Second-hand smoke and pregnancy and the effects of second-hand smoke exposure on children’s health

A review of the literature

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1. Second-hand smoke and pregnancy

Active maternal smoking during pregnancy can increase the risk of a range of conditions, including impairment of fetal growth and development. However non-smoking mothers who are exposed to second-hand smoke may also risk similar effects on fetal and reproductive health, although the risk is smaller than that of smoking mothers.

Almost 19,000 babies exposed to passive smoke during gestation are born with low birth weight each year in the UK (Royal College of Physicians, 2010). Latest figures from Scotland suggest an annual decline in the numbers of mothers reporting smoking at first booking and first visit (ISD, 2011). 18.8% of women were active smokers at booking (first antenatal appointment); a decrease of 9% on 2005 figures. Maternal smoking rates at first visit from a health visitor were 18.1% for the same period (a fall from 22.2% in 2005). Mothers in the most deprived categories were more likely to report smoking at first booking compared to mothers from the least deprived (30.6% compared to 6.1%) (ISD, 2011).

Some studies have suggested that babies born to mothers that smoke during pregnancy weigh an average 250g less than babies born to non-smoking mothers whilst babies born to (non-smoking) mothers who are exposed to second-hand smoke may have a reduced birth weight of between 30 – 40g (Royal College of Physicians, 2010). A recent systematic review and meta-analyses of 76 studies that included 50,000 mothers exposed to second-hand smoke and 100,000 non-exposed mothers concluded that mothers who are exposed to second-hand smoke have an increased risk of giving birth to babies that are between 40 – 80g lighter than non-exposed mothers, with a further trend toward low birth-weight (Salmasi, Grady, Jones & McDonald, 2010). Low birth-weight in turn, has been associated with coronary heart disease, type 2 diabetes, and being overweight in adulthood (Lumley et al, 2009). While Salmasi et al suggest that the risks to women exposed to second-hand smoke are ‘likely’ to be relatively small, the risks may be more significant for those women who are active smokers or have other health conditions that put them at higher risk of poor perinatal outcomes (Salmasi et al, 2010).

In one recent retrospective cohort study the authors analysed Scotland’s national administrative pregnancy data in order to assess the impact of Scotland’s smoke-free public places legislation on pre-term delivery and small for gestational age (Mackay, Nelson, Haw and Pell, 2012). Analysis of 716,941 cases found that following 1 January 2006 (the introduction of smoke-free public places legislation), there was a significant drop in overall preterm deliveries and a significant decrease in the number of infants born small, and very small, for gestational age. These reductions occurred in both mothers who smoked and those who had never smoked and suggest that the introduction of national, comprehensive smoke-free legislation
in Scotland was associated with significant reductions in preterm delivery and babies being born small for gestational age (Mackay et al, 2012).

In an earlier case-control study of 1,154 babies, the researchers assessed the relationship between preterm/early preterm delivery and active smoking as well as second-hand smoke exposure in a sample of pregnant women. Cases of preterm birth were singleton babies born before the 37th gestational week; babies born before the 35th gestational week were considered early preterm births. Controls were babies with gestational ages equal to the 37th week. A total of 299 preterm cases (including 105 early preterm) and 855 controls were analysed. Analysis showed a relationship between active smoking during pregnancy and preterm/early preterm delivery. A dose–response relationship\(^1\) was found for the number of cigarettes smoked daily. For example women who smoked were more likely to have a preterm or early preterm delivery compared to non smokers and this risk increased with increasing cigarette consumption. In addition, second-hand smoke exposure was associated with early preterm delivery with a dose–response relationship with the number of smokers in the home (Fantuzzi et al, 2007).

Though not conclusive, some studies have argued that maternal passive smoking may reduce fertility, increase fetal and perinatal mortality and increase the risk of some congenital abnormalities (Royal College of Physicians 2010).

The recent publication of the National Institute for Clinical Excellence (NICE) guidance aimed at stopping smoking in pregnancy and following childbirth recommended that midwives should identify pregnant women who smoke through discussion and the use of CO tests to assess their exposure to tobacco smoke. This would help identify levels of exposure both through active and passive smoking (NICE, 2010). The NICE guidance also recommended that partners and other smokers in the household should be offered help to stop smoking, as well as information and advice on the risks of passive smoking on the mother and baby.

The guide has produced a referral pathway from maternity services to NHS Stop Smoking Services (SSS) and includes a recommendation for reviews of smoking status at later appointments. In addition the guide recommended that other health workers, such as GPs, health visitors and family nurses should also use any appointments with pregnant women as an opportunity to ask them about their smoking status and offer referral to local SSS (NICE, 2010).

**Summary**

Second-hand smoke exposure during pregnancy may increase the risk of premature birth and contribute to lower birth weight of babies. One study identified an association between premature delivery and the numbers of smokers in the home, suggesting a dose-response relationship among expectant mothers exposed to second-hand smoke. Recent guidance from NICE has recommended the use of CO tests for pregnant women to ascertain levels of second-hand smoke exposure via passive and active smoking. Partners and other smokers living with the expectant mother should also be offered support to stop smoking. The guidance recommends

\(^1\) A dose-response relationship refers to the relationship between the amount of exposure (dose) and the resulting changes in body function or health (response).
joined-up working between midwives, other health workers, smoking cessation services and other agencies that work with disadvantaged women.

2. Effects of second-hand smoke exposure on children’s health

Children and infants face the highest level of second-hand smoke exposure in the home as they are often unable to remove themselves from smoky environments. With their smaller airways, faster rates of breathing and immature immune systems children and infants are generally more vulnerable to any adverse health effects compared with adults (Bearer, 2005).

Infants and children inhale double the quantity of household dust compared to adults, and so inhale more dust containing second-hand smoke particulates (Thomson, Wilson and Howden-Chapman, 2005). Infants also have greater hand/object/mouth contact, and so absorb proportionately more second-hand smoke through their digestive system, as well as through their respiratory system (Matt et al, 2004).

A study that examined multiple measures of infant exposure to second-hand smoke in 49 families found that infants in families with smokers who try to protect their child from second-hand smoke (e.g. refraining from smoking in front of the child or smoking outside) are still exposed to between five and ten times more second-hand smoke toxins than in families without smokers. Nevertheless these families do manage to at least halve their infant’s exposure when compared to those who take no steps to protect their infants. Dust and surfaces in homes of smokers are contaminated with second-hand smoke and infants of smokers are at risk of second-hand smoke exposure in their homes through dust, surfaces, and air. Smoking outside the home and away from the infant reduces but does not completely protect a smoker’s home from second-hand smoke contamination and the infant from second-hand smoke exposure (Matt et al, 2004; Johansson, Hermansson and Ludvigsson, 2004b).

Exposure to second-hand smoke in childhood is associated with reduced lung function, middle ear disease, an increased risk of a range of respiratory symptoms, a higher incidence of respiratory tract infections and Sudden Infant Death Syndrome (SIDS) (SCOTH, 2004; McMartin et al, 2002; Anderson and Cook, 1997; Blair et al, 1999).

The UK Confidential Inquiry into Stillbirths and Death in Infancy estimates that in families where only the father smokes, risk of sudden infant death syndrome (SIDS) is increased 2.5 times. Where both parents smoke, the risk of SIDS is increased almost 4 times (UK Confidential Inquiry into Stillbirths, 2002). A systematic quantitative review of epidemiological evidence relating to parental smoking and SIDS examined the separate roles of prenatal and postnatal exposure. Thirty-nine studies were reviewed and all but one showed a positive association between prenatal exposure and SIDS. However the association between prenatal exposure and SIDS is difficult to determine as most women who smoke during pregnancy continue to smoke afterwards, thus the independent effect of prenatal smoking is difficult to ascertain (Anderson and Cook, 1997).
Second-hand smoke exposure in early infancy increases the risk of serious morbidity from infections. The impact exposure to second-hand smoke is greater in low birth-weight and premature babies. A population-based study of 8,327 Hong Kong children found that infants exposed to second-hand smoke in the first three months of life were most vulnerable to infections requiring hospitalisation. Thus the authors conclude reducing household second-hand smoke exposure in infants and particularly more vulnerable babies can reduce infectious morbidity and hospitalisation (Kwok et al, 2008).

Exposure to second-hand smoke in childhood is associated with reduced lung function in children (SCOTH, 2004), a higher incidence of respiratory tract infections including bronchitis, bronchiolitis, croup and pneumonia, and an increased risk of respiratory symptoms such as breathlessness, phlegm, coughing and wheezing (Bradley et al, 2005). A recent systematic review and meta-analysis of 60 studies concluded that exposure to second-hand smoke, in particular via maternal smoking, caused a statistically significant increase in the risk of children younger than two years of age developing lower respiratory infections (LRI), especially bronchiolitis (Jones et al, 2011).

Furthermore, exposure to second-hand smoke can cause asthma in children, and may increase the severity of the condition in children who are already affected (Mannino, Homa and Redd, 2002; Strachan and Cook, 1998). Second-hand smoke is cited by up to 80% of asthmatics as a trigger for further attacks (National Asthma Campaign, 1996). A systematic review and meta-analyses of 71 studies suggests pre- or post-natal exposure to second-hand smoke may account for an increased risk of wheezing and asthma (Burke et al, 2012). The authors calculate that exposure to pre-or post-natal second-hand smoke exposure is associated with a 30 – 70% increased risk of incident wheezing, with the strongest effect from post-natal maternal smoking on wheeze in children aged less than 2 years. They also found a 21% to 85% increase in incident asthma with the strongest effect from pre-natal smoking on asthma in children less than 2 years old (Burke et al, 2012).

It is estimated that in the UK over 7,000 new cases of wheeze in children aged less than 2 years and over 15,000 new cases of asthma in children over the age of 3 is due to second-hand smoke exposure (Royal College of Physicians, 2010). Children with asthma whose parents smoke at home are at least twice as likely to have asthma symptoms all year compared to children of non-smokers (Slish et al, 2004) while exposure to second-hand smoke is associated with increased sleep problems among children with asthma (Yolton et al, 2010).

In one study which explored vascular damage in young adults, Geerts et al (2008) collected birth data and ultrasound measurement of common carotid artery intima-media thickness (CIMT) from a cohort of 732 young adults. Offspring of mothers who smoked had thicker CIMT than offspring of mothers who did not smoke in pregnancy. Thicker CIMT was associated with exclusive paternal smoking in pregnancy, somewhat stronger with exclusive maternal smoking and strongest with both parents smoking. Thus permanent vascular damage is partly attributable to familial tobacco smoke exposure, an association that might be initiated in gestation (Geerts et al, 2008).
Exposure to second-hand smoke can cause middle ear disease, including recurrent ear infections in children (Hinton and Buckley, 1988; Strachan, Jarvis and Feyeraband, 1989; American Academy of Paediatrics, 1997). A study of over 32,000 children found that there was a slightly higher risk of middle ear infection in early childhood when children were exposed to tobacco smoke both pre- and post-natal (Håberg et al, 2010). In an earlier study of almost 12,000 children, Lieu and Feinstein (2002) found that the occurrence of any ear infection was not increased by passive postnatal smoke exposure, but was slightly increased by antenatal smoke exposure. However the risk of recurrent ear infections was significantly increased with combined antenatal and postnatal smoke exposure (Lieu and Feinstein, 2002).

A systematic review and meta-analysis of 61 epidemiological studies suggests exposure to second-hand smoke, particularly to smoking by the mother, increases the risk of middle ear disease in childhood and specifically increases the risk of middle ear disease requiring surgery (Jones et al (2012). Furthermore the authors show that annually over 130,000 cases of child middle ear disease in the UK are directly attributable to second-hand smoke exposure in the home (Jones et al, 2012).

Recent data suggests that parents may have little knowledge about the specific health risks to children that are associated with second-hand smoke exposure. A cross-sectional survey of 318 households in Leeds with at least one child under 16 showed the majority of participants were aware of the adverse impacts of second-hand smoke exposure, regardless of whether they smoked or not. However when asked about the adverse potential health impacts of exposure to second-hand smoke on children, most listed non-specific effects such as ‘breathing problems’ and ‘passive smoking’ (Alwan et al, 2009). Similar findings elsewhere have documented poor knowledge of specific illnesses although there is awareness of the general consequences of second-hand smoke exposure (Johansson, Hermansson and Ludvigsson, 2004a; Robinson and Kirkcaldy, 2007a).

Tobacco smoke exposure has also been associated with behavioural problems, reduced intellectual ability, hyperactivity, decreased attention span, language skills and grade retention (Braun et al 2006; Huiznik and Mulder, 2005; Kukla et al, 2008; Yolton et al, 2005). Nevertheless some caution is required as research in this area is relatively scarce and the causes and risk factors for behavioural problems and learning disabilities are relatively poorly understood (Thapar et al, 2009; Anderko et al, 2010).

A further effect of tobacco exposure on children is that children of smokers are themselves more likely to become smokers (Sherman et al, 2009; den Exter et al, 2004; Jackson et al, 1998; Vink, Willemsen and Boomsma, 2003). A Scottish survey of 10,063 school pupils showed that pupils who smoke are more likely to have parents who are smokers than non-smoking pupils (Ipsos MORI, 2009). Breaking a family history of smoking is one of the most important actions a parent can do to improve their child’s well being and life span.
Summary

Children and infants face higher levels of second-hand smoke exposure in the home than adults due to their inability to remove themselves from smoky atmospheres and their faster rates of breathing. Not only do they inhale more dust containing second-hand smoke particulates, they will also ingest greater quantities. It is estimated that even where smoking parents restrict smoking in front of the child, the child’s exposure to the toxins in second-hand smoke is still 5 to 10 times greater than a child from a non-smoking household. Where no restrictions are put in place, the exposure is greater still.

Exposure to second-hand smoke in childhood is associated with a range of illnesses including reduced lung function, middle ear disease, a higher incidence of respiratory tract infections and Sudden Infant Death Syndrome. Furthermore children with asthma may be affected more severely when exposed to second-hand smoke. The studies which link exposure to health outcomes have taken socioeconomic factors into consideration, i.e. the relationship is not merely explained by children from less affluent communities being at increased risk for both exposure to tobacco smoke and respiratory tract symptoms. Some research has suggested a link between smoking during pregnancy and behavioural problems in children however the evidence is tenuous and more research is required to establish the strength of this association.

While there is a broad understanding of the general health effects of exposure to second-hand smoke, parents generally have less knowledge of the specific health effects of second-hand smoke exposure on children’s health. Nevertheless, parents can improve the health of their children, grandchildren and all subsequent generations by breaking the family tradition of smoking.

References


Blair P.S., Fleming P.J., Smith I.J., Platt M.W., Young J., Nadin P., Berry P.J.,


