NHS hospitals, eight million GP consultations and seven million prescriptions are the result of a smoking-related illness.<sup>138</sup>

Smoking during pregnancy results in increased healthcare costs, with higher rates of admissions to neonatal intensive care units and hospitals, as well as outpatient and emergency treatment. One study in the USA estimated the costs of smoking-attributable maternal ill-health during pregnancy at \$167 million annually.<sup>139</sup> Another estimated that the direct medical costs of childhood illness caused by parental smoking totaled \$4.6 billion each year.<sup>140</sup>

Exposure to second-hand smoke in childhood is associated with increased hospitalisation. It is estimated that each year, more than 17,000 children under five years old are admitted to UK hospitals because of respiratory illness caused by exposure to other people's cigarette smoke.<sup>77</sup> The costs of children's medical care from exposure to second-hand smoke in the UK have been estimated at £167 million at 1997 prices.<sup>141</sup>

**Table 2: Estimated population impact of smoking on selected aspects of reproductive life**

	Relative risk	Exposure in group affected (%)	Population attributable proportion (%)	Estimated smoking-related cases per year (UK)
<b>Sexual health (active smoking)</b>				
Male sexual impotence (age 30-49 years)	1.5	34	14.5	120,000
Cervical cancer (malignant)	3	32	39	1,200
<b>Pregnancy (active smoking)</b>				
Miscarriage	1.25	20 - 32	5 - 7	3,100 – 5,000
Low birth-weight	3	20 - 32	29 - 39	14,000 –19,000
Stillbirth	1.4	20 - 32	7 - 11	270 - 420
Death of the newborn (less than 4 weeks old)	1.4	20 - 32	7 - 11	170 - 260
<b>Pregnancy (passive smoking)</b>				
Low birth-weight	1.2	21	4	2,000
<b>Infant and child health (passive smoking)</b>				
Cot death (mother only)	2.13	11	11	-
Cot death (father only)	1.71-2.12	18	11 - 17	-
Asthma	1.37	42	13	-
Recurrent ear infection	1.48	42	17	-
Hospital admission for respiratory illness, bronchitis, pneumonia	1.71	42	23	-

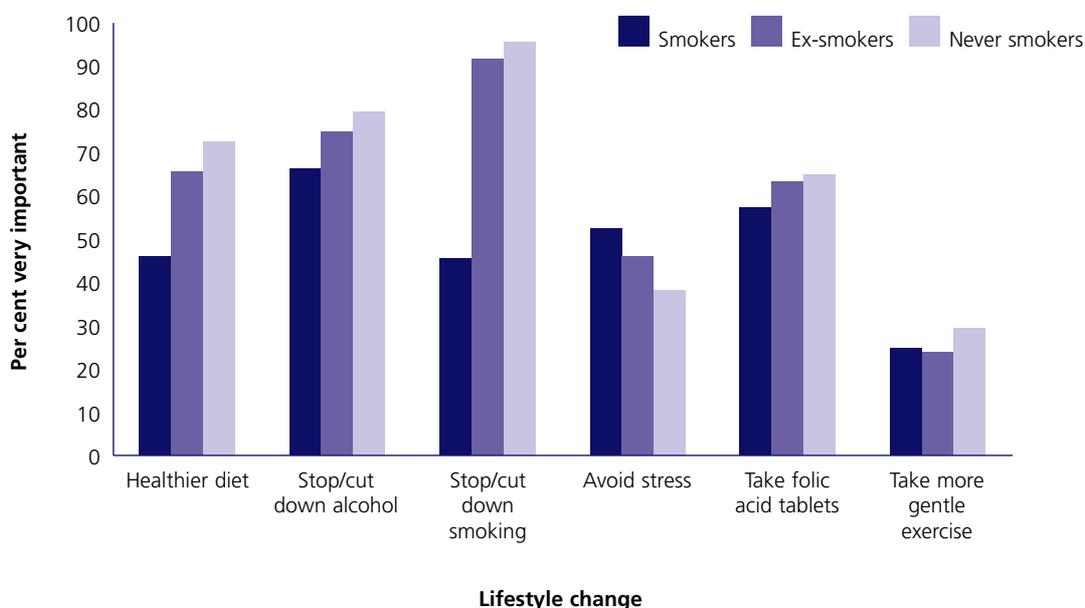
For details, references and notes, see **Appendix B**.

## Public awareness of the impact of smoking on reproductive health

Surveys have found that while public awareness of certain effects of smoking on reproductive health is high, knowledge of others is poor. The best-known effects are those related to pregnancy. Three out of four pregnant women agree that a woman who smokes during pregnancy is more likely to have a small baby. However, attitudes differ markedly between smokers and non-smokers: only half as many smokers (39%) believed that smoking increased the risk of having a small baby. Similarly, while more than nine out of 10 (95%) non-smokers considered it very important to stop smoking during pregnancy, just half as many (45%) smokers agreed.<sup>142</sup>

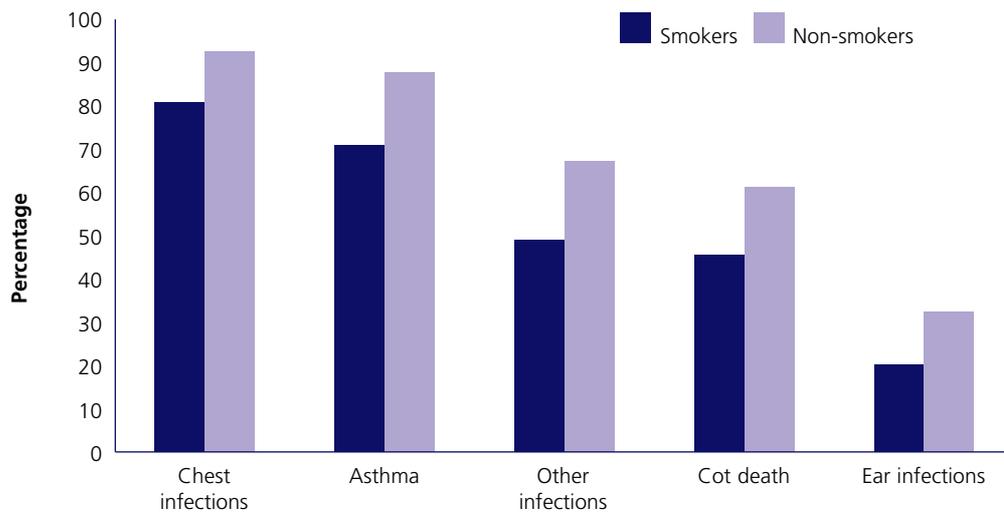
Many pregnant smokers do not perceive smoking as a real and substantial threat to their own health or to that of their baby. A recent survey in London found that while both non-smokers and ex-smokers correctly identified stopping smoking as the most important lifestyle change a pregnant woman could make, smokers tended to believe that other changes were more important (**figure 8**).<sup>143</sup> Some pregnant women rationalise continued smoking by citing successful pregnancies that they or their smoking friends and relatives have had, or by mistakenly believing that a low birth-weight or smaller baby will lead to an easier labour.<sup>144</sup>

**Figure 8: Pregnant women's attitudes to the importance of lifestyle changes during pregnancy**



Among the general public, awareness of certain health risks to babies and children from second-hand smoke is high. But while almost nine out of 10 agree that passive smoking increases the risk of chest infections, fewer than half know that passive smoking increases the risk of cot death and glue ear. Awareness of these risks is higher among smokers than among non-smokers (**figure 9**).

**Figure 9: Knowledge of health risks to children from second-hand smoke**



Public awareness of other smoking-related conditions that affect reproductive life is less readily assessed, as data is not collected in regular official surveys. The limited number of studies and opinion polls that have been carried out suggest, however, that awareness is low.

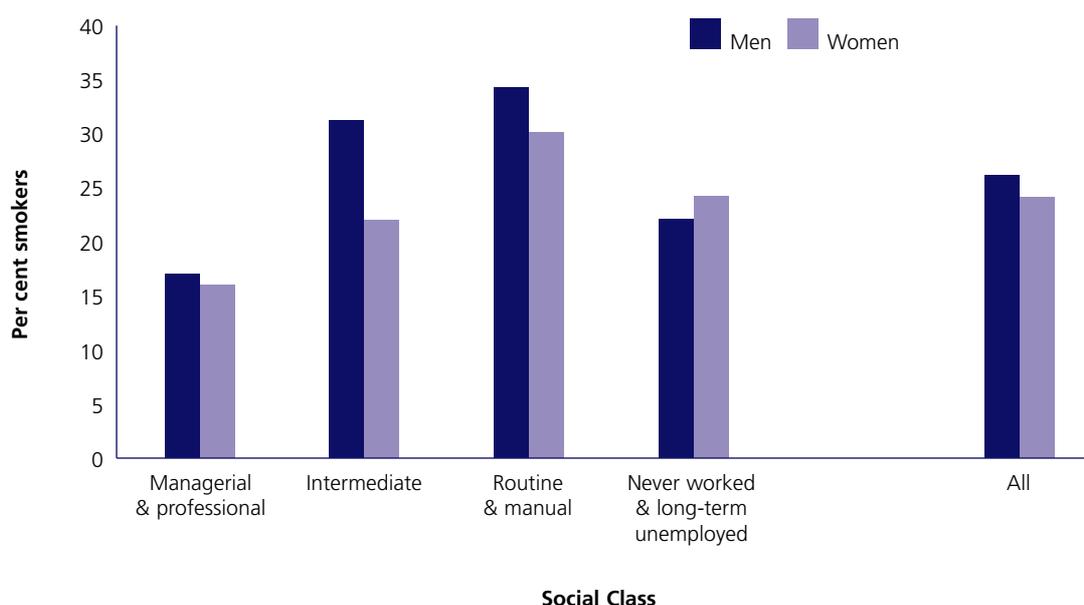
One study of women attending a women's health clinic indicated that those who smoke are largely unaware of their increased risk of invasive cervical cancer, and do not appreciate the particular importance of having regular smear tests for smokers.<sup>145</sup> This is of particular concern given that smokers are less likely to attend for smears than non-smokers. Another survey, carried out in 2001, found that many women remain unaware of the threats posed by smoking to women's health.<sup>146</sup> Almost seven in 10 (68%) of those questioned did not realise that smoking could increase the risk of miscarriage, while nearly nine out of 10 were unaware that smoking is linked to cervical cancer.

In 1999, a MORI poll conducted for the National Impotence Association found that just 13 per cent of men who smoked could identify smoking as a cause of impotence.<sup>147</sup> In 2001, a MORI poll conducted for the National Infertility Awareness Campaign found that among both men and women, recognition of smoking as a cause of fertility problems was low.<sup>148</sup>

## Smoking in the UK – rates and trends

In 2002, some 26 per cent of men and 24 per cent of women were smokers.<sup>149</sup> Smoking shows a strong socioeconomic gradient, with rates being lowest among professional groups and highest among semi-skilled workers (figure 10). The gap between these groups appears to have widened in recent years, particularly for women smokers. Since the early 1970s, smoking rates have been cut by almost half among the most advantaged groups, but have remained unchanged among the most deprived. Over the same period, the number of smokers giving up doubled in the most affluent groups, while quit rates among the least affluent remained unchanged.<sup>150</sup>

Figure 10: Social class and smoking



Smoking rates across the country – both regional and local – reflect socioeconomic trends. The greater the level of socioeconomic deprivation, the higher the rate of smoking. Within England,<sup>149</sup> smoking rates are lowest in the South at around 24 per cent, but highest in London<sup>151</sup> and the North, at around 29 per cent. In Scotland,<sup>152</sup> smoking rates have been found to vary between postcode areas from 15 per cent to 71 per cent.

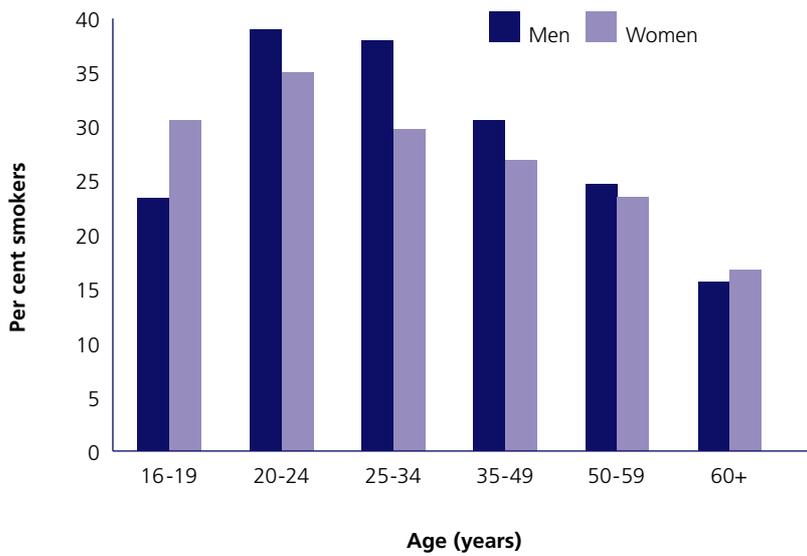
Rates of smoking among the most disadvantaged are extremely high. A lone mother with a poor level of education, living in council accommodation and receiving income support has an 80 per cent risk of being a smoker.<sup>153</sup>

### Smoking in younger adults<sup>y</sup>

Smoking rates among younger adults (aged 35 years and under) are higher than those in the overall UK population. In 2001, rates were highest among men aged 20–24 (39%) and 25–34 (38%). Among women, smoking was most prevalent among 20–24 year-olds (35%). Age-specific smoking rates in men and women are presented in figure 11. While over the past decade the prevalence of smoking has fallen considerably among those aged 35 and older, no clear downward trend has been seen among younger adults. In recent years, smoking prevalence has increased among girls and young women, who now account for the majority of new smokers.

<sup>y</sup> The BMA policy report, *Adolescent health*, was published in December 2003. This report focuses on the problems facing adolescents and examines the evidence surrounding adolescent health, behaviour and interventions. It reviews four important areas in adolescent health: nutrition, exercise and obesity; smoking, drinking and drug use; mental health; and sexual health.

**Figure 11: Age-specific smoking rates in men and women (2001)**

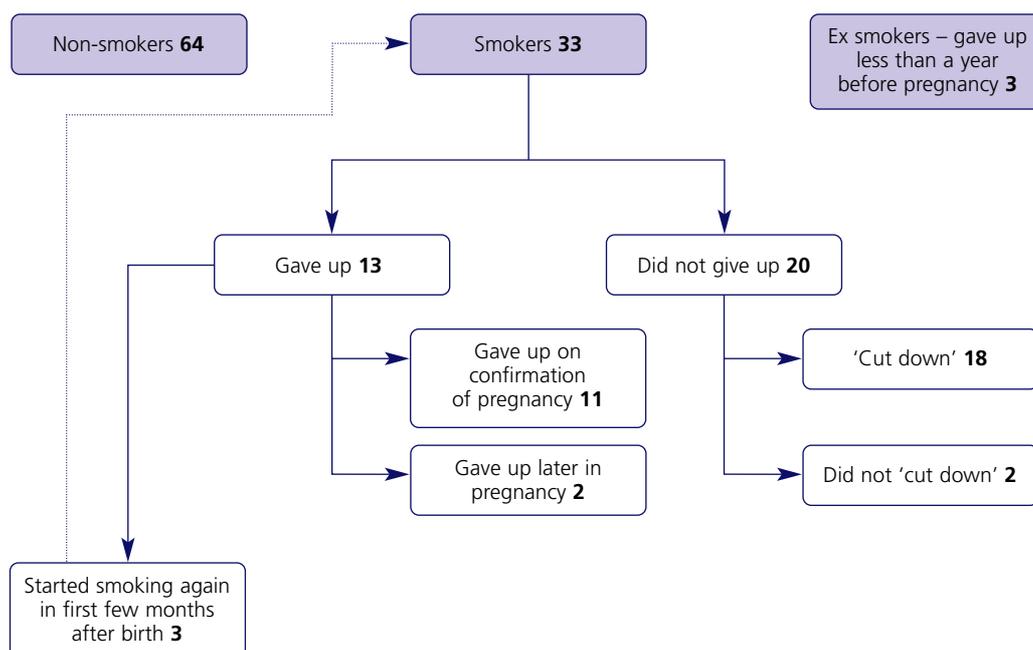


**Smoking in pregnancy**

In 2000, just over one in three (35%) pregnant women in the UK had smoked in the 12 months before they became pregnant. One in five (20%) women smoked throughout pregnancy. One in three of those who smoked therefore succeeded in stopping either before or during pregnancy. Of the pregnant women who had stopped smoking, just one in five (20%) gave up before becoming pregnant. The vast majority (73%) of those who stopped smoking did so on confirmation of the pregnancy, with just one in 14 (7%) giving up later in pregnancy (figure 12).

Within 10 weeks of giving birth, almost one in four (23%) women who had managed to stop smoking had begun again. Almost all of those who smoked during pregnancy continued to smoke after the birth (99%).

**Figure 12: Smoking during pregnancy – one hundred pregnant women**



The above data are drawn from the UK Infant Feeding Survey,<sup>154</sup> and are based on mothers' own recollection of their smoking during pregnancy. However, studies that have used clinical tests to verify survey data estimate rates of smoking during pregnancy as considerably higher (**box 7**).

#### **Box 7: Smoking in pregnancy – a note on the database**

The UK Infant Feeding Survey<sup>154</sup> provides the most recent data on smoking during pregnancy. The 1995 survey also provides the baseline against which UK government targets to reduce smoking in pregnancy will be measured. In 1995, the survey estimated that at the beginning of their pregnancy, 35 per cent of mothers smoked before pregnancy, and 23 per cent continued to smoke throughout.

Data from the Infant Feeding Survey are based on retrospective self-report – women are asked after their babies' birth about their smoking before, during and after pregnancy. Research shows that in such surveys, women may not always report smoking status during pregnancy accurately.

Surveys carried out by the Health Education Authority suggest that in 1999, 45 per cent of pregnant women smoked before they became pregnant, and 30 per cent reported smoking while pregnant.<sup>142</sup> A 2001 study in which survey data were validated using blood tests suggested that the prevalence of smoking among pregnant women was 32 per cent.<sup>155</sup>

Certain studies also estimate the rate of relapse after pregnancy at substantially higher than that reported in the Infant Feeding Survey: validated survey data suggest that in fact the majority of women who succeed in stopping smoking during pregnancy are smoking again one year after the baby has been born.<sup>156</sup> One recent study, carried out in London, found that just over half (54%) of women who had stopped smoking at the beginning of their pregnancy were still non-smokers by the time their baby was born. Six months after the baby was born, almost eight in 10 (77%) had begun smoking again.<sup>157</sup>

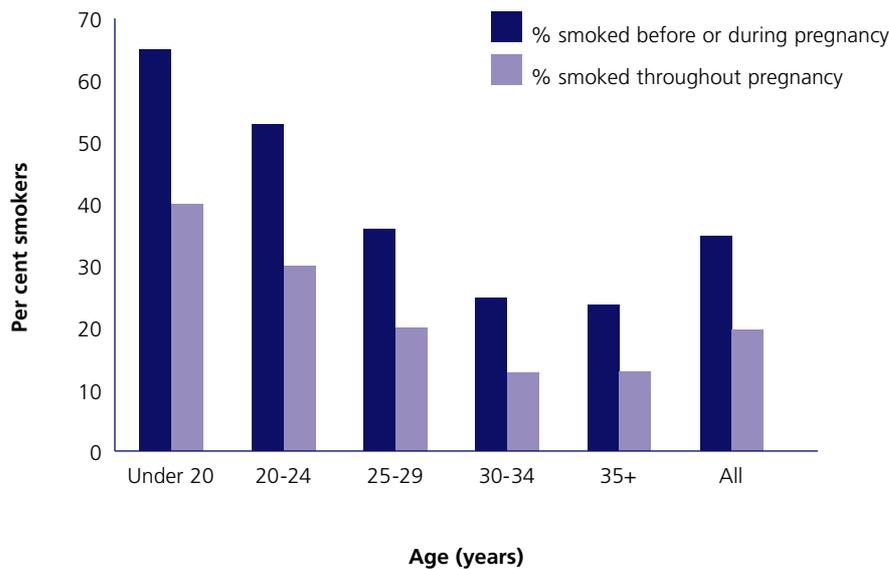
Validated survey data also suggest that while many women who continue to smoke during pregnancy may report smoking fewer cigarettes ('cutting down'), their consumption of tobacco does not change.<sup>158</sup>

Rates of smoking among newly pregnant women vary by age and social class, reflecting trends in the population at large. Moreover, women of lower education, income and employment status are much more likely to continue smoking during pregnancy.

Younger mothers are considerably more likely to smoke both before and during pregnancy (**figure 13**). Two out of three teenage mothers smoked before they became pregnant, and around four in 10 continued to smoke throughout their pregnancy.

The lower a woman's socioeconomic status, the more likely she is to smoke during pregnancy. Women in manual occupations are four times more likely to smoke during pregnancy than those in non-manual occupations. Just four per cent of professional women smoke while pregnant, compared with 26 per cent in unskilled occupations.

**Figure 13: Smoking in pregnancy by mother's age (UK 2000)**



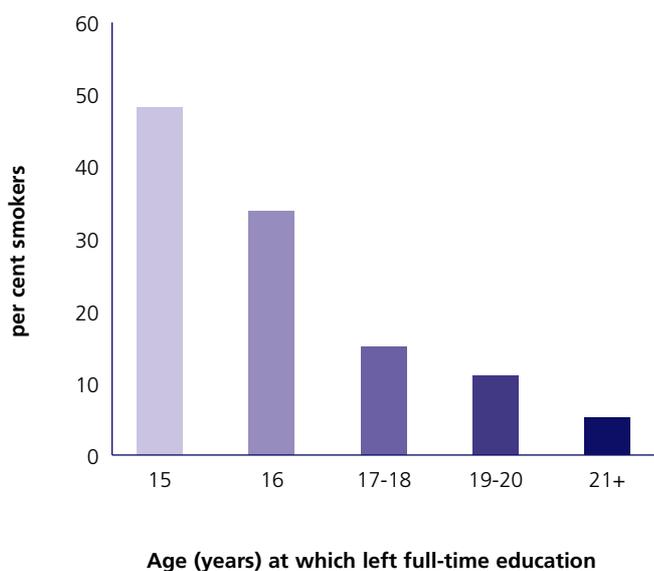
The more educated a woman, the less likely she is to smoke during pregnancy. Women with the least education are almost 10 times more likely to smoke during pregnancy than their better-educated peers. While only one in 20 women who stay in full-time education until age 21 smokes when pregnant, almost half of those who left school aged 15 years do so (**figure 14**).<sup>159</sup>

Other factors associated with an increased likelihood of smoking during pregnancy include being a heavy smoker, having an unplanned pregnancy, and being unemployed. Women who are pregnant for the first time are more likely to give up smoking than women who have smoked during a previous pregnancy.<sup>160</sup>

Pregnant smokers tend to have partners who smoke: two-thirds (67%) of pregnant smokers have a partner who smokes. In one study, women with partners who smoked were four times more likely to smoke during pregnancy than those who had a non-smoking partner<sup>160</sup> (41% versus 10%).

More than eight out of ten pregnant women who smoke want to stop, yet just three in ten manage to do so. **Box 8** presents research on women smokers' attitudes to smoking during pregnancy, their experience of trying to stop, and the factors which help or hinder their attempts.

**Figure 14: Smoking in pregnancy by mother's educational level**



Many women who manage to stop smoking during pregnancy begin again after the birth. A recent review found that two main factors were associated with women returning to smoking after the birth: having family and friends who smoked, and not breastfeeding.<sup>161</sup> Women who stop smoking mainly because of their pregnancy tend to begin smoking again soon after the birth of the baby. In contrast, women who gave up both for their own health and that of the baby appear to be more likely to remain non-smokers.<sup>162</sup>

### **Exposure to second-hand smoke**

For non-smokers – children and adults alike – who share their household with a smoker, the most significant exposure to second-hand smoke is likely to occur in the home. Some 21 per cent of non-smoking adults live in households where at least one person smokes. One in five (21%) pregnant non-smokers who live with another person is exposed to second-hand smoke in their home. Women in more disadvantaged groups are more likely to live with a partner who smokes.

Almost three in 10 (29%) of all pregnant workers are exposed to tobacco smoke at work. Workers who are less well educated and those who work in manual or service jobs are more likely to be exposed to second-hand smoke in the workplace.<sup>22</sup>

Some 42 per cent of children live in households where at least one person smokes. More than half (54%) of babies and young children in poorer homes are exposed to second-hand smoke at home, compared with fewer than two in 10 (18%) of those from professional backgrounds.<sup>162</sup>

A 1998 survey found that overall, children's exposure to second-hand smoke – as measured by cotinine levels – had almost halved since the late 1980s. However, this trend was largely accounted for by an increase in the proportion of children living in non-smoking households (from 48% to 54%), and by reductions in exposure outside the home. Among children with one or more parents who smoked, exposure to second-hand smoke in the home did not decrease significantly.<sup>163</sup>

### **Box 8: Smoking and pregnancy: women's experiences**

One Scottish study<sup>162</sup> provides a typical picture of women's experiences of smoking and pregnancy.

Women who smoked during pregnancy had strong feelings of guilt. Knowledge of the risks of smoking in pregnancy to the baby's health before and after birth was generally good. However, women tended to try to rationalise and discount the health effects of smoking, as a way of coping. Women described the role that smoking played in their lives: they perceived it as offering a break, helping them cope with boredom, and acting as a social prop.

Few women reported being offered support to stop, and few actively sought help from healthcare professionals. Guilty feelings led some to report smoking fewer cigarettes than they actually did.

Women found it difficult to stop smoking, and some found themselves delaying the decision to do so. Morning sickness was a trigger for some. Others had family or friends who agreed to give up smoking at the same time: the more supportive family and friends were, the more encouraged the woman felt to stop. However, although most partners stated that women should not smoke during pregnancy, few partners who smoked made any change in their own behaviour.

Among women who did succeed in giving up, some returned to smoking directly after the birth of the baby, often while still in hospital, where a smoking room was available. Many women said that they did not smoke around their newborn at home, nor did they let anyone else do so. After a few months, however, most returned to their normal smoking pattern. The triggers for relapse were seen as stress, social situations where others were smoking, and even seeing smoking on television.

Research with young women smokers on low incomes echoes many of these themes. For example, a recent study carried out in Edinburgh found that the overriding feeling that women had about their smoking was one of guilt.<sup>164</sup> Many worried about the effect smoking had on their health, and on that of their children. Most had tried – and failed – to give up smoking, and felt disgusted at themselves and their habit, and powerless to change their behaviour.

## *Smoking in the UK – current policies*

Various international bodies have made recommendations on the need to reduce the burden of smoking on reproductive and child health. Selected recommendations are presented in **Box 9**.

### **Box 9: Smoking and reproductive life: selected recommendations**

The risks posed to children's health by exposure to second-hand smoke have been recognised by the leaders of the G8 nations. In their 1997 declaration on Children's Environmental Health, they state: *'We affirm that environmental [second-hand] tobacco smoke is a significant public health risk to young children and that parents need to know about the risks of smoking in the home around their young children. We agree to co-operate on education and public awareness efforts aimed at reducing children's exposure to environmental tobacco smoke.'*

An expert consultation on child health convened by WHO concluded: *'Swift action to highlight the need for strong public policies to protect children from exposure to tobacco smoke is essential. This can be achieved by two complementary strategies: eliminating children's contact with tobacco smoke in utero and in childhood, and reducing overall consumption of tobacco products. Effectively implementing these strategies requires combining educational programmes and legislative interventions aimed particularly at eliminating tobacco use in settings frequented by children.'* It also highlighted the need to encourage prospective parents to stop smoking, stating that *'particular attention should be given to interventions to assist pregnant women to stop smoking. Preventing them from relapsing and inducing their partners to stop smoking will increase the likelihood of a smoke-free environment for children. Training for health professionals who work with pregnant women is crucial.'*<sup>7</sup>

The European Commission, noting that children are especially vulnerable to the secondary effects of smoking, has stated its intention to develop a code of practice on the right to a smoke-free environment for children, based on the existing European Code Against Cancer. The Commission has also undertaken to *'promote measures to increase awareness among the public and especially pregnant women of the dangers of smoking – both active and passive – to the unborn.'*<sup>165</sup>

The 1998 white paper *Smoking Kills*<sup>166</sup> recognises the importance of reducing smoking rates as a strategy for improving health. The paper sets out the following strategies to achieve this:

- increasing tobacco taxes and combating tobacco smuggling
- ending tobacco advertising, promotion and sponsorship
- mass media health promotion campaigns
- establishing smoking cessation services for smokers who wish to quit
- protecting non-smokers from second-hand smoke.

Health promotion and disease prevention are identified as key components of the NHS modernisation review.<sup>167</sup> Smoking cessation has been identified as central to meeting the targets in the National Service Framework on CHD and the NHS Cancer Plan.

The government has also recognised the importance of reducing smoking rates in tackling health inequalities. Key national targets in reducing health inequalities are to narrow the gap in life expectancy and to reduce the difference in infant mortality across social classes by 2010. The 2002 cross-cutting governmental review *Tackling Health Inequalities*<sup>168</sup> noted that smoking accounts for a major part of differences in life expectancy. It identified as a priority reducing smoking among manual social groups through smoking cessation and

other supporting interventions. Reduction of smoking in pregnancy was identified as being likely to have a major impact on infant mortality.

Government targets have been set for reducing smoking among three key population groups: young people, adults, and pregnant women. **Table 3** presents current targets for reducing smoking in England, Wales, Scotland and Northern Ireland, and notes the progress made.

In addition, the NHS Cancer Plan has set a target of reducing smoking among manual groups from 32 per cent to 26 per cent by 2010. The NHS National Service Framework has set targets for smoking cessation: to achieve 800,000 smokers successfully quitting at four weeks by 2006; and to achieve one percentage point reduction per year in the proportion of women who continue to smoke during pregnancy, with a particular focus on disadvantaged groups.

**Table 3: Progress towards government targets to reduce smoking**

	England (% smokers)			
	1996	2005	2010	<b>Current 2002</b>
<b>All adults</b>	28	26	24	<b>26</b>
<b>During pregnancy</b>	23	18	15	<b>19</b>
<b>Young people (11-15 years)</b>	13	11	9	<b>10</b>
<b>Manual groups (1998)</b>	32	–	26	<b>32</b>

	Scotland (% smokers) <sup>169</sup>		
	1995	2010	<b>Current 2002</b>
<b>All adults</b>	35	31	<b>28</b>
<b>During pregnancy</b>	29	20	<b>25.3</b>
<b>Young people (12-15 years)</b>	14	11	<b>14</b>
<b>Manual groups</b>	–	–	–

	N. Ireland (% smokers) <sup>170</sup>		
	2000-01	2006	<b>Current 2001</b>
<b>All adults</b>	27	25	<b>27</b>
<b>During pregnancy</b>	22	18	<b>22</b>
<b>Young people (11-16 years)</b>	13.5	11	<b>13.5</b>
<b>Manual groups</b>	35	31	<b>31</b>

	Wales (% smokers) <sup>171</sup>		
	1996	2002	<b>Current 2000</b>
<b>All adults</b>	27	20	<b>25</b>
<b>During pregnancy</b>	–	1/3 pregnant smokers to stop	–
<b>Young people (15 years)</b>	26	18	<b>24.5</b>
<b>Manual groups</b>	–	–	–

## Tackling the problem – what works?

Tackling the burden of smoking on sexual, reproductive and child health will require strategies that: reduce smoking rates in the population at large, and especially among younger adults; reduce smoking during pregnancy; and protect pregnant women and children from exposure to second-hand smoke.

This section summarises the available evidence on the effectiveness of public health policies to cut tobacco consumption, smoking cessation interventions, and strategies to reduce exposure to second-hand smoke; drawing on both research from the UK and elsewhere.

### *Public health policies*

Comprehensive tobacco control programmes are effective in cutting tobacco consumption. The World Bank has concluded that an integrated tobacco control strategy would include measures to increase tobacco taxes, add prominent warning labels to cigarettes, adopt comprehensive bans on advertising and promotion, and restrict smoking in workplaces and public places.<sup>172</sup> **Table 4** shows the estimated reduction in tobacco consumption produced by key elements of a comprehensive tobacco control programme.

**Table 4: Estimated impact of tobacco control measures**

Measure	Reductions in tobacco consumption (%)
Comprehensive ban on tobacco advertising and promotion	6
Increase tobacco taxes 10%	4
Legislation for smoke-free workplaces and public places	4–10

Despite the ban on tobacco advertising, promotion and sponsorship in the UK, which became law on 14 February 2003, marketing of tobacco remains a serious concern, in the UK and elsewhere. Marketing, including branding and product design, is used to create images that appeal directly to young men and women. When marketing to women, attributes such as slimness, femininity and independence are emphasised; when marketing to men, masculinity, risk-taking and courage are highlighted.<sup>173</sup> **Box 10** describes the techniques used to market tobacco worldwide, and their influence on young people.

### **Box 10: Tobacco: marketing the myth**

Marketing of tobacco may be direct or indirect, via the broadcast media, billboards, print media, mail shots, and electronic media. Tobacco promotion through sports sponsorship creates and perpetuates misleading beliefs regarding the consequences of tobacco use.<sup>174,175</sup> Tobacco promotions involving the arts, including sponsorship deals and product placement in movies and television shows, can also affect children and young people. Sponsorship of rock concerts, popular music, fashion shows, and popular youth figures by tobacco firms and portrayal of brand names in movies have been used as a way of glamourising tobacco use. There is evidence that children and young people are influenced by the smoking habits of their favourite film stars<sup>176</sup> and by smoking in the films.<sup>177</sup> Children are often the main target of brand name promotions through clothing and other promotional items.

In a recent report,<sup>178</sup> the United Nations Children's Fund assessed the impact of tobacco promotion on children and concluded that: '*deliberate misinformation by tobacco companies and media messages that lead to positive attitudes towards tobacco use pose serious threats to children's rights as provided for in the Convention*'. The report indicates that tobacco advertising violates Article 17 of the Convention, which protects the child from harmful or misleading materials.

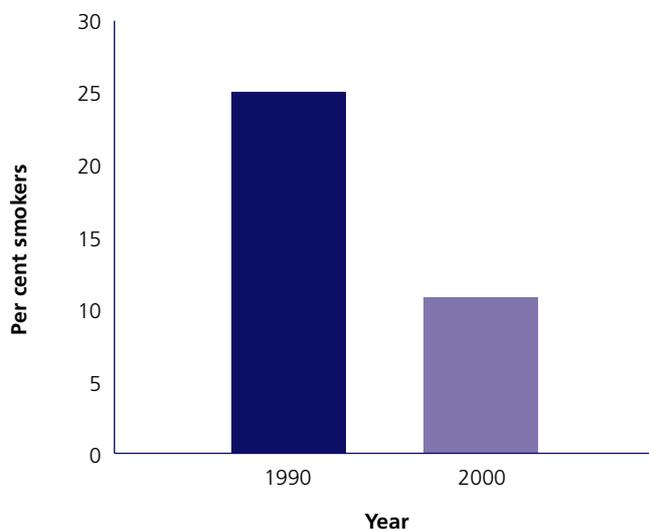
Where comprehensive, adequately funded tobacco control strategies have been implemented, smoking prevalence has fallen across all population groups, including pregnant women. For example, after the introduction of a state-wide tobacco control programme in Massachusetts, smoking rates fell within the general population and halved among pregnant women in 10 years. In Ireland, renewed efforts in a national tobacco control programme have seen smoking rates – stagnant during much of the 1990s – fall four percentage points in four years. The decrease has been consistent across all population groups (**box 11**).

### Box 11: Policies: Massachusetts and Ireland

In the 1990s, the state of Massachusetts in the USA implemented a tobacco control programme with three main goals. The programme aimed to prevent young people from using tobacco products through education and reducing access to tobacco products; to persuade and help smokers to quit smoking; and to protect non-smokers from second-hand smoke. A proportion of tobacco tax revenue was earmarked to fund the programme.

Over the decade 1990–2000, smoking among adults fell from 22.6 per cent to 17.9 per cent. This represented a 14 per cent reduction in the number of smokers, and a 36 per cent reduction in cigarette consumption. Smoking by pregnant women more than halved, from 25 per cent to 11 per cent. Among young people, smoking rates and smokeless tobacco use also declined.

#### *Massachusetts: Smoking in pregnancy*



In 2000, the Irish Government published its first policy document on tobacco *Towards a Tobacco Free Society*, outlining an integrated tobacco control strategy. In 2000, an independent Office of Tobacco Control was established to advise on the control and regulation of tobacco products. Awareness of the dangers of smoking has been raised by sustained public debate. Smoking cessation services provide support for smokers who want to stop. A high-profile mass media campaign aimed particularly at young women has been launched. The price of tobacco has been increased through taxation in successive budgets. In 2000, tobacco advertising and sponsorship was banned. In 2001, the sale of tobacco to people under 18 years of age was prohibited. In 2003, the Minister for Health and Children issued draft regulations to make all workplaces smoke-free from early in 2004.

In the four years from 1999–2003, smoking rates among adults in Ireland have dropped from 31 per cent to 27 per cent.<sup>179</sup> Rates have fallen among both men (28%) and women (26%). The trend is consistent across all social groups. Exposure to second-hand smoke also fell over the period.

Health warnings on tobacco products are an important part of a comprehensive tobacco control strategy. As the result of a new EU Directive,<sup>180</sup> cigarettes sold in the UK from 30th September 2003 are required to carry prominent new health warnings, covering 30 per cent of the front of the pack, and 40 per cent of the back of the pack. Among the rotating messages are four that are particularly relevant to sexual, reproductive and child health:

- smoking may reduce the blood flow and causes impotence
- smoking can damage the sperm and decreases fertility
- smoking when pregnant harms your baby
- protect children – don't make them breathe your smoke.

The directive also provides for member states to add graphic images to illustrate the health warnings. Such picture warnings have been introduced in several countries including Canada, and have proven particularly effective in reaching young people and people with poor literacy. Examples of relevant picture warnings are presented in **figure 15**.

**Figure 15: Selected Canadian health warnings relevant to sexual, reproductive and child health**



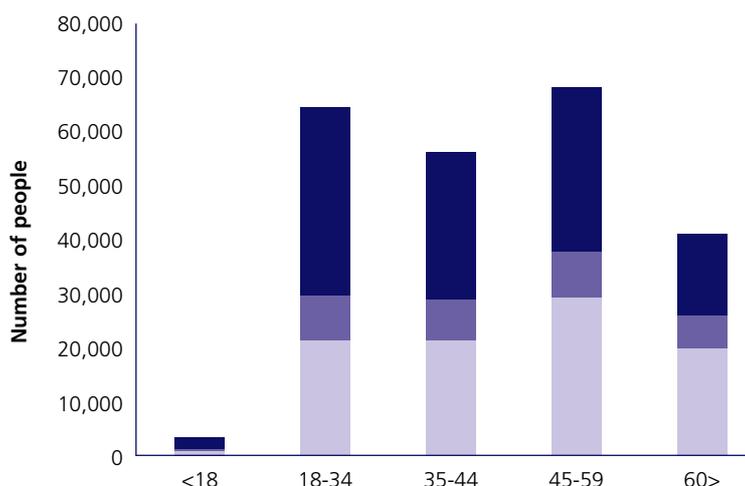


### *Smoking cessation – helping smokers to stop*

More than seven out of ten of smokers in the UK say they would like to stop smoking, and almost as many have made at least one attempt to do so.<sup>181</sup> Smokers can and do stop smoking without any help, but success rates are low: just one to three per cent of smokers who try to stop smoking unaided will still be abstinent 12 months later. Support from a healthcare professional increases success rates. The more intensive the support, the better the outcome. Brief (three to five minutes) advice from a GP increases the success rate to around five per cent. Specialist support in a smokers' clinic increases it to 10 per cent.

In the UK, the NHS smoking cessation services have had success in helping smokers to stop. NHS funding for specialist services has led to the establishment of smoking cessation clinics across the country. These services are achieving impressive rates of early success among smokers (**figure 16**).<sup>182</sup>

**Figure 16: Smoking cessation in specialist services: England, 2002–03**



	<18	18-34	35-44	45-59	60>
Set a quit date	3,498	64,646	56,508	68,694	41,088
Self-reported success at 4 weeks	1,227	29,973	28,803	38,173	25,705
CO-validated success at 4 weeks	847	21,487	21,573	29,098	19,662

**Age groups**

The smoking cessation services are used more by women (58% of clients) than by men. Almost seven out of 10 clients are aged 35 and older. In 2001, some 6,768 pregnant women set a quit date with the services, of whom 2,992 (44%) reported that they had succeeded in stopping smoking for at least four weeks.

More than half (53%) of smokers who set a quit date with the services succeed in stopping for at least four weeks. In the longer term, it is estimated that about one-third of those who succeed in stopping for four weeks are helped to stop smoking for good. However, no collated data are currently available on longer-term quit rates among users of stop smoking services.

More than eight out of 10 (84%) of those who stopped smoking with the help of the services use pharmacotherapies, such as nicotine replacement therapy (NRT) and/or bupropion. These therapies are now available on NHS prescription, and guidelines for their effective use have been issued by the UK National Institute for Clinical Excellence (NICE) (**box 12**).

The effectiveness of NRT in pregnancy has yet to be studied in clinical trials. Concerns remain about possible effects of nicotine on the foetus; however, it has been noted that any harmful effects of NRT seem likely to be greatly outweighed by the risks of continued smoking.<sup>183</sup> The NICE guidelines state that NRT can be prescribed to pregnant or breastfeeding women after discussion with a health professional. The British National Formulary recommends that nicotine replacement therapy be used in pregnancy ‘*only if smoking cessation without nicotine replacement fails*’.<sup>184</sup> Bupropion should not be prescribed for women who are pregnant or breastfeeding.

### Box 12: Pharmacotherapies and smoking cessation

Pharmacological treatment is effective in helping smokers to stop. Nicotine replacement therapy (NRT) increases success rates 1.74 fold: clinical trials of smoking cessation interventions have shown that around 17 per cent of smokers receiving specialist support and who use NRT will still be abstinent 12 months later, compared with 10 per cent of those who received a placebo. This increase is not affected by whether the intervention takes place in primary care, in the community, in a smoking clinic or in a hospital.<sup>184</sup> Various NRTs are available both over the counter and on NHS prescription.

Bupropion (marketed as Zyban®) is an antidepressant that is effective in smoking cessation. It doubles (2.05 times) success rates. In clinical trials, 19 per cent of smokers using bupropion were still abstinent at 12 months, compared to nine per cent of those receiving a placebo. In the UK, bupropion is licensed for use in smoking cessation with motivational support. It is available only on prescription, and can be supplied on the NHS.

Both NRT and bupropion may be supplied on prescription by suitably trained non-medical healthcare professionals through use of a Patient Group Directive. Guidelines for setting up such a Directive have been published.<sup>186</sup>

Programmes to help pregnant women do not usually involve the provision of NRT, but rather rely on information and motivational support. There is a need for consistency in the advice, support and services offered to pregnant women who smoke. Despite the harm associated with smoking in pregnancy, and the benefits of stopping smoking, fewer than four in 10 pregnant smokers report receiving advice on smoking from a healthcare professional (**box 13**). Moreover, a survey of purchasers and providers of maternity services in England carried out in 1998 found that smoking cessation interventions in pregnancy were diverse and *ad hoc*. Data collection and monitoring were described as haphazard.<sup>187</sup>

### Box 13: Advice on smoking in pregnancy: women's experiences

Despite the harm associated with smoking in pregnancy, and the benefits of stopping smoking, a survey carried out for the Health Development Agency (HDA) in 1999 found that fewer than four in 10 (38%) pregnant smokers report receiving advice on smoking from a healthcare professional.<sup>142</sup> Healthcare professionals varied in the advice they gave: while GPs were almost twice as likely to advise giving up (50%) as cutting down (28%), midwives were just as likely to advise cutting down on smoking as giving up (31%).

One study in Northern Ireland explored pregnant women's perceptions of the advice they received from healthcare professionals.<sup>188</sup> None of the women reported receiving help in planning to stop smoking. Nor did any report that their partner or family had been given advice about the risks of active and passive smoking. Some women reported being advised to switch to low-tar brands.

Women felt that healthcare professionals should discuss smoking with them, and that this was best done by their GP. However, in a few cases, they felt doctors were judgmental and unapproachable. While healthcare professionals feared that repeatedly discussing smoking at each encounter might harm their relationship with the patient, the women thought that advice and support should be given throughout pregnancy and did not feel that this would adversely affect their relationship with the doctor.

Clinical trials in the UK have found that programmes that rely on the distribution of self-help information during pregnancy are not effective in helping pregnant women stop smoking.<sup>189</sup> A combination of information and support, however, can have an impact. A meta-analysis of the evidence found that smoking cessation interventions with pregnant women are effective. Interventions that focussed on helping women understand the reasons for their smoking and on giving them skills to help change their behaviour were more effective than those which relied on educating women about the threat posed by smoking.<sup>190</sup> Programmes that offered on-going support were more effective. A Cochrane review of interventions for promoting smoking cessation during pregnancy found that high-quality, high-intensity interventions doubled the rate of smoking cessation among pregnant women, and resulted in fewer low birth-weight and premature babies being born.<sup>191</sup>

The HDA recently reviewed the evidence on the effectiveness of smoking cessation in preventing low birth-weight.<sup>192</sup> Effective smoking cessation interventions reduce the prevalence of low birth-weight and increase birth-weight in babies born to mothers who succeed in giving up during pregnancy. The review concluded that formal smoking cessation interventions, provided by a specialist as part of antenatal care, are effective in increasing smoking cessation rates among pregnant women. However, the HDA also noted that in studies evaluating interventions in real-life settings, the findings are less favourable. Moreover, little is known about what interventions may increase cessation among women in lower socioeconomic groups.

The review also concluded that there is little evidence on what interventions are effective in preventing relapse, both during pregnancy and beyond. The content of effective smoking cessation interventions is not clear, nor are effective methods of recruitment, nor the benefits of intensive versus brief interventions. Pre-conception counselling was identified as being important, as was reaching women early in their pregnancies. Training for healthcare professionals also emerged as a feature of effective interventions.

In Sweden, a combination of national tobacco control policies and specialised support including midwife-led interventions with pregnant women has cut smoking during pregnancy from 31 per cent in 1989 to 13 per cent in 2001. However, most women who had stopped smoking during pregnancy began again after the birth (**box 14**).

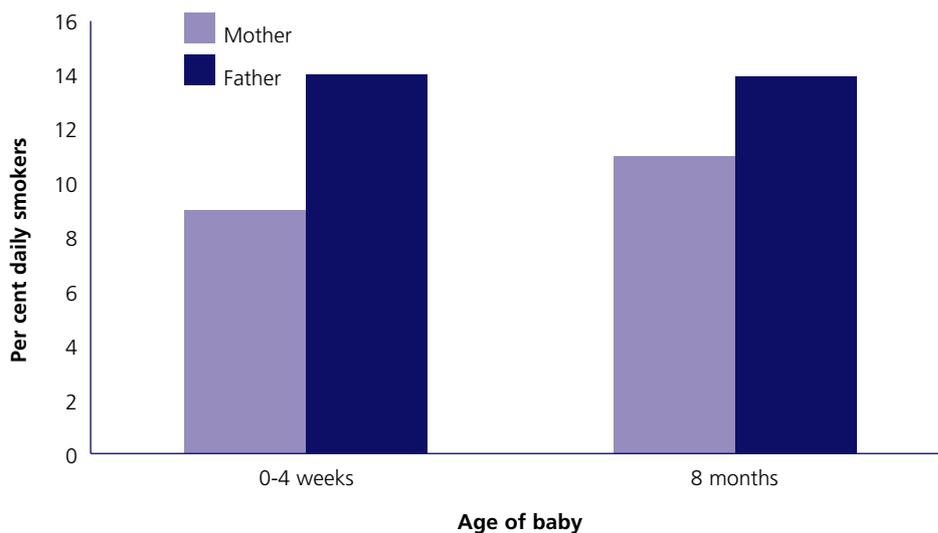
In the UK, two thirds of pregnant smokers have a partner who smokes. Women whose partner smokes are less likely to succeed in stopping smoking during pregnancy, and those who do manage to stop are more likely to return to smoking after the baby is born. Surveys show that just one in four (24%) of men whose partners are pregnant make any change to their own smoking behaviour, and just one in twenty (5%) gives up smoking.<sup>142</sup> However, little evidence is available on smoking cessation interventions with families or partners.

### Box 14: Case Study: smoke-free children, Sweden

Sweden is alone among European countries in having met the WHO target of having fewer than 20 per cent of adults smoking by the year 2000. This has been achieved through an integrated tobacco control strategy, including a comprehensive ban on advertising and legislation to restrict smoking in public places and in workplaces. As a result, prevalence of smoking has fallen from 33 per cent in 1980, to 19 per cent in 2000.

Between 1983 and 1992, smoking among pregnant women in Sweden fell from almost 30 per cent to 22 per cent. This fall was accompanied by a decrease in the frequency of growth retardation among new-born babies.<sup>193</sup> In 1992, with the support of the National Institute of Public Health, the Smoke-free Children campaign began in Sweden.<sup>194</sup> Its aim was to reduce the number of women who smoked and to give children a tobacco-free start to life. The programme has worked with health professionals caring for mothers and babies, to set professional standards and increase awareness among staff in maternity and paediatric health care. An information campaign including a lecture tour, newsletters and media coverage increased public awareness of the issue. Between 1990 and 2000, the proportion of women smoking at the beginning of pregnancy halved, from 24 per cent to 12 per cent, and just 9 per cent of women continued to smoke throughout pregnancy.

#### Smoking among parents of Swedish infants born in 2000



The Smoke-free Children campaign did not aim to influence men, and smoking rates among fathers remain the same during their partner's pregnancy and after the child is born. Nearly all the women who stop smoking during pregnancy begin again within a year of their baby's birth.

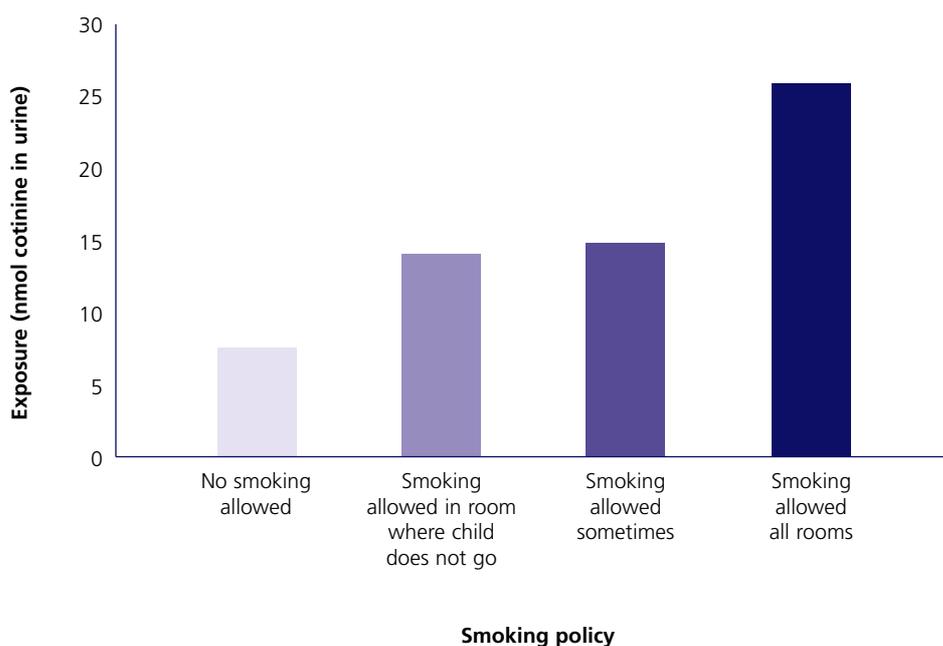
## Protection from second-hand smoke

Legislation from smoke-free public places is effective in protecting non-smokers – including pregnant women and children – from the health risks of passive smoking. Expectant and new mothers are currently entitled, under a European Directive, to be protected against known health risks in the workplace. Despite this, three in 10 pregnant women in the UK are exposed to second-hand smoke at work.

Protection from second-hand smoke in the home centres on education and encouraging smokers to modify their behaviour. One strategy is to restrict smoking to designated places indoors, or to allow smoking only outdoors. Surveys suggest that most smokers are willing to modify their smoking behaviour in the presence of non-smokers, particularly children.<sup>149</sup> However, the evidence on the effectiveness of such strategies is mixed.

Certain studies from other countries suggest that smoking restrictions in the home can reduce exposure to second-hand smoke.<sup>195</sup> For example, one study conducted in the USA assessed the effectiveness of a programme to reduce exposure among asthmatic children whose parents smoked. In homes where smoking was permitted only outdoors, children's exposure to second-hand smoke was reduced more than three-fold. Partial smoking restrictions, although less effective, also provided some protection (figure 17).<sup>196</sup>

**Figure 17: Home smoking restrictions and children's exposure to second-hand smoke**



Surveys in the UK show that pregnant women whose partner smokes continue to be exposed to second-hand smoke at home. A recent survey found that just one in ten men (10%) had changed their smoking patterns in a way that might offer protection from second-hand smoke: five per cent did not smoke around the pregnant woman, while five per cent gave up smoking themselves.<sup>142</sup> Moreover, a UK survey also suggests that despite a growing appreciation of the health risks of passive smoking over recent years, children who live with smokers are no less likely to be exposed to second-hand smoke in the home.<sup>197</sup> Rather, children's exposure to second-hand smoke at home is most closely linked to smoking rates among younger adults.

The effectiveness of interventions to reduce exposure to second-hand smoke in the home may be linked to public policies to protect non-smokers from tobacco smoke in public places. Evidence from countries such as the USA, Canada and Australia suggests that the introduction of legislation for smoke-free workplaces and public places may also have the effect of enhancing protection from second-hand smoke in the home. For example, in Australia, the introduction of legislation for smoke-free workplaces during the 1990s was accompanied by a steep increase in the proportion of adults who avoided exposing children to tobacco smoke at home. Among households with children, the proportion with smoking restrictions more than doubled, from 25 per cent in 1989 to 59 per cent in 1997. The increase among households where parents smoked was even more dramatic: among homes where one adult smoked, the proportion with smoking restrictions rose from 17 per cent to 53 per cent; among those where all adults smoked, it increased from two per cent to 32 per cent.<sup>198</sup>

# Recommendations

## Research

### *Health impact*

1. **Research is needed to better characterise the association between smoking and certain reproductive health outcomes, including: menstrual disorders; alterations of sex hormone metabolism; and foetal malformation.**
2. **Research into the role of smoking in cot death should continue.** The effects of nicotine on the developing nervous system are of particular interest.
3. **The long-term effects of parental smoking on child health – including behavioural problems and childhood and other cancers – warrant further investigation.**

### *Burden and costs*

4. **The burden of smoking on sexual, reproductive and child health in the UK should be determined.** The healthcare costs of the impact of smoking on sexual, reproductive and child health should be estimated.

### *Accurate monitoring of trends*

5. **Wherever possible, survey data on smoking should be validated using biological markers, such as cotinine or carbon monoxide monitoring.** This is particularly important for studies of smoking during pregnancy, when assessing children's exposure to second-hand smoke and for determining the success of smoking cessation interventions.

### *Interventions*

6. **Randomised controlled studies of the effectiveness of smoking cessation interventions in pregnant women are needed.** Studies to address the safety and efficacy of nicotine replacement therapy in pregnancy are urgently required.
7. **The role of partner support in smoking cessation, in preventing relapse and in protecting children from second-hand smoke in the home requires closer evaluation.**
8. **The factors that make for successful smoking cessation interventions for pregnant women require further characterisation.** Research should address recruitment, participation, success rates, relapse and outcomes in real-life settings. Special consideration should be given to reaching women in lower socioeconomic groups.

## Public education and information

9. **There is a need for better recognition of the impact of smoking on sexual, reproductive and child health and an appreciation of the associated benefits of smoking cessation.** We hope that this report will provide a useful summary. The media, health care professionals and specialist health interest organisations all have a role to play in communicating the risks of smoking to sexual, reproductive and child health.
10. **A baseline survey of public awareness of the effects of smoking on sexual, reproductive and child health should be carried out.** For certain health effects, data on public awareness of certain hazards posed by smoking to reproductive health are scanty. Such information would prove useful in developing effective public information campaigns.
11. **The range of health warnings should be extended further to reflect the established risks posed by smoking to reproductive life.** Health warnings on tobacco are an effective way of communicating with smokers. Picture warnings have been found to be particularly effective in reaching young smokers and those with low literacy. Appropriate picture warnings should be developed.
12. **Media figures, producers, editors and celebrities should be aware of their influence on young people, and should not promote or glamourise smoking.** Promotion of tobacco through channels that appeal to young people – particularly films, sport, television, magazines, fashion and role models – remains a grave concern.

## Healthcare professionals and healthcare systems

13. **Healthcare professionals have a responsibility to provide accurate information on the risks smoking poses both to the health of the smoker and to those around them.** Smokers should be given clear, firm advice to stop smoking, and offered suitable support, including prescription of pharmacotherapies and referral to specialist services.
14. **Better support is needed for women who stop smoking during pregnancy, with the aim of preventing and addressing relapse.** Among women who do succeed in stopping while pregnant, many relapse when the baby is born.
15. **For certain groups – in particular those with young children, those on low incomes, shift or casual workers, and the self-employed – attendance at smoking cessation services may present barriers.** Consideration should be given to smoking cessation outreach programmes aimed at reaching such groups in the community and in the workplace.
16. **Encouraging prospective, expectant and existing parents to stop smoking provides an opportunity to protect their health and the future health of the infant and child.** Where feasible, information and services for smokers should be integrated into existing services dealing with sexual, reproductive and child health. Such services include maternity services, male health clinics, well woman clinics, cervical screening services, centres for reproductive medicine, and child health clinics.
17. **Where appropriate, treatment protocols should include smoking cessation advice and support.** Stopping smoking ameliorates or eliminates many of the harmful effects of smoking on sexual, reproductive and child health.

## Government targets and policies

18. **Targets for reducing overall smoking rates should now be made more ambitious.** Existing government targets for reducing overall smoking rates among adults in England and Scotland are within reach.
19. **Achieving targets for reducing overall smoking rates among adults in Wales will need renewed efforts, as current trends suggest they are unlikely to be met.**
20. **If the effectiveness of policies to reduce smoking is to be judged, the prevalence of smoking in relevant population groups must be more accurately assessed.** Survey data should be validated where feasible using biological markers, such as cotinine testing or carbon monoxide monitoring. Anonymous cotinine testing of routine blood samples from pregnant women should be considered to establish a more accurate picture of smoking during pregnancy.
21. **Continued efforts are needed to address the factors that underlie the high level of smoking among the least advantaged groups.** The recognition of the pivotal role of smoking in perpetuating health inequalities is welcome.
22. **A proportion of the revenue raised through tobacco taxation should be used to fund comprehensive tobacco control programmes, including programmes to help smokers to stop smoking.** Comprehensive, adequately resourced tobacco control programmes can cut smoking rates. Smoking prevention and smoking cessation have a central role to play in reducing health inequalities.
23. **Protection of children from second-hand smoke in the home is a priority.** Recent government initiatives to raise awareness of the health effects of second-hand smoke are welcomed. However, parents and carers who smoke must also be informed of the actions they can take to protect their children from second-hand smoke, and that the best way to protect their children's health is to stop smoking.
24. **Better protection from second-hand smoke is needed in public places, especially for pregnant women, infants and children.** Smoke-free public places are effective in protecting non-smokers, and reduce smoking rates in the population at large. Moreover, the introduction of legislation for smoke-free public places has been linked to an increase in smoking restrictions at home. Legislation for smoke-free public places should be introduced immediately.
25. **Pregnant women have a legal right to protection from health risks in the workplace, under the EU Directive 92/85/EEC.** The government should ensure employers are aware of their obligations under the directive, and issue specific guidance on protecting pregnant workers from exposure to second-hand smoke at work. Women who cannot be effectively protected should be entitled to leave on full pay for the duration of their pregnancy.

## International

26. **The European Commission should make actions on reducing exposure to second-hand smoke a priority.** The EU consultation on Environment and Child Health should recognise the real hazards posed to children from second-hand smoke, and back measures to make all premises to which children have access, smoke-free.
27. **Urgent consideration should be given to how the European Commission can best ensure protection against second-hand smoke for workers, and in particular, for pregnant workers.** The implementation and effectiveness of EU Directive 92/85/EEC in member states should be reviewed. Second-hand smoke should be classified as a workplace carcinogen.
28. **The European Commission should promote exchange of information and best practice on effective strategies to address the harm posed by smoking to sexual, reproductive and child health, with a view to supporting member states in meeting their obligations under the treaty.** As a signatory to the WHO Framework Convention on Tobacco Control (FCTC), adopted by the World Health Assembly in May 2003, the EU is committed to introducing effective, evidence-based strategies to inform the public of the risks of smoking and passive smoking, to promote smoking cessation and to protect smokers from second-hand smoke.
29. **The impact of smoking on maternal and child health should be estimated with particular regard to the millenium development goals.** In view of global smoking trends, and in particular the increase in the uptake of smoking in developing countries and among young women, the burden of smoking on reproductive health is set to rise. International organisations, agencies and funding bodies should be aware of this trend, and consider all steps to incorporate measures to combat smoking into their work plans and programmes.
30. **Governments, international organisations and agencies, and non-governmental organisations with an interest in development should make every effort to ensure that the FCTC is implemented to the full.** The FCTC represents a sensible response to the huge problem of the global tobacco epidemic. The treaty sets out a series of evidence-based measures, which if fully implemented, could curb the devastating damage caused by tobacco to health.

## **Appendix A: Assessment of causality**

Assessment of the relationship between and exposure and a particular outcome is made on the balance of all the available evidence. Sir Austin Bradford-Hill proposed several considerations to be taken into account, which have been widely used and adapted. Some key considerations follow.

### **Strength of the association**

Strong associations are more likely to be causal than weak ones. Weak associations are more likely to be explained by undetected biases. However, this does not rule out the possibility of a weak association being causal.

### **Consistency of the association**

An association is more likely to be causal when a number of similar results emerge from different studies done in different populations. Lack of consistency, however, does not rule out a causal association.

### **Temporality**

For an exposure to cause an outcome, it must precede the effect.

### **Plausibility**

Is there a biologically plausible mechanism by which the exposure could cause the outcome? The existence of a plausible mechanism may strengthen the evidence for causality; however, lack of such a mechanism may simply reflect limitations in the current state of knowledge.

### **Biological gradient**

The observation that an increasing dose of an exposure increases the risk of an outcome strengthens the evidence for causality. Again, however, absence of a dose-response, does not rule out a causal association.

### **Coherence**

Coherence implies that the association does not conflict with current knowledge about the outcome.

### **Experimental evidence**

Experimental studies in which changing the level of an exposure is found to change the risk of an outcome provide strong evidence for causality. Such studies may not, however, always be possible, for practical or ethical reasons.

## Appendix B: Notes on table 2

Estimates of the impact of parental smoking on infant and child health are drawn from Rushton et al.<sup>137</sup>

Estimates of the impact of smoking on selected aspects of sexual and reproductive health in the UK presented in Table 2 are made by the British Medical Association Tobacco Control Resource Centre.

These figures should not be regarded as precise measures. However, they do provide a reasonable indication of the magnitude of the burden of smoking on reproductive life.

### Calculation of the population impact of an exposure

Estimates of the proportion of cases of a condition or a disease that can be attributed to a particular exposure (the population attributable risk per cent, or PAR) can be made using the following formula:

$$\text{PAR} = \frac{\text{PP}(\text{RR}-1)}{\text{PP}(\text{RR}-1)+1} \times 100$$

Where PP is the population prevalence, or the proportion of the population exposed, and RR is the relative risk of the condition or disease associated with the exposure. The number of cases of the disease or condition that can be attributed to the exposure can then be calculated by multiplying the PAR by the number of cases in the population.

### Sexual health

#### *Male sexual impotence*

This estimate is taken from reference 8.

#### *Cervical cancer*

The calculation is based on the following assumptions:

- The risk of cervical cancer among women who smoke is three times that among non-smokers
- The prevalence of smoking among women in the age groups among which most new cases of cervical cancer occur is 20 – 49 years (32%).
- In 1998, 3243 new cases of malignant cervical cancer were registered in the UK.

### Pregnancy – active smoking

Data on births, stillbirths and neonatal deaths are drawn from the Registrars General records for 2002. Data were compiled for England and Wales, Scotland and Northern Ireland.

Estimates of the prevalence of smoking during pregnancy vary (for further information, see **box 7**). The likely impact is therefore estimated as a range, assuming a lower limit of 20 per cent of women smoking throughout pregnancy, and an upper limit of 32 per cent of women smoking throughout pregnancy.

#### *Miscarriage*

It is estimated that between 10 – 15 per cent of all conceptions result in miscarriage. A conservative estimate of miscarriages is therefore 10 per cent of live births. There were 688,569 live births in UK in 2002. The number of miscarriages is therefore estimated at 68,850.

In smokers, it is estimated the risk of miscarriage is increased by 25 per cent.<sup>5</sup>

### ***Low birth-weight***

A total of 49,633 low-birth weight babies (weight <2500g) were born in the UK in 2002. In smokers, it is estimated the risk of low birth-weight is increased three-fold.<sup>5</sup>

### ***Stillbirth***

There were a total of 3,703 stillbirths in the UK in 2002. In smokers, it is estimated the risk of stillbirth is increased by 40 per cent.<sup>5</sup>

### ***Death of the newborn***

A total of 2,298 babies died aged four weeks or younger in the UK in 2002. Among babies whose mothers smoked during pregnancy, it is estimated that the risk of dying in the first four weeks of life is increased by 40 per cent.<sup>99</sup>

### ***Pregnancy – passive smoking***

A conservative estimate is made, assuming 21 per cent of non-smoking pregnant women are exposed to second-hand smoke. Exposure in the workplace is not included. In pregnant non-smokers exposed to second-hand smoke, it is estimated that the risk of having a low-birth weight baby is increased by 20 per cent.<sup>107</sup>

### ***Infant and child health***

All estimates in this section are adapted from Ruston et al.<sup>137</sup>

#### ***Cot death***

Exposure estimates are based on the most recently available data for the number of households with children in which either the mother or the father alone smokes as follows:

- 11 per cent of households where only the mother smoked
- 18 per cent, where only the father smoked
- 17 per cent where both parents smoked.<sup>197</sup>

More recent data for smoking by either parent alone are not available.

#### ***Asthma, recurrent ear infection and hospitalisation***

Estimates were recalculated using an exposure figure of 42 per cent, representing a more recent estimate of the percentage of children exposed to second-hand smoke in the home.<sup>197</sup>

Estimates of risk were calculated using odds ratios from Cook and Strachan 1999.<sup>117</sup> Case number estimates have not been attempted for child health outcomes.

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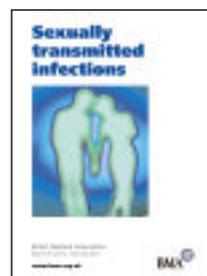
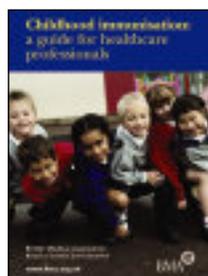
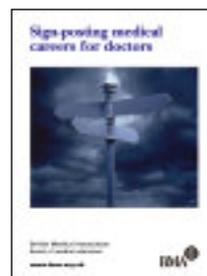
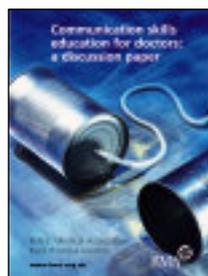
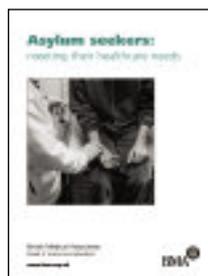
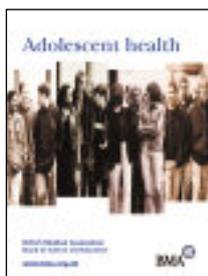
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# Smoking and reproductive life

## The impact of smoking on sexual, reproductive and child health

This report presents the first focused overview of the impact of smoking on sexual, reproductive and child health in the United Kingdom (UK). It considers active and passive smoking by both men and women, and summarises the impact on sexual health, conception and pregnancy, as well as effects on the reproductive system. The impact of smoking on infant and child health is also considered.

The benefits of smoking cessation are presented. The current situation in the UK with regard to both active and passive smoking throughout the life-course is outlined, and the potential impact of smoking prevention and cessation on alleviating the burden of illness highlighted.

The report frames smoking as an important consideration in sexual, reproductive and child health. It makes recommendations to reduce the burden of sexual, reproductive and childhood ill health caused by tobacco, including recommendations for research, healthcare professionals and public policy.

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