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Smoking and reproduction

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Introduction This fact sheet explains how smoking affects fertility in both men and women. It reviews the harm caused by smoking during pregnancy as well as some of the longer-term risks to the health of children born to parents who smoke.

A 2008 review of the literature examining the relationship between smoking and fertility concluded that tobacco use affects every system involved in the reproductive process.¹ This finding is supported by a systematic review of the scientific literature on the impact of cigarette smoking and smoke constituents on the different stages of reproductive function which found that “all stages of reproductive functions are targets of cigarette smoke toxicants.”²

A study published by the US Centers for Disease Control and Prevention notes that while smoking rates amongst pregnant women in the Western world have fallen in recent years, smoking remains a major cause of new-born deaths, early births and babies born with low birth weight. Researchers found that smoking was associated with:

- 5-8% of premature births
- 13-19% of cases of low birth weight in babies carried to full term
- 5-7% of preterm-related deaths
- 23-34% of deaths caused by sudden infant death syndrome (cot death).³

In the UK, smoking in pregnancy causes up to 5,000 miscarriages, 300 perinatal deaths and around 2,200 premature births each year.⁴

Fertility
Female
fertility Research has established beyond doubt that smoking can have a negative impact on female fertility. Women who smoke take longer to conceive than women who do not smoke.⁵

A 2007 study found that tobacco consumption affects uterine receptivity, with heavy smokers more likely to be affected.⁶ Among smokers, the chances of conceiving fall by 10 to 40% per cycle and the greater the number of cigarettes smoked, the longer a woman is likely to take to conceive.⁷ However, even comparatively low levels of smoking can have a significant impact on female fertility. An investigation involving almost 11,000 women in Denmark revealed that women who smoked between five and nine cigarettes a day were 1.8 times more likely than non-smokers to take longer than 12 months to conceive.⁸

There is some evidence to suggest that smoking reduces the success rates of fertility treatment. Studies of women undergoing assisted reproductive treatment have demonstrated a significant negative effect associated with smoking.^{9 10 11} Furthermore, it has been found that exposure to secondhand smoke can be as damaging as smoking itself in terms of successful pregnancy outcomes for women undergoing IVF.¹²

A growing body of research suggests that maternal smoking may have a negative impact on the fertility of both female and male off-spring.^{13 14} Smoking during pregnancy reduces the number of germ cells (the cells that form eggs in females and sperm in males) and somatic cells (the cells that form every other part of the body) that form in the developing foetus.¹⁵ Smoking during pregnancy also has an impact on protamine, a protein essential in sperm production which can lead to fertility problems.¹⁶ However, further research into this issue is needed before a causal link can be definitively established.

Male fertility & sexual impotence

Cigarette smoking affects male fertility. Men who smoke have a lower sperm count than non-smokers, and their semen contains a higher proportion of malformed sperm.^{17 18} By-products of nicotine present in semen of smokers have been found to reduce the motility of sperm.¹⁹ Studies have found that sperm damaged by smoking may also result in more couples having baby girls than boys.²⁰ The researchers suggest that the sperm cells carrying the Y chromosome are more vulnerable to the toxins in cigarette smoke.²¹ While there is a correlation between the number of cigarettes smoked and the damage to semen, researchers have found that there is no “safe” level of smoking. Even light smoking is associated with reduced male fertility.¹⁷

Mounting evidence shows a significant association between smoking and male sexual impotence with the association increasing with the number of cigarettes smoked per day.^{22 23 24 25} A meta-analysis of studies published between 1980 and 2001 found that 40% of impotent men were current smokers compared with 28% of men in the general population.²⁶

Smoking in pregnancy

Women who smoke in pregnancy are more likely to be younger, single, of lower educational achievement and in unskilled occupations.²⁷ In December 1998, the Government set a target to reduce the percentage of women who smoked during pregnancy from 23% to 15% by 2010.

Prevalence of smoking in pregnancy

The 2005 Infant Feeding Survey found that almost half (49%) of women who smoked before pregnancy managed to stop once they became pregnant but 17% of mothers-to-be continued to smoke throughout their pregnancy.²⁷ By 2010, the percentage of mothers reported to be smoking at delivery in England had dropped to 13.6% in 2010/11 (Quarter 1 figures) (This figure is lower than the same period in 2009/10 - 14.1% and 2008/09 - 14.4%.)²⁸ The target appears, therefore, to have been met. However, numerous researchers have argued that these figures rely on self-reporting and, as such, are unlikely to be accurate.^{29 30}

Foetal growth and birth weight

Maternal smoking is a major risk factor for low birth weight.³¹ Babies born to women who smoke are on average 200-250 grams lighter than babies born to non-smoking mothers. Furthermore, the more cigarettes a woman smokes during pregnancy, the less well the foetus grows and develops.³² One study reported that approximately 30% of growth-restricted neonates could be independently associated with maternal smoking.³³ Another recently published study found that smoking during pregnancy can lead to slower growth of the

foetus' head.³⁴ Research suggests that cigarettes can impede the flow of blood in the placenta which in turn restricts the amount of nutrients that reach the foetus.³⁵

Perinatal mortality and Sudden Infant Death Syndrome

Perinatal mortality includes still-birth (loss of the foetus after the 24th week of pregnancy) and neonatal death (death of the newborn within the first four weeks of life). It is estimated that about one third of all perinatal deaths in the UK are caused by maternal smoking.³² This equates to approximately 300 deaths per year.

More than one-quarter of the risk of death due to Sudden Infant Death Syndrome (cot death) is attributable to maternal smoking³⁶ and smoking during pregnancy.³⁷ The risk of cot death is trebled in infants whose mothers smoke both during and after pregnancy. The greater the number of cigarettes smoked, the higher the risk of cot death.³⁸ One possible explanation for this is that nicotine and its derivatives easily reach the cerebrospinal fluid in the foetus, causing damage to the ependymal (the lining providing a protective barrier and filtration system separating the brain from cerebrospinal fluid).³⁹

Pre-term birth is a major clinical problem, accounting for about half of all neonatal deaths. Recent research in Sweden examined the relationship between maternal smoking and pre-term birth and found that, compared to non-smokers, moderate smokers had a two-fold increase in risk of preterm labour, which rose to two and a half times greater risk among heavy smokers.⁴⁰ Additional research from Sweden found an increased risk of pre-term birth amongst snuff users.⁴¹

Maternal smoking and child health

Infants and children of parents who smoke are twice as likely to suffer from a serious **respiratory infection** as the children of non-smokers. Smoking during pregnancy can also increase the risk of **asthma** in young children.⁴² New research suggests that the increased risk of asthma and respiratory infections may be due to changes in biological receptors in the baby's immune system that are responsible for recognising and fighting infections and bacteria.⁴³ Smoking in pregnancy is also associated with an increased risk of **infantile colic**.⁴⁴

Smoking in pregnancy may also have implications for the **long term physical growth** and **intellectual development** of the child. Smoking has been associated with reduced height of children of smoking mothers compared with non-smoking mothers, with lower attainments in reading and mathematics up to age 16 and even with the highest qualification achieved by the age of 23.⁴⁵ There is also evidence that smoking interferes with a woman's **hormonal balance** during pregnancy and that this may have long-term consequences on the reproductive organs of her children.^{71 46}

A 27 year study examining cholesterol in children found evidence suggesting that maternal smoking in pregnancy is associated with an increased rise in total **cholesterol** levels and a tendency towards an adverse lipoprotein profile in the offspring.⁴⁷ Adults who were small for gestational age at birth as a result of maternal smoking also have an increased risk of hypercholesterolemia (high cholesterol).⁴⁸

Other risks of smoking during pregnancy

Further impacts include:

- Increased risk of **congenital defects** in the offspring of smokers, ⁴⁹ including an increased risk of **oral clefts**.^{50 51}
- Some evidence shows an association between maternal smoking, early childhood exposure to secondhand smoke and the development of **emphysema in adulthood**. The findings suggest that the lungs may not recover completely from the effects of early-life exposure.^{52 53} Researchers have also found that adults exposed to tobacco smoke in utero had a more adverse **cardiovascular disease risk** profile.⁵⁴
- One study found that maternal smoking during pregnancy is linked to high foetal testosterone (FT), which leads to an increased risk for **autism, ADHD, conduct disorder and antisocial behaviour**.⁵⁵ Numerous other studies have demonstrated a link between maternal smoking and ADHD.^{56 57}
- A population level study of children in Finland found that the risk of **psychiatric morbidity** was significantly higher in the children of mothers who smoked during pregnancy.⁵⁸
- A longitudinal study found that smoking during pregnancy and in early childhood were “quite strong” predictors of **conduct problems, anti-social behaviour** and crime later in life.⁵⁹ This finding is supported by other studies exploring the relationship between maternal smoking during pregnancy and behaviour problems in childhood.^{60 61 62}
- Maternal smoking has been associated with an increased risk of **learning difficulties**.⁶³
- Some evidence suggests that prenatal exposure to tobacco smoke may be associated with **benign breast disease** later in life.⁶⁴

Passive smoking and pregnancy

Non-smoking women exposed to other people's tobacco smoke during pregnancy are more likely to have lower weight babies. On average, infants born to women exposed to secondhand smoke during pregnancy are 40-50g lighter than those born to women who are not exposed.³⁸ Babies born to non-smoking women whose partners smoke have been found to weigh less than babies born to non-smoking couples.^{65 66} Women exposed to secondhand smoke in the workplace are also affected.⁶⁷

Other research suggests that non-smoking women who are exposed to second-hand smoke during their pregnancy are at increased risk of giving birth prematurely⁶⁸ of stillbirth,⁶⁹ and of spontaneous abortion.⁷⁰

Additionally, some evidence suggests that female fertility can be damaged in utero if the woman's mother was exposed to secondhand smoke while pregnant.⁷¹

Breast feeding

Research has shown that smoking cigarettes may contribute to inadequate breast milk production. Prolactin is vital 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.⁷² Nicotine has been shown to hamper the production of prolactin. Fat concentrations have been found to be lower in the milk from mothers who smoked and milk volumes lower.⁷³ In breastfeeding mothers who smoke, milk output is reduced by more than 250 ml per day compared with non-smoking mothers.^{74 75} These factors may increase the likelihood of women giving up breastfeeding earlier.

Smoking and oral contraceptives

Women who use combined oral contraceptives are liable to 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. However, among pill-users who smoke, the risk of succumbing to a heart attack is 20 times higher.⁷⁶ It is therefore important that all women who take the contraceptive pill are advised not to smoke.

Smoking and the menopause

Smoking is associated with early onset of menopause⁷⁷ with the natural menopause occurring up to two years earlier in smokers.³⁸ The likelihood of an earlier menopause is related to the number of cigarettes smoked, with those smoking more than ten cigarettes a day having an increased risk of an early menopause.⁷⁸

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. Research suggests that polycyclic aromatic hydrocarbons found in tobacco smoke can trigger premature egg cell death which may in turn lead to earlier menopause.⁷⁹ Another study suggests that chemicals in tobacco smoke alter endocrine function which in turn affects the release of pituitary hormones. This endocrine disruption is thought to contribute to adverse outcomes including earlier menopause.⁸⁰

Quitting smoking during pregnancy

Because smoking poses a high risk of harm to both mother and foetus, it is important that pregnant women are supported to help them stop smoking at least for the duration of the pregnancy. A 2009 Cochrane review found that interventions reduced the proportion of women smoking in late pregnancy by about 6% overall. The most effective intervention appeared to be providing incentives, which helped around 24% of women to quit smoking during pregnancy. The smoking cessation interventions reduced the number of babies with low birthweight and preterm births.⁸¹

A recent review of the efficacy and safety of nicotine replacement therapy in pregnancy concluded that there was insufficient evidence to determine whether or not NRT is effective or safe when used in pregnancy.⁸² However, compared with continuing to smoke, any health risks from using NRT are likely to be minimal. A US review of studies found that NRT use significantly decreased the risk of preterm delivery and low birth weight compared to that of smokers and also found that NRT use does not appear to increase the risk of malformations.⁸³

The Department of Health has published guidance on stop smoking interventions in primary and secondary care which recommends establishing treatment pathways for all smokers including pregnant women.⁸⁴ The National Institute for Health and Clinical Excellence (NICE) has also published guidance on stopping smoking in pregnancy and following childbirth.⁸⁵

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