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SMOKING IN THE HOME AFTER CHILDBIRTH: PREVALENCE, DETERMINANTS AND THE RELATIONSHIP TO SMOKING IN PREGNANCY

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ABSTRACT

Childhood secondhand smoke (SHS) exposure causes substantial ill health and mortality, and poses a significant economic and social cost. Reducing child and infant SHS exposure is therefore a public health priority. However, the factors associated with children's SHS exposure in the home, the primary source of exposure, remain unclear. In particular, little is known about the prevalence of, and factors associated with, SHS exposure in the homes of the youngest infants (≤3 months). Furthermore, many women stop smoking during pregnancy but return to smoking shortly afterwards, putting their infants at risk of SHS exposure. Women who were able to stop during pregnancy are a potentially motivated group who may be receptive to making behaviour changes postpartum to protect their infant from SHS. A greater understanding of these issues within this at-risk group is important for the development of future, more effective interventions to prevent or reduce infant and child SHS exposure.

Three studies were conducted. The aim of the first was to identify by systematic review the factors that are associated with children's SHS exposure in the home, determined by parent or child reports and/or biochemically validated measures. Forty-one studies were included in the review. Parental smoking, low socioeconomic status (SES) and being less educated were all consistently found to be independently associated with children's SHS exposure in the home. Children whose parents held more negative attitudes towards SHS were less likely to be exposed. Associations were strongest for parental cigarette smoking status; compared to children of non-smokers, those whose mothers or both parents smoked were between two and 13 times more likely to be exposed to SHS. A novel

finding was that younger children may be more likely to be exposed. Multiple factors are therefore associated with child SHS exposure in the home. Interventions targeted towards socially disadvantaged parents that aim to change attitudes to smoking in the presence of children and that provide practical support to help parents smoke outside the home could be effective. Future research is needed to explore SHS exposure specifically in young children or infants (<2 years old); just three studies in this review explored factors associated with SHS exposure in this age group.

The second study aimed to estimate maternal self-reported prevalence of SHS exposure among young infants (3 months old) of women who smoked just before or during pregnancy, and to identify factors associated with this exposure. This study used data from the Nottingham (England) Pregnancy Lifestyle Survey, which recruited 850 current and recent ex-smoking pregnant women who then self-completed questionnaires at 8-26 weeks gestation and 3 months after childbirth. In 471 households, the prevalence of smoking in the home 3 months after childbirth was 16.3% (95% confidence interval (CI) 13.2-19.8%) and after multiple imputation controlling for non-response was 18.2% (95% CI 14.0-22.5%). Fifty-nine percent of mothers were current smokers and of these, 24.0% reported that smoking occurred in their home compared to 4.7% of non-smokers. In multivariable logistic regression, mothers smoking ≥11 cigarettes per day were 8.2 times (95% CI 3.4-19.6) more likely to report smoking in the home. Younger maternal age, being of non-white ethnicity, being from a lower SES group and less negative attitudes towards SHS were also significantly associated with smoking in the home. This study found a lower prevalence than has been reported previously in older children (4-15 years). Interventions to support smoking mothers to quit, or to restrict smoking in the home, should target attitudinal change, and address inequality relating to social disadvantage, younger age and/or non-white ethnic groups.

In the third study, using interpretative phenomenological analysis methodology, nine semi-structured interviews were conducted with women who quit smoking during pregnancy, but returned to smoking ≤3 months postpartum. Central to mothers' accounts of their smoking behaviours during pregnancy and postpartum was their desire to be a 'responsible mother'. Mothers described using strategies to protect their infant or child from SHS exposure, and held strong negative attitudes towards other smoking parents. After returning to smoking, mothers appeared to reposition themselves as 'social' or 'occasional' smokers rather than the 'regular' smokers they perceived themselves to be prior to pregnancy. These findings suggest that interventions to prevent/reduce infant and child SHS exposure in the home should build on mothers' intentions to be responsible parents. As mothers who returned to smoking principally viewed themselves as 'social' or 'occasional' smokers, interventions that are marketed as relevant for women with these types of smoking patterns may be more likely to be responded to, and, ultimately, be effective.

Future research should focus on the development and testing of novel interventions to prevent or reduce infant and child SHS exposure in the home. Potential content for interventions includes education, modelling and promoting self-identity and identity associated with the changed behaviour.

PUBLICATIONS AND CONFERENCE PRESENTATIONS

1.1 PUBLICATIONS FROM THESIS WORK

Orton, S., Jones, L. L., Cooper, S., Lewis, S. & Coleman, T., Predictors of children's secondhand smoke exposure at home: a systematic review and narrative synthesis of the evidence. PloS ONE, 2014. **9**(11): p. e112690.

Orton, S., Bowker, K., Cooper, S., Naughton, F., Ussher, M., Pickett, K., Leonardi-Bee, J., Sutton, Dhalwani, N. & Coleman, T., Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy: study methods and baseline data. BMJ Open, 2014. **4**(5): p. e004915.

Orton, S., Coleman, T., Jones, L. L., Cooper, S. & Lewis, S., Smoking in the home after childbirth: prevalence and determinants in an English cohort. BMJ Open 2015. **5**(9): p. e008856.

1.1.1 Manuscripts in preparation

Orton, S., Coleman, T., Lewis, S., Cooper, S. & Jones, L.L. Experiences and beliefs of women who stopped smoking in pregnancy but relapsed postpartum: a qualitative exploration.

1.2 CONFERENCE AND SEMINAR PRESENTATIONS

1.2.1 Oral presentations

Orton, S., Coleman, T., Lewis, S., & Jones, L. L. Smoking in the home after childbirth: a qualitative exploration of the experiences and beliefs of women who abstained from smoking for at least part of pregnancy but had relapsed by the early postpartum period. UK Nicotine & Smoking Cessation Conference, Manchester, June 2015.

Orton, S., Coleman, T., Cooper, S., Lewis, S., & Jones, L. L. A systematic narrative review of the predictors of children's secondhand smoke exposure. School of Medicine Post Graduate Researchers Oral Presentation Event, Nottingham. November 2014.

Orton, S., Bowker, K., Cooper, S. & Coleman, T., Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy. Society for Academic Primary Care East Midlands Regional Conference, Sheffield. March 2013.

Orton, S., Bowker, K., Cooper, S. & Coleman, T., Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy. Royal College of Midwives Annual Conference, Brighton. November, 2012.

1.2.2 Seminar presentations

Orton S. Smoking in the home after childbirth: prevalence, determinants and the relationship to smoking in pregnancy. Division of Primary Care, School of Medicine, University of Nottingham, Nottingham, 18th November 2015.

Orton, S. Smoking in the home after childbirth: prevalence and determinants. Academic Orthopaedics, Trauma and Sports Medicine, University of Nottingham, Nottingham, 23rd March 2015.

Orton, S. Smoking in the home after childbirth: prevalence and determinants. Division of Epidemiology and Public Health, University of Nottingham, Nottingham, 16th March 2015.

Orton, S., Bowker, K., Cooper, S. & Coleman, T., Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy. NIHR Smoking in Pregnancy Research Programme Annual Event, University of Nottingham, Nottingham, 1st October 2013.

1.2.3 Poster/poster-oral presentations

Orton, S., Coleman, T., Lewis, S., Cooper, S. & Jones, L.L. Experiences and beliefs of women who stopped smoking during pregnancy, but relapsed after delivery: a qualitative study. National Institute of Health Research, School of Primary Care Research Trainee Event, Oxford. September 2015. (Poster-oral presentation)

Orton, S., Coleman, T., Jones, L.L., Cooper, S., & Lewis, S. Smoking in the Home After Childbirth: Prevalence and Determinants. Society for Research on Nicotine and Tobacco, Philadelphia, USA. February 2015. (Poster presentation)

Orton, S., Coleman, T., Cooper, S., Lewis, S., & Jones, L. L. A systematic narrative review of the predictors of children's secondhand smoke exposure. National Institute of Health Research, School of Primary Care Research Trainee Event, Oxford. September 2014. (Poster-oral presentation)

Orton, S., Coleman, T., Cooper, S., Lewis, S., & Jones, L. L. A systematic narrative review of the predictors of children's secondhand smoke exposure. UK National Smoking Cessation Conference, London, June 2014. (Poster presentation)

Orton, S., Coleman, T., Cooper, S., Lewis, S., & Jones, L. L. Smoking in the home after childbirth. UK Society for Behavioural Medicine 2013 Annual Scientific Meeting, Oxford. December 2013. (Poster-oral presentation)

Orton, S., Coleman, T., Cooper, S., Lewis, S., & Jones, L. L. Smoking in the home after childbirth. National Institute of Health Research, School of Primary Care Research Trainee Event, Oxford. September 2013. (Poster-oral presentation)

Orton, S., Jones, L. L., Cooper, S., Lewis, S. & Coleman, T., Smoking in the home after childbirth: Prevalence, determinants and its relationship to smoking in pregnancy. Society for Academic Primary Care East Midlands Regional Conference, Sheffield. March 2013. (Poster presentation)

Orton, S., Jones, L. L., Cooper, S., Lewis, S. & Coleman, T., Smoking in the home after childbirth: prevalence, determinants and the relationship to smoking in pregnancy. Community Health Sciences Post Graduate Research Conference, Nottingham. November 2012. (Poster presentation)

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DECLARATION

Between July 2011 and July 2012, I worked as a research fellow in the Division of Primary Care, School of Medicine, at the University of Nottingham. My role involved working on an NIHR funded programme 'Improving the effectiveness and reach of NHS support for smoking cessation in pregnancy', and specifically within this programme working on the Pregnancy Lifestyle Survey longitudinal cohort survey, the data from which has formed part of my PhD. As part of my role on this project, my responsibilities included: helping to develop data collection tools; setting up and developing the recruitment process; liaising with recruitment sites; developing the recruitment methodology; recruitment of participants into the study; monitoring the recruitment progress to fulfil enrolment targets; designing, building and implementing a study management database to securely store participant information; the coordination of participant follow-ups. During my PhD, my continued responsibilities on the Pregnancy Lifestyle Survey cohort were to ensure good follow-up response rates, designing the database for questionnaire data entry, data cleaning and preparation of the NIHR programme study outputs.

I would like to acknowledge the contributions of colleagues who were involved in the design or implementation of the Pregnancy Lifestyle Survey longitudinal cohort, namely Katharine Bowker, Tim Coleman, Sue Cooper, Rachel Whitemore, Felix Naughton, Michael Ussher, Kate E. Pickett, Jo Leonardi-Bee and Stephen Sutton.

GLOSSARY

CI	Confidence interval
DSM IV	Diagnostic and Statistical Manual of Mental Disorders
GCSE	General Certificate of Secondary Education
HR	Hazard ratio
HSE	Health Survey for England
HSI	Heaviness of smoking index
IFS	Infant Feeding Survey
IMD	Indices of multiple deprivation
MCS	Millennium Cohort Survey
NHS	National Health Service
NIHR	National Institute for Health Research
OR	Odds ratio
PLS	Pregnancy Lifestyle Survey
SD	Standard Deviation
SDQ	Strengths and difficulties questionnaire
SES	Socioeconomic status
SFH	Smoke-free home
SHS	Secondhand smoke
SSSP	Stop smoking services in pregnancy
THS	Thirdhand smoke
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

CHAPTER 1 BACKGROUND

1.1 INFANT AND CHILD SECONDHAND SMOKE EXPOSURE; PREVALENCE AND TRENDS

1.1.1 What is secondhand smoke exposure?

Secondhand smoke (SHS), also known as passive smoking or environmental tobacco smoke, is breathing in other people's cigarette smoke. Secondhand smoke is composed of sidestream smoke from the burning tip of the cigarette and the mainstream smoke exhaled by the smoker, containing over 4,000 chemicals.[1] A World Health Organisation (WHO) consultation report in 1999 concluded that SHS was a substantial threat to child health,[2] with the 2006 and 2014 US Surgeon General reports later concluding that there is no safe level of SHS exposure.[1 3] Forty percent of children globally are exposed to SHS.[4] In the UK, around two million children are estimated to be exposed to SHS in the home,[1] with 38.7% of children (aged 4-15 years) who live with one or more smoking parents in England being regularly exposed.[5]

1.1.1.1 Measuring secondhand smoke exposure in children

Nicotine is a chemical found in all tobacco products.[6] The proximate metabolite of nicotine is cotinine, the presence of which in blood, saliva, urine or hair can be used as a quantitative proxy measure of SHS exposure.[6] Salivary cotinine in particular is a commonly used biomarker of nicotine metabolism,[6] and a validated measure of both active smoking and SHS within children and adolescents.[7] Urinary cotinine is often presented as a cotinine to creatinine ratio to adjust for individual differences in fluid intake and urine dilution.[8] Although able to provide a quantifiable measure of SHS exposure, there are limitations to using these biomarkers; cotinine concentrations are subject to individual differences in both uptake and metabolism, only provide reliable measures of exposure over a short period of time due to the half-life of cotinine, and can be difficult to collect in sufficient amounts in children and young infants without causing distress.[9]

The collection of proxy parental reports is less invasive than biomarkers, although there is some question over whether they can provide an accurate and clinically useful measure of child SHS exposure. Parental reports have been argued to be subject to bias as parents may be inclined to give socially desirable responses, inaccurate estimates of duration and frequency of their child's exposure to SHS, and their responses may be subject to recall biases.[9] However, there is evidence that parental proxy reports can be a valid indicator of child SHS exposure; previous research has found biomarkers and reported child SHS exposure in the home to be moderately correlated across a range of ages (r range = 0.36-0.66).[8-10] In infants and children aged under 2.5 years, maternal reported SHS exposure through maternal and home smoking behaviours have been found to be moderately correlated with both urinary cotinine and home environmental nicotine (r range = 0.30–0.62).[10] The convenience and cost-effectiveness of using proxy parental reports make it a popular and commonly used measure of child SHS exposure.

1.1.2 Defining infant and child terminology

As far as the author is aware, there are no universally accepted definitions for the age ranges of neonates or newborns, infants or children. Throughout this thesis, the following definitions will be used, as defined by the Stedman's Medical Dictionary:[11] newborn or neonate, within the first

28 days of life; infant, the first 12 months of life; baby, unspecified age encompassing both newborns and infants; child, end of infancy onwards. In this thesis, the term 'young infant' is used to describe infants approximately ≤3 months of age, and 'young child' to define children aged 12-24 months old. Where there is ambiguity over age, the general term 'child' is used.

1.1.3 Child SHS exposure prevalence and trends in the UK

General declines in children's SHS exposure in England have been observed since the 1980's. Jarvis and colleagues[12] explored SHS exposure trends using data from cross sectional surveys carried out by the Office for National Statistics in England between 1988 and 1998. The surveys were designed to measure smoking in nationally representative samples of secondary school children aged 11-15. Examination of salivary cotinine concentrations of non-smoking children showed substantial reductions between 1988 and 1998, with geometric mean levels almost halving over this time, from 0.96ng/ml to 0.52ng/ml. However, the most significant reductions were in children from non-smoking homes, whereas those children whose mother or both parents smoked only displayed borderline significant reductions in cotinine concentrations.

Sims et al.[13] used Health Survey for England (HSE) data to explore trends in child SHS exposure. The HSE is an annual, nationally representative, cross sectional survey of households. Salivary cotinine in non-smoking 4-15 year olds, smoking status of parents and carers, and smoking in the home were examined between 1996 and 2006. Geometric mean cotinine concentrations in children declined by 59%, from 0.59ng/ml to 0.24ng/ml, during this period. The most substantial reductions were between 2005 and 2006. The greatest declines in SHS exposure were in children who were most exposed to SHS, whereby children whose parents were both smokers had annual median declines in cotinine of 0.115ng/ml. The authors concluded that there had been an overall fall in the level of SHS exposure in children in England and a reduction in inequalities in exposure.

These studies were conducted prior to smoke-free legislations, which were implemented in Scotland in March 2006, in Wales and Northern Ireland in April 2007, and in England in July 2007, banning smoking in workplaces and enclosed public places. Debates preceding implementation raised concerns that children’s health would be adversely affected through displacement of smoking into the home.[14] Several studies were conducted in the years immediately following the legislation to examine the impact on child SHS exposure.

In Scotland, Akhtar et al.[15] reported findings from the Child Exposure to Environmental Tobacco Smoke (CHETS) study examining the impact of the smoke-free legislation in Scotland on children’s SHS exposure. This was a cross sectional, class-based survey of primary school children with a mean age of 11.4 years. Salivary cotinine concentrations, reports of parental smoking, and exposure to tobacco smoke in public and private places were compared pre and post-legislation. There was a 39% reduction in the geometric mean salivary cotinine concentration in non-smoking children following the introduction of the legislation; however, this was only significant among children from non-smoking homes or those where only the father smoked. There was therefore no evidence of an increase in SHS exposure among children following the legislation, although there was little change or reduction of SHS exposure among children from smoking homes.

Holliday et al.[16] also used a cross-sectional survey to assess changes in child SHS exposure following the implementation of smoke-free legislation in Wales. Self-report questionnaires and salivary cotinine concentrations were conducted in 1,750 10-11 year old children from 75 Welsh Primary schools pre and post-legislation. There was a small but non-significant reduction in geometric mean cotinine concentrations of 12% (0.17ng/ml pre-legislation to 0.15ng/ml post-legislation). When cotinine concentrations were divided into tertiles, there was significant movement from the middle (0.10-0.50ng/ml) to the lower tertile (<0.1ng/ml), indicating the proportion of children with cotinine concentrations of less than 0.1ng/ml increased significantly. Whilst there were less substantial declines than those observed in Scottish data, significant reductions in SHS exposure were still found.

Using a similar methodology to that employed in Scotland,[15] The Health Promotion Agency[17] found a small but non-significant fall of 9% (from 0.17ng/ml to 0.16ng/ml) in geometric mean cotinine concentrations following the implementation of smoke-free legislation in Northern Ireland. There was a significant increase in the percentage of children reporting that they were 'never' exposed to SHS.

In England, Jarvis et al.[14] analysed the HSE data to compare the proportion of children living in smoke-free homes (SFH), and the proportion of children with undetectable cotinine concentrations, before and after the introduction of the smoke-free legislation in 2007. Salivary cotinine concentrations of 10,825 non-smoking children aged between 4-15 years, parental self-reported smoking status and home smoking behaviour from surveys distributed between 1998 and 2008 were examined. There was a general trend for increasing adoption of smoke-free policies in the homes of smoking parents, from 16% to 48% between 1998 and 2008, with a significant increase in SFHs in 2008 following the introduction of the smoking ban in mid-2007. The proportion of children with undetectable salivary cotinine concentrations increased from 34% (95% Confidence Interval (CI) 30.8%-37.3%) in 2006 to 41.1% (95% CI 38.9%-43.4%) in 2008. Furthermore, there were reductions in overall geometric mean salivary cotinine concentrations among all children between 1998 and 2008. Whilst the most significant reductions were observed between the years 2005 and 2006, there was a further marginal reduction following the smoking ban between 2006 and 2008, from 0.24ng/ml (95% CI 0.21–0.26) to 0.21ng/ml (95% CI 0.20–0.23) respectively. The authors concluded that the introduction of the smoking ban had led to an increasing trend for adopting home smoke-free policies among smoking parents. There had been little change in the overall SHS exposure in children; however, there was no evidence of increased exposure following the smoking legislation.

In a recent paper, Jarvis et al.[5] updated these findings up to the year 2012, again using HSE data and the methods described above. In 2012, 38.7% (95% CI 44.5 - 33.2%) of children in England aged 4-15 years with one or both parents being smokers did not live in a SFH. At this time, 68.6% (95% CI 64.3 – 72.6%) of children aged 4-15 had undetectable levels of cotinine. The authors argued that children's exposure to SHS in England had declined by 79% since 1998, indicating that there is an increasing social norm for the adoption of SFHs, even among those parents who are smokers.

The most recent estimates for the prevalence of child SHS exposure in the UK come from Moore et al.'s updated CHETS Wales study conducted in 2014.[18 19] Using a similar methodology to the earlier 2008 CHETS Wales study, 75 nationally representative schools were recruited, and questionnaire data on SHS exposure in private spaces collected from 1601 children aged 10-11 years within these. Child reported smoking in the home declined substantially between 2008 and 2014; 52% of children who had one or more smoking parents reported that their parents smoked in the home, compared to 71% of children in 2008. Furthermore, 74% of all children in this sample and 51% of children with one or more smoking parents reported living in a SFH. The authors noted that those children from low socioeconomic status (SES) groups were more likely to report being exposed to SHS in the home, and that whilst reductions in exposure between 2008 and 2014 had been observed across all SES groups, SES inequalities remained.

1.1.3.1 Prevalence of infant and young child SHS exposure

The author is aware of only one previous study in the UK that estimated the prevalence of SHS amongst young infants, published in 2003.[20] The study included 314 infants (aged 4-24 weeks, average 12 weeks), whose parents were smokers, born within two NHS trusts in the West Midlands, England, within a 9 month period. Parents were asked to participate by their family health visitors, and data were collected through interviews carried out in the home by a trained nurse. The sample was 82% white ethnicity, and was described to be of a lower social class compared to the UK average for households with infants, with a high proportion of participants in manual occupations or unemployed, and holding no educational qualifications. Based on parental self-report, 82% of young infants were exposed to SHS in the home, as just 18% of parents reported having a SFH.[20] Among young children (18-30 months), 86.1% of those whose parents were smokers were found to be exposed to SHS in the home in a study conducted in England in 2004.[21] Elsewhere, the author is aware of just two studies, from the USA, in which 10.8-21.4% of infants of smoking mothers aged ≤9 months were exposed to SHS in the home,[22] and 24.5% were exposed to SHS for ≥1 hour per day.[23] Although these studies suggest infant SHS exposure may be a substantial issue, they were conducted prior to,[20 23] or around the time[22] that comprehensive smoke-free legislations were introduced. There are no contemporary estimates of prevalence in this age group.

1.1.3.2 Summary

Secondhand smoke exposure in children has been declining since the 1980's, with further reductions following the introduction of legislations banning or restricting smoking in public enclosed spaces. There is no evidence from the UK that the legislation resulted in smoking being displaced into the home, however there is evidence that the positive effects of the smoke-free legislation have been limited to those children who were least exposed, with children from smoking households displaying only modest reductions in SHS exposure. Furthermore, research examining the prevalence of childhood SHS exposure in the home pre and post smoke-free legislation may have been influenced by wider socio-political factors, and it is possible that there was some pressure to demonstrate the effectiveness of the smoke-free legislations as being of public health benefit. The primary limitation of the currently available literature however is the focus on school-age children. This is likely to be due to the convenience with which school-aged children can be accessed and the ease with which saliva samples can be collected from these older children. Those studies including infants and children aged 4 years or younger do not report prevalence of SHS exposure in this age group independently of older, school-age children. Consequently, there is no current accurate estimate for the prevalence of SHS exposure in children less than 4 years of age. More specifically, there is no contemporary research measuring SHS exposure in young children or infants. Due to the omission of this age group within the currently available literature, it is not possible to quantify the true scale of SHS exposure, and whether this has changed over time, among younger children in the UK.

1.2 HARMFUL EFFECTS OF CHILD SHS EXPOSURE

Children's SHS exposure has been causally linked to increased risks of a range of ill health and societal outcomes; the most important of these are discussed below.

1.2.1 Respiratory tract infections

Respiratory tract infections, whilst a common childhood illness, are of particular concern for young infants as they can result in severe infections requiring hospitalisation. Jones et al.[24] conducted a systematic review and meta-analysis of 60 studies to examine the association between SHS exposure and lower respiratory tract infections in young children and infants aged 2 years and under. Lower respiratory tract infections include bronchitis, bronchiolitis and pneumonia. There were significant increased risks of lower respiratory tract infections for those infants or young children exposed to any household member smoking (odds ratio (OR) 1.54, 95% CI, 1.40-1.69), smoking by both parents (OR 1.62, 95% CI 1.38-1.89), paternal smoking (OR 1.22, 95% CI 1.10-1.35) and maternal smoking (OR 1.58, 95% CI, 1.45-1.73).[24] The strongest association was between bronchiolitis and exposure to smoking by any household member (OR 2.51, 95% CI 1.96-3.21).[24] The authors concluded that their findings were confirmation of the significant risk of lower respiratory tract infections associated with SHS exposure during the first 2 years of life.[24]

A recent study[25] examined the relationship between the introduction of the smoke-free legislation in England and hospitalisation for respiratory tract infections among children (<15 years). After the introduction of the smoke-free legislation, hospital admissions for lower respiratory tract infections reduced by 13.8% (95% CI -15.6 - -12.0%), and admissions for both upper and lower respiratory tract infections reduced by 3.5% (95% CI -4.7 - -2.3%). Overall, this represented approximately 11,000 fewer hospital admissions in England among children aged <15 years for respiratory tract infections each year.

1.2.2 Wheeze and asthma

The association between wheeze and asthma in children and exposure to SHS has long been researched. In a systematic review and meta-analysis of 79 studies, Burke et al.[26] reported that exposure to pre or post-natal SHS was associated with between 30-70% increased risk of wheeze, and 21-85% increase risk in asthma. The strongest associated risk for incident wheeze was among young children and infants aged 2 years and under exposed to maternal smoking (OR 1.70, 95% CI 1.24-2.35).[26] Whilst evidence for exposure to paternal smoking was limited, this meta-analysis did report an increased risk of wheeze in children aged 5-18 years (OR 1.38, 95% CI 1.05-1.85) based on the two available studies.[26] Household SHS exposure was also associated with an increased risk of wheeze in young children and infants aged 2 years and under (OR 1.35, 95% CI 1.10-1.64), and children aged 5-18 years (OR 1.32, 95% CI 1.12-1.55); however, there was no significant association in children aged 3-4 years (OR 1.06, 95% CI 0.88-1.27).[26]

The association between SHS exposure and asthma tended to be weaker than that for incident wheeze. There was a borderline significant ($p=0.08$) association between exposure to maternal SHS and asthma only in the age group 5-18 years (OR 1.20, 95% CI 0.98-1.46), with no significant associations in young children/infants aged less than 2 years or ages 3-4 years.[26] The authors comment on the high level of heterogeneity between the studies, and highlight that those reporting hazard ratios revealed an increased risk of 21% incidence of asthma associated with maternal smoking (hazard ratio (HR) 1.21, 95% CI 1.01-1.45).[26] Although the number of studies was limited, paternal smoking significantly increased the risk of asthma in young children and infants under 2 years of age (OR 1.34, 95% CI 1.23-1.46); however, not among children aged 5-18 years (OR 0.98, 95% CI 0.71-1.36).[26] There was no significant association between household SHS exposure and asthma among children/infants aged 2 years and under (OR 1.14, 95% CI 0.94-1.38); however, there was a borderline significant association in 3-4 year olds (OR 1.21, 95% CI 1.00-1.47) and 5-18 year olds (OR 1.30, 95% CI 1.04-1.62).[26] In comparing their findings to previous meta-analyses, the authors comment that the effects of passive smoking on incident wheeze and asthma are substantially higher than previous estimates, and conclude that passive smoking is an important risk factor for both conditions throughout childhood.[26]

A further systematic review and meta-analysis[27] published in 2013 also found a link between SHS exposure and physician diagnosed childhood asthma. In this review of 20 studies, exposure to SHS was significantly associated with childhood asthma, with a pooled odds ratio of 1.32 (95% CI 1.23-1.42).

1.2.3 Middle ear infections

There is substantial evidence that exposure to SHS increases the risks of middle ear disease in children. A systematic review and meta-analysis found increased risks of middle ear infections associated with exposure to maternal smoking (OR 1.62, 95% CI 1.33-1.97) and any household member smoking (OR 1.37, 95% CI, 1.25-1.50).[28] In particular, there was an increased risk of surgery for middle ear infections, whereby exposure to both maternal and paternal smoking increased risks by over 80% (OR 1.86, 95% CI, 1.31-2.63, and OR 1.83, 95% CI, 1.61-2.07

respectively).[28] The authors report that 7.5% of episodes of middle ear infections can be attributed to household smoking in the UK, resulting in approximately 130,200 additional episodes annually.[28] The link between middle ear infections and SHS exposure is of concern because middle ear infections can have wide-ranging implications for children, which are likely to exacerbate some of the other complex problems that children with SHS exposure are observed to experience. For example, hearing loss associated with middle ear infections can negatively affect academic performance and behavioural problems in school.

1.2.4 Sudden unexpected death in infancy

Sudden unexpected death in infancy is a devastating condition that is clearly of specific relevance to infants. The Passive Smoking and Children report published by Royal College of Physicians found that maternal smoking after birth was associated with a three-fold increased risk of sudden unexpected death in infancy (OR 3.15, 95% CI 2.58-3.85).[29] Paternal or other household member smoking also increased the risk (OR 2.31, 95% CI 1.95-2.73); however, this was reduced to an OR of 1.45 (95% CI 1.07-1.96) when excluding studies where this effect was likely to be confounded by maternal smoking.[29] The authors concluded having one or more smokers living in the household more than doubled the risk of sudden unexpected death in infancy. A 2013 meta-analysis conducted by Zhang et al.[30] also reported postpartum smoking to be associated with an increased risk of sudden unexpected death in infancy (OR 1.97, 95% CI 1.77–2.19), which was elevated further when considered alongside co-sleeping (OR 2.65, 95% CI 1.33–2.04).

1.2.5 Invasive meningococcal disease

Invasive Meningococcal disease is a serious cause of morbidity and mortality in children and young adults.[31] Just under 5% of cases are fatal, and around 16% are left with serious morbidity including intellectual disability, deafness, epilepsy or spasticity.[32] A systematic review and meta-analysis of 18 studies found that exposure to SHS in the home more than doubled the risk of invasive meningococcal disease (OR 2.18, 95% CI 1.63-2.92), with the greatest increased risk found for children and infants under the age of 5 years (OR 2.48, 95% CI 1.51-4.09).[33] Maternal smoking after birth also increased the risk of invasive meningococcal disease two-fold (OR, 2.26, 95% CI 1.54-3.31).[33] The authors concluded that SHS exposure increased the risk of invasive meningococcal disease in children, resulting in an estimated 630 additional cases of the disease in under 16s each year in the UK.[33]

1.2.6 Psychological and behavioural problems

There is also emerging evidence that postnatal exposure to SHS may be associated with neurobehavioural problems in children. Kabir et al.[34] reported that children exposed to SHS in the home were at 50% increased risk of neurobehavioural health problems, including learning disabilities (weighted prevalence 8.2%, 95% CI 7.5-8.8), attention deficit hyperactivity disorder (5.9%, 95% CI 5.5-6.4), and behavioural and conduct disorders (3.6%, 95% CI 3.1-4.0).[34] Older children (aged 9-11 years) and those living in the highest levels of poverty were most at risk. This study was not able to control for prenatal smoke exposure, and the authors note that further research is needed to confirm their findings. However, SHS exposure in the home may be a significant contributor to many common childhood neurobehavioural problems.[34]

An association between exposure to SHS and poor mental health outcomes in children has also been reported in a number of studies. Among a nationally representative sample of US children and adolescents aged 8-15 years, cotinine concentrations were positively associated with Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) symptoms for major depressive disorder, generalised anxiety disorder, attention deficit hyperactivity disorder and conduct disorder.[35] This association remained after adjustment for age, sex, ethnicity, poverty, and with the exception of attention deficit hyperactivity disorder, also remained significant after controlling for maternal smoking during pregnancy.[35] A similar link between SHS exposure and poor mental health in children has been observed in the UK. The association between SHS exposure and psychological difficulties was assessed in a community-based population survey conducted in Scotland.[36] There was a significant dose-response relationship between salivary cotinine and poor mental health in children with a mean age of 8.2 years, as measured by the Strengths and Difficulties Questionnaire (SDQ scale).[36] This effect remained significant after adjustment for SES group and a range of general health measures.[36] Furthermore, in a Spanish population based cross-sectional study, those children habitually exposed to SHS in the home (≥1 hour per day) had an increased OR of 2.73 (95% CI 1.38–5.41) for probable mental disorder as measured by the SDQ, and an increased OR of 3.14 (95% CI 1.63–6.04) for attention-deficit and hyperactivity disorder compared to non-exposed children.[37]

An association between exposure to SHS and behavioural problems has also been observed. In a longitudinal sample of nearly 6,000 children enrolled in the German Infant Nutrition Intervention, Rueckinger et al.[38]

examined emotional symptoms, conduct problems, hyperactivity/inattention and peer relationship problems using the SDQ scale. After controlling for prenatal smoke exposure, and adjustment for parental education, father's employment, time spent in front of a computer or television screen, having a single parent and mother's age, children exposed to SHS postnatally were 30% (95% CI 0.9-1.9) more likely to be classified as abnormal in the SDQ scale at age 10 years.[38] There have been similar findings in a sample of pre-school children up to 6 years of age; a dose-response relationship was observed between hyperactivity/inattention and conduct disorder as measured by the SDQ scale, after adjustment for maternal prenatal smoking, SES factors and low birth weight.[39] Those children who had 'low' and 'high' SHS exposure were at an increased risk of hyperactivity/inattention (OR 1.32, 95% CI 1.02-1.78, OR 2.39, 95% CI 1.62-3.53 respectively) and conduct disorder (OR 1.84, 95% CI 1.37-2.06, and OR 1.93, 95% CI 1.39-2.68 respectively).[39]

The currently available literature exploring the link between SHS exposure and neurobehavioural problems is limited, and at present is focused upon cross sectional studies. Based on the available evidence it is difficult to ascertain whether poor mental health outcomes are associated with SHS exposure or are mediated by other factors such as social or familial problems. However, these studies do highlight a further potential negative health outcome for children exposed to SHS in the home, and further research is warranted to explore this.

1.2.7 Increased likelihood of smoking uptake

The Passive Smoking and Children report published by Royal College of Physicians identified exposure to smoking role models in the form of smoking parents, siblings and other household members as a substantial risk factor for smoking uptake in children and adolescents.[29] Since the publication of this report, an updated meta-analysis evidenced that where both parents smoke, the risk of smoking uptake increases by almost three-fold (OR 2.73, 95% CI 2.28-3.28).[40] There were significant increases in smoking uptake risks for children with just one smoking parent (OR 1.72, 95% CI 1.59-1.86), with the risks being greatest if that parent was the mother (OR 2.19, 95% CI 1.73-2.79).[40] Paternal smoking (OR 1.66, 95% CI 1.42-1.94) and sibling smoking (OR 2.3, 95% CI 1.85-2.86) also significantly increased the risks of smoking uptake.[40] An estimated 23,000 adolescents in the UK were reported to take up smoking each year as a result of exposure to household smoking.[40]

More recently, McIntire et al.[41] tried to establish whether the observed association between SHS exposure and subsequent smoking uptake was causal, rather than due to other confounding factors, such as greater exposure to pro-tobacco media. The authors analysed data from the 2009 National Youth Tobacco Survey using propensity score matching techniques. This method reduces bias in estimated coefficients by comparing subsets of participants in the exposed and non-exposed groups who are similar on a number of relevant confounding variables. After adjusting for smoking in their social environment, smoking-related beliefs and exposure to tobacco-related media, the susceptibility to smoke among those exposed to SHS increased from an OR of 1.47 (95% CI 1.30-1.65) to 1.52 (95% CI 1.31-1.76). The authors argued that these methods provided a more robust estimate of the influence that SHS exposure has on the likelihood of smoking uptake than previous research, and reiterated the dangers of SHS exposure for children.

Exposure to smoking role models in the home is likely to be only one of many factors contributing to smoking uptake in children and adolescents. Smoking in the home is known to be more common among socially disadvantaged families and communities, and therefore children within these groups are likely to be exposed to smoking within their wider social network.[29] However, the observed association between SHS exposure in the home and subsequent smoking uptake in children and adolescents is concerning as it perpetuates the cycle of smoking across generations and within socially disadvantaged groups.[29] The evidence highlights that SHS exposure in the home can have not only an immediate increased risk of ill health, but through the behavioural consequence of contributing towards smoking initiation and the increased risks of further morbidity and mortality associated with active smoking.[40] The adverse short and long-term consequences of smoking in the home make it a significant avoidable health risk.

1.2.8 Economic cost of child SHS exposure

The economic cost associated with SHS exposure in children is likely to be substantial. The Passive Smoking and Children report published by Royal College of Physicians estimated that child SHS exposure cost approximately £9.1 million in primary care consultations and asthma treatment costs and £13.6 million in hospital admissions in the UK annually.[29]

A further economic cost based on subsequent increased uptake in smoking was assessed. Associated future healthcare costs were estimated to be between £48 million and £78 million over a lifetime, and future workplace costs attributable to smoking-related disease and smoking breaks to be up to £72 million over 40 year working careers.[29] The authors noted that such estimations were likely to be conservative, particularly as this did not take into consideration the neurobehavioural issues described above.

1.2.9 Social cost of child SHS exposure

Given the increased risks of a range of illnesses linked to SHS exposure, it is unsurprising that those children exposed to SHS in the home may have significantly more absenteeism from school. Levy et al.[42] reported that children who lived with at least one smoker in the household had 1.06 (95% CI 0.54-1.55) additional days absent from school annually, and those living with 2 or more smokers had 1.54 (95% CI 0.95-2.12) additional days absent compared to children who do not live with a smoker. Twenty-four percent (95% CI 14-32) of school days missed in children living with one smoker, and 34% (95% CI 24-43) in children living with two or more smokers, could be attributed to SHS in the home, with a significant economic cost through associated lost parental earnings.[42] A Hong-Kong based study similarly found evidence that exposure to SHS in the home is linearly related to poor academic performance in non-smoking adolescents, which was found to be true after controlling for SES factors.[43] Whilst the authors comment that this may be through toxicant exposure and cognitive mechanisms,[43] it is also possible that this is linked to a child's increased cumulative absenteeism across their education; however, this was not examined in this study. Nonetheless, taken together, these studies suggest that exposure to SHS in the home can negatively impact a child academically.

It is difficult to control for all possible confounding factors when investigating the association between postnatal SHS exposure and behavioural problems in childhood; a wide range of familial, parental psychological or social factors not included in the discussed literatures' analyses may mediate the relationship. Further research is needed to explore family and home circumstances more widely. However, taken together the observed increased risks of school absenteeism and poor academic performance among children exposed to SHS are concerning given that SHS exposure is more common among socially disadvantaged groups. These issues have the potential to perpetuate the cycle of social disadvantage and exacerbate inequalities.

1.2.10 Summary

Childhood SHS exposure is a significant cause of ill health and mortality, and poses a substantial economic and social cost through associated health costs, behavioural issues and increased likelihood of smoking uptake in adulthood. Furthermore, it is likely that the discussed harmful effects of child SHS exposure are cumulative. One instance of respiratory tract infection is unlikely to negatively affect a child's well-being or development; however, it is probable that children exposed to SHS face recurrent episodes of illness, or a combination of harmful effects. Cumulatively, the impact of these ill-health issues will be wide-ranging and have a negative impact in other areas of the child's life, for example, academic performance or behaviour. In addition, many of the illnesses associated with SHS exposure are of particular concern in young infants as they are more likely to require hospitalisation among this vulnerable age group, which, if prolonged, could impact upon child development. These issues are completely avoidable; preventing and reducing childhood SHS exposure should be a public health priority.

1.3 SOURCES OF CHILD SHS EXPOSURE AND EFFECTIVENESS OF STRATEGIES TO REDUCE EXPOSURE

1.3.1 Parental and household member smoking

Following the introduction of smoke-free legislations across the UK, parental smoking and smoking in the home are now the primary sources of exposure to SHS for children.[4 29] Maternal smoking is consistently reported to be associated with child SHS exposure. Sims et al.[13] found salivary cotinine levels to be significantly higher among children aged 4-15 years who had a smoking mother (OR 2.09, 95% CI 1.96-2.28) compared to children who did not have a smoking parent. A similar increased risk of exposure associated with maternal smoking was observed by Delpisheh et al.[44] and Rachiotis et al.[45] (OR 2.5, 95% CI 1.8–3.4 and OR 2.34, 95% CI 1.87–2.94 respectively). Other research however has suggested that the risk may be higher than this; Gonzales et al.[46] found that mothers who smoked were over three times more likely (OR 3.31, 95% CI 1.47–7.46) to report their child to be exposed to SHS in the home. When using child self-reported SHS exposure as an outcome measure, children of smoking mothers are up to seven times (OR range 6.5–6.9) more likely to report being exposed to SHS in the home.[47-49]

Paternal smoking is also an important source of exposure. Rachiotis et al.[45] found children of smoking fathers aged 11-17 years were around twice as likely to be exposed to SHS (OR 2.08, 95% CI 1.76–2.46). In Rudatsikira et al.'s[49] research, children aged 13-15 years were over three and a half times (OR 3.65, 95% CI 3.10–4.30) more likely to be exposed to SHS if only their father was a smoker compared to children whose father was a non-smoker. Other research has found higher risks associated with paternal smoking; Peltzer et al.[47] reported children aged 11-17 years to be over four times (OR 4.25, 95% CI 3.41–5.30) more likely to report being exposed to SHS at home if their father was a smoker, while Raisamo et al.[48] found 12-14 year olds to be almost six times (OR 5.8, 95% CI 5.1–6.7) more likely to be exposed if their father was a smoker.

The greatest observed risks across the literature are for children of parents who both smoke, who have been found to be up to 13.5 times (OR range across studies 2.9 to 13.5) more likely to be exposed to SHS in the home.[13 45 47-50] There is some evidence of a relationship between increased number of cigarettes smoked by parents,[51-53] or an increased number of cigarettes smoked in the home,[54-56] and higher child SHS exposure. The relationship between parental or caregiver smoking and child SHS exposure is unsurprising due to the close and frequent contact that children have with their parents.[57] This is likely to have important implications for younger children of pre-school age, who spend an increased proportion of their time at home with their mothers compared to older, school-aged children.[57 58]

The research exploring child SHS exposure from other smoking adults in the home, such as grandparents or extended family members, is more limited. In 2012 in England, Jarvis et al.[5] found 2.8% (95% CI 4.10-1.90) of children aged 4-15 whose parents were non-smokers did not live in a SFH, indicating that at least some SHS exposure in the home can be attributed to other household members or visitors smoking. Dell'Orco et al.[52] found that the presence of 'other smokers' in the home that were not the child's mother or father was associated with a significant increase in mean urinary cotinine ($p < 0.001$) among their sample of non-smoking children aged 12-15. King et al.[59] analysed data from the Medical Expenditure Panel Survey between 2000-2004 in the USA. Children who lived in households headed by an adult other than their parents, for example, a grandparent or other relative, were significantly more likely ($p < 0.0001$) to live with a smoking adult, or multiple smoking adults ($p < 0.0001$) than children living in parent-headed households.[59] These adult smokers could be either grandparents, or siblings of their parents. Children who lived in poverty (< 100% of the federal poverty level) or belonged to a minority race/ethnicity were significantly ($p < 0.0001$) more likely to live in non-parent headed households.[59]

1.3.2 The effectiveness of harm reduction strategies

An increasing number of households are making their homes smoke-free;[14] however, there remain many homes where smoking restrictions are either not in place or are ineffective. Winklestein et al.'s[60] research was one of the first studies that looked at which harm reduction strategies were effective in reducing SHS exposure in the home. Parents of 58 children aged 1-19 years reported harm reduction strategies used in the home, including opening windows whilst smoking, smoking in another room to their child, limiting the number of cigarettes smoked and restricting smoking to outside the home. Only restricting smoking to outside the home was associated with a significant decrease in children's urinary cotinine. Similarly, Wakefield and colleagues[61] used a cross sectional survey to explore the association between levels of restrictions on smoking in the home and children's exposure to SHS. The authors compared urinary cotinine in children aged 1-11 years who had a total smoking ban at home, a ban on smoking but where exceptions were allowed, smoking limited to parts of the home, or unrestricted smoking. Those children living in homes where smoking was unrestricted had the highest observed urinary cotinine levels (26.0 nmol/mmol); however, children whose homes had smoking restrictions with some exceptions (14.9 nmol/mmol), or limited smoking to certain parts of the home (14.1 nmol/mmol) also experienced significantly higher levels of SHS exposure compared to children living in homes with complete bans (7.6 nmol/mmol). The authors concluded that although partial restrictions on smoking in the home may result in reduced SHS exposure in children, they were unlikely to offer sufficient protection.

There are similar findings in younger age groups. Blackburn et al.[20], whose study exploring the prevalence of infant SHS exposure in the home was described previously, also examined the association between parent's self-reported use of smoking harm reduction strategies in the home (such as taking steps to avoid smoking in the vicinity of the infant or ventilation following smoking) and urinary cotinine levels in 164 infants (aged 4-24 weeks). Those infants whose parents reported strict no-smoking policies in the home had significantly lower mean log transformed urinary cotinine to creatinine ratio (1.26 ng/ml:mmol/l, 95% CI 0.68-1.82) compared to infants of parents who had less strict or no smoking restrictions (2.58

ng/ml:mmol/l, 95% CI 2.38-2.78). The authors concluded that complete smoking bans in the home were associated with a significant reduction in SHS exposure; however, less strict restrictions or no restrictions had no effect on infant's exposure. Johansson et al.[62] examined urinary cotinine samples of children aged 2.5 to 3 years old participating in the All Babies in Southeast Sweden study. Parents reported whereabouts they smoked at home, including outdoors, indoors, indoors with the kitchen fan on, or a combination. Children whose parents smoked exclusively outdoors with the door closed had significantly lower urinary cotinine to creatinine ratios compared to those whose parents reported any smoking indoors. Spencer et al.[21] also compared urinary cotinine in children aged 18-30 months. Parents in this study reported either: having a complete smoking ban at home; smoking being permitted in the home, but harm reduction strategies used such as not smoking in the vicinity of the child or airing the room after smoking; or smoking being allowed in the home with no harm reduction strategies used. Those children whose parents reported complete smoking bans in the home had significantly lower mean log cotinine:creatinine ratios (1.11, 95% CI 0.64-1.49) compared to children whose parents used no or less strict harm reduction strategies (1.87, 95% CI 1.64-2.10). After controlling for mother's cigarette consumption and other confounders, only a total ban on smoking in the home was associated with a significant reduction in child SHS exposure.

Taken together, these findings indicate that for those parents unwilling or unable to quit smoking, making their homes smoke-free is the next most effective way to reduce their child's SHS exposure.[61] Harm reduction strategies, such as restricting smoking to certain areas of the home or smoking near open windows do not offer sufficient protection against SHS exposure.

1.3.3 Thirdhand smoke exposure

Thirdhand smoke (THS) exposure is a potentially harmful environmental pollutant linked to tobacco smoke, and may in part explain why harm reduction strategies used by parents who smoke in the home are ineffective at preventing SHS exposure. Matt et al. define THS as "residual tobacco smoke pollutants that remain on surfaces and in dust after tobacco has been smoked, are re-emitted into the gas phase, or react with oxidants and other compounds in the environment to yield secondary pollutants" (p. 129).[63] Some of the health risks associated with THS are common to SHS and active smoking, however THS has important chemical differences to SHS and is therefore beginning to be considered as a distinct toxicant.[63] Physical and chemical transformations of residual tobacco smoke take place over time, creating secondary pollutants.[63] For example, the reaction between absorbed nicotine and nitrous acid creates the carcinogenic tobacco-specific nitrosamines, substantial levels of which have been found on surfaces of smoker's vehicles.[64] Furthermore, in an experimental environmental chamber using cotton and Teflon surfaces, products of concern to human health were found to occur through oxidisation of nicotine with atmospheric ozone, including formaldehyde and N-methylformamide.[65] Nicotine and THS pollutants have been shown to persist within indoor environments for several months following smoking,[66] accumulating over time and being absorbed into household surfaces including carpets, upholstery, wood and walls.[63] Pollutants are re-emitted over time as suspended air particles or as deposited particles on surfaces and in dust.[63] There is evidence that THS contamination within enclosed spaces is not eradicated using common cleaning methods and ventilation.[66-68]

Exposure to THS pollutants after re-emission occurs through inhalation, ingestion or dermal transfer.[63] Children are believed to be particularly susceptible to exposure, reportedly ingesting twice the amount of dust particles as adults.[69] Infants engage in mouthing behaviour of non-food objects, have a breathing zone close to the floor, and as mobility increases between 6 and 12 months are likely to generate and be exposed to increasing dust particles from carpets and upholstery.[70 71] These behaviours increase not just ingestion but also inhalation of environmental pollutants, including THS pollutants.

Research has indicated that there is limited knowledge and understanding of the dangers of THS, particularly among parents who smoke. Using USA based census data, Winickoff et al.[71] assessed the health beliefs held by adults about THS exposure and infants. Whilst the majority (93.2%) of both smokers and non-smokers agreed that SHS exposure was harmful to children, only 65.2% of non-smokers and 43.3% of smokers believed the same to be true of THS.[71] Beliefs about the harms of THS for children were independently associated with home smoking bans.[71] Drehmer et al.[72] similarly found that parents who strongly believed that THS was harmful to health were more likely to enforce strict no-smoking policies in their homes or cars.

Research surrounding THS is still relatively new, and much remains to be done to understand the dangers. Much of the existing THS research has been conducted in laboratory settings, which lacks relevance to real-world settings, such as the homes of smoking families. Despite research documenting the potential dangers of THS, there are no estimates of the number of ill-health outcomes or deaths attributable to THS exposure as it is difficult to isolate THS from SHS exposure. Whilst research suggests that communicating the risks of THS exposure may have a potential benefit in increasing the number of homes implementing full smoking bans, care needs to be taken to avoid inciting unnecessary anxiety among parents and families given the lack of knowledge about its harmful effects.

1.4 FACTORS ASSOCIATED WITH SHS EXPOSURE

The Passive Smoking and Children report published by Royal College of Physicians[29] examined the predictors of SHS exposure in children using data from the Health Survey for England.[13 73] As described above, parental smoking status was found to be an important determinant of child SHS exposure, whereby children of smoking mothers had geometric mean cotinine levels 6.4 times higher (95% CI 6.06-6.79) than children of non-smoking mothers, and in children of parents who both smoked this was 8.9 times higher (95% CI 8.26-9.55). Younger children were also at an increased risk, with those aged 4 years having cotinine levels 1.4 times higher than those in children aged 15 years. Other risk factors included parents being in semi-skilled or unskilled manual occupations compared to professional or managerial occupations(OR 3.12, 95% CI 2.91 – 3.34), parents being unemployed (OR 2.69, 95% CI 2.42-2.98), or parents having no educational qualifications (OR 3.85, 95% CI 3.55-4.18).

Across other research, young parental age,[23 55] low income,[74-76] child age,[13 51 54 55 77] ethnicity,[13 23 78] and marital status[23 48 79] have all been found to be associated with child SHS exposure. However, these associations are not consistently reported. For example, some studies have found no association between parental age and child SHS exposure.[46 80-82] Similarly, the link between child age and SHS exposure is inconsistent; some studies have found younger children to be less likely to be exposed,[45 49 83] whilst others report the opposite association.[13 51] The factors that are most important in determining likely SHS exposure therefore remain unclear.

1.4.1 Factors associated with SHS in young infants

There is little research exploring predictors of SHS exposure specifically in young infants, with the majority of literature either not sampling this group,[13 21 46 55 62 74 84-86] or considering these young infants together with older children.[51 78 80 87-89] The only UK study the author is aware of was conducted in England prior to the smoke-free legislation, since which time considerable changes in smoking prevalence and behaviour have been observed. In this 2003 study, described previously, Blackburn et al.[20] reported lower social class and low maternal educational attainment to increase the risk of smoking in the home with infants aged 4-24 weeks. In data collected in the USA between 2004 and 2008, Gibbs et al.[22] reported that having no home smoking restrictions among parents of infants aged less than 9 months were associated with low income, low SES group, young maternal age, ethnicity, being a single parent and smoking in pregnancy. Whilst these studies suggest similarities with literature of older age groups, it is difficult to draw firm conclusions based on the limited available evidence. As discussed in section 1.6.1

below, there is evidence that parents and carers perceive differences between the vulnerability of infants and older children to SHS exposure, and report being more cautious about infant exposure. The factors associated with infant and child SHS exposure may therefore be different, however there is limited evidence to establish whether this is the case. Better understanding of the factors associated with SHS exposure in infancy is essential to help identify which groups are most at risk and provide an evidence base to underpin future initiatives and more targeted interventions in this area.

1.5 REDUCING CHILD SHS EXPOSURE

1.5.1 Parental knowledge, awareness and attitudes towards SHS exposure

Those parents with knowledge about, or negative attitudes towards, SHS, may be more aware about their child's exposure and take greater measures to prevent it. Soliman et al's.[78] analysis of the 1992 and 2000 US National Health Interview Survey data found parents who agreed that SHS was harmful were over 70% less likely to report smoking in the home (OR 0.27, 95% CI 0.23-0.32) compared to those who did not believe SHS to be harmful. Even parents within this sample who were unsure whether SHS was harmful were significantly less likely to report smoking in the home (OR 0.66, 95% CI 0.54-0.81). In Taiwan, parental perceptions have also been reported to be associated with smoking in the presence of children. Liao et al.[82] developed a scale to measure parental perceptions, evaluations of the consequences and family reactions to smoking in the presence of children. Each incremental increase of 1 in parent's score on this scale, indicating more negative perceptions of child SHS exposure, was associated with a decrease in likelihood of smoking in the presence of children (OR 0.93, 95% CI = 0.89-0.97). Smoking in the presence of children was less likely among parents who perceived a greater number of negative consequences of child SHS exposure (OR = 0.88, 95% CI 0.82-0.93) and perceived more anti-smoking responses from other family members (OR = 0.95, 95% CI 0.93-0.97).

However, the relationship between parental perception of risks and subsequent child SHS exposure are not straightforward. Firstly, the above findings have not been replicated in the UK; Mills et al.[55] found no significant associations between maternal attitudes towards statements such as 'children are more at risk from other people's tobacco smoke than adults' and 'other people's tobacco smoke can cause significant health problems for children' and either household particulate matter or child salivary cotinine concentrations. Similarly, in a sample of fathers of young infants, a low knowledge score about SHS exposure was not significantly related to trying or managing to stop smoking in the home.[90] Secondly, further research has highlighted that there are likely to be optimistic biases when members of the general public appraise the risks posed by SHS exposure.[91] A repeated cross-sectional study conducted in 1999 and 2006 in a representative Irish population found that whilst risk perceptions around SHS exposure increased during this time frame, smokers' perceptions of the risks posed by SHS for a range of diseases were significantly lower than those of non-smokers. These findings suggest that increasing parental knowledge about risks posed to their children by SHS exposure alone is insufficient to promote SFHs.

1.5.2 Barriers and facilitators to creating smoke-free homes

Even where there is knowledge or acceptance of the risks associated with SHS exposure, managing smoking in the home can be a complex issue.[92] Some evidence for this has been found in qualitative research, for example, enforcing smoke-free rules may mean mothers or parents negotiating with other smokers to implement restrictions, which can be challenging in some social circumstances and is dependent upon equity in relationships.[92-96] Some women and families also report struggling to create smoke-free environments, as smoking outside whilst leaving their child indoors conflicts with their caregiving responsibilities.[94 95 97] Environmental constraints such as lack of outside space, and the desire to smoke in privacy and comfort are cited by parents as further barriers to the creation and maintenance of SFHs.[94 96-98] Parental confidence to overcome these issues may hinder the implementation of SFHs. Some evidence of this was found by Temple et al.,[99] who used a 10-item scale to measure mother's/primary caregiver's self-efficacy in providing a smoke-free environment at home; a high self-efficacy score was positively associated with having a SFH (adjusted OR 1.15, 95% CI 1.11-1.2). Women with lower self-efficacy were less likely to report having a SFH. These barriers to creating SFHs, or low self-efficacy to overcome barriers, may result in fluidity in home smoking restrictions,[97] which, as discussed above, provide insufficient protection against SHS exposure in the home.[61]

Despite the barriers to implementing SFHs, research has also identified facilitators that may encourage positive behaviour change. The main motivators found in qualitative research carried out by Jones et al.[97] were improvements to home décor and smell, the desire to quit smoking, the presence of newborns in the household and concerns about child health. Similarly, Herbert et al.[100] found awareness of the adverse health effects of SHS, guilt about exposing children to SHS, making a commitment to make the home smoke free and incorporating smoking outside with other outdoor activities were cited by parents as helping to make homes smoke-free.[100] Further qualitative research found that there may be certain 'triggers' that can act as pivotal points in facilitating positive changes to smoking in the home, such as the birth of a new baby, moving to a new home, or child health problems.[92]

1.5.3 Interventions to reduce SHS exposure in children

A systematic search and narrative review published in 2011[101] examined the effectiveness of interventions aimed to encourage the establishment of SFHs in pregnancy and the first year postpartum. Systematic searches were conducted up to 2009, identifying 12 interventions for inclusion.[101] The interventions were varied, including counselling, counselling plus additional information, individualised SFH plans and motivational interviewing. These were delivered within home or clinic settings, and measured effectiveness using either parental self-report of home smoking behaviours, smoking biomarkers or a combination of both. Taken together, intervention studies in this area were inconclusive; no one intervention type, setting or outcome measurement was more effective in increasing SFHs in pregnancy and the early postpartum period.[101] Research in this area was limited due to low study quality, small sample sizes and poor reporting of outcomes. Few interventions used a theoretical underpinning, and in studies using both self-report and biomarker outcome measures findings were often contradictory.[101] Further high quality intervention studies were recommended, with appropriate control groups and longer follow-up periods.[101]

A 2014 updated Cochrane Review of family and carer interventions to reduce SHS exposure in children aged 0-12 years was similarly inconclusive.[102] Fifty-seven studies were identified that used health promotion, social-behavioural therapies, technology, education and clinical interventions to reduce child SHS exposure. Only 14 of these studies showed a statistically significant intervention effect. There was limited evidence that motivational interviewing or intensive counselling in clinical settings had an impact on child SHS exposure; however, overall the authors concluded that there was no clear indication of any intervention strategy being more effective. Thirty-two of the studies showed a reduction in SHS exposure in children irrespective of their group allocation, suggesting that there may be a more general trend for reduced parental smoking or child exposure over time, or that participation in the intervention led to a measurement effect even in control groups. Further research using validated measures of child SHS exposure, larger sample sizes and interventions designed to take into consideration general reductions in child SHS exposure in control groups were recommended.

A further meta-analysis[103] of 30 randomised controlled trials of interventions designed to protect children from SHS was published in 2014. Improvements in exposure were observed both in intervention and control groups. There was a small benefit to participants in the intervention groups, where 7% more children were protected from SHS exposure, however this was only observed in interventions using parental reports as an outcome measure rather than biomarkers. It was concluded that interventions to prevent SHS exposure were moderately beneficial, but further research was needed to identify more interventions that are effective.

Taken together, these reviews indicate that the effectiveness of any one interventional approach to reduce children's SHS exposure has not been conclusively demonstrated and as such there remains a need for novel, evidence-based interventions in this area.

1.6 SHS EXPOSURE IN EARLY INFANCY

Previous research has provided insight into the attitudes, behaviours, barriers and facilitators of parents whose children are exposed to SHS in the home; however, there is little research about these issues specifically in parents of infants. The previously discussed literature has examined barriers to creating SFHs among parents of children either of unspecified age,[93 98 104] under 18 years of age,[92 96] or under 5-6 years of age[94 97 105]. These studies may have included parents of infants (12 months of age and younger) within their sample; however, this was not explicitly reported.

Whilst SHS exposure is dangerous for children of all ages, infants and young children under 2 years of age are thought to be particularly susceptible to the risks of SHS exposure as they have a higher respiration rate[70 106] and SHS exposure may have an adverse effect on their developing lungs.[107 108] This is likely to be exacerbated further as infants experience increased SHS exposure due to spending much of their time indoors in close proximity to smoking parents.[58] As discussed previously, infants are potentially at a further increased risk of THS exposure due to their close proximity to contaminated surfaces such as carpets, and having more hand to mouth contact.[58] Infants have been reported to have higher cotinine concentrations than do older children and adults,[109] which evidence suggests is due to greater exposure rather than slower nicotine metabolism and elimination compared to older age groups.[110]

This increased susceptibility is reflected in research, which has shown SHS exposure to be linked to health problems specifically in young infants. Infants exposed to SHS in the first 3 months of life have been found to have reduced growth,[111] be more vulnerable to infections requiring hospitalisation,[112] with hospital admission being significantly more likely among infants whose parents did not practice 'good smoking hygiene' by smoking more than 3 meters away from the infant.[113] SHS exposure in the early postnatal period is also reportedly related to poor respiratory health, including episodes of wheeze,[114 115] lower respiratory infection,[114] chronic bronchitis[115] and sleep-disordered breathing[116] in infants. There is a further reported increased risk of sudden unexpected death in early infancy amongst those exposed to SHS,[29] a devastating condition that is specific to young infants.

1.6.1 Parental attitudes towards SHS exposure in early infancy

There is some evidence that infants and newborns are perceived to be more vulnerable to the effects of SHS exposure than older children. In a study conducted in the USA,[117] smoking mothers interviewed up to 6 months postpartum described how they considered newborn babies and infants to be particularly vulnerable to SHS, however this vulnerability was perceived to lessen as the baby grew, and mothers began to feel that they could increase their smoking. Similarly Holdsworth and Robinson found in their interviews with smoking families from low SES groups that parents recognised the need to avoid smoking around newborns, but this was relaxed as the infant grew and was considered more robust.[118] In focus groups with smoking parents of children aged 5 years and under, Robinson and Kirkcaldy found all participants to unequivocally agree that newborn babies should not be exposed to SHS, and these beliefs were shared by the people within their wider social network making smoking restrictions easier to apply.[119] Nonetheless, parent's efforts to create smoke-free environments for their baby were not maintained in the longer term, with many parents relaxing their smoking restrictions between 6 and 12 months of age.[119] The main reasons parents cited for this were the baby appearing more physically developed and their increased mobility meaning they could avoid smoke.[119] Therefore, despite some recognition among smoking parents of the risks of SHS to their baby, the literature highlights that there is a transition when the infant is perceived to be less vulnerable and home smoking restrictions begin to be relaxed. However, there is currently limited understanding about the reasons behind parent's behaviours, thoughts and beliefs surrounding this change in smoking in the home during infancy. We do not yet fully understand why parents may feel that their infants might be less vulnerable to SHS exposure as they get older. Furthermore, it is not known to what extent the barriers to creating SFHs identified in the above literature among parents of children across a range of ages, are equally relevant to parents of young infants.

1.7 SMOKING IN PREGNANCY AND SHS EXPOSURE

1.7.1 Smoking in pregnancy and SHS exposure in early infancy

Very little research has been conducted which examines the relationship between smoking, quitting and returning to smoking during pregnancy and subsequent SHS exposure in early infancy. The only study the author is aware of was conducted in the USA. Gibbs et al.[22] estimated the prevalence of complete SFH rules among women with infants (aged approximately 9 months), assessing smoking in pregnancy as a variable in their analyses. Data was gathered between 2004-2008 as part of the Pregnancy Risk Assessment Monitoring System, and included information from 41,535 women who had recently given birth across five states. Women were asked the average number of cigarettes they smoked in the 3 months prior to pregnancy, during the final 3 months of their pregnancy and after delivery.[22] Women were categorised into 1) non-smokers before pregnancy, during and postpartum, 2) quit during pregnancy and remained quit postpartum, 3) quit during pregnancy and returned to smoking postpartum, or 4) smoked during pregnancy and postpartum.[22] It was found that complete SFH rules were less likely to be reported among women who had quit smoking during pregnancy and returned to smoking postpartum (adjusted prevalence ratio 0.96, 95% CI 0.95-0.97) and women who had smoked both during and after pregnancy (adjusted prevalence ratio 0.9, 95% CI 0.89-0.92).[22] Of women who had only partial or no home smoking rules, 44% were non-smokers during pregnancy and postpartum, and 42% were smokers during pregnancy and postpartum.[22]

It seems intuitive to consider the possibility that smoking behaviours across pregnancy and the early postpartum period may impact upon subsequent SHS exposure in early infancy. Over half (54%) of women manage to quit smoking before or during their pregnancy; however, a reported 70% of these women returned to smoking in the first 6 months postpartum.[120 121] As maternal smoking is one of the primary sources of child SHS exposure in the home,[13] postpartum return to smoking may have important implications for infant and child SHS exposure. Women's smoking behaviour during pregnancy may be indicative of their motivation to protect their baby from SHS exposure.[117 119 122] Protecting their baby from SHS exposure may also be mediated by other factors within their home environment, for example, the smoking behaviour of others within their household.[123 124] At present there is no research that explores the relationship between smoking behaviours during pregnancy and subsequent infant SHS exposure qualitatively; this is likely to be important given the complexity of factors that influence infant and child SHS exposure that has been discussed, and how this can change over time.

1.8 SUMMARY AND THESIS OBJECTIVES

1.8.1 Summary

Childhood SHS exposure causes substantial ill health, and poses a significant economic and social cost; reducing child and infant SHS exposure is therefore a public health priority. Since the introduction of smoke-free legislations, parental smoking and smoking in the home are now the primary sources of child SHS exposure.[29] Previous research has described the trends in prevalence of child SHS exposure in the UK, however there are no contemporary prevalence estimates for SHS exposure in young infants (≤3 months). Due to the omission of young infants within the currently available literature, it is not possible to quantify the scale of SHS exposure among young children and infants, and if this has changed over time. This age group is of concern because infants and young children under 2 years of age are thought to be particularly susceptible to the risks of SHS exposure as they have a higher respiration rate[70 106] and SHS exposure may have an adverse effect on their developing lungs.[107 108] This is likely to be exacerbated further as infants experience increased SHS exposure due to spending much of their time indoors in close proximity to smoking parents.[58]

Previous research has also explored factors that are associated with SHS exposure in the home; however, these are not consistent across the literature, and the factors that are most important in determining likely SHS exposure in children and infants remain unclear. Finally, little is known about smoking behaviours in pregnancy and the early postnatal period, and subsequent SHS exposure in early infancy. Many women stop smoking during pregnancy but return to smoking shortly afterwards, and may therefore put their infants at risk of SHS exposure. Women who were able to stop during pregnancy are a potentially motivated group who may be receptive to making behaviour changes postpartum to protect their infant from SHS. Greater understanding about these issues within this at-risk age group is essential for the development of future, more effective, targeted interventions to prevent or reduce SHS exposure.

1.8.2 Research aims

The overall aims of this thesis are to explore the prevalence and determinants of smoking in the home after childbirth, and to understand the experience and attitudes of mothers who stop smoking during pregnancy but return to smoking shortly after delivery. The following objectives are addressed:

1. To identify factors, such as environmental or SES characteristics, which have been shown to be independently associated with children's (aged ≤18 years) SHS exposure in the home.

2. To estimate the maternal self-reported prevalence of SHS exposure amongst young infants (aged ≤3 months) born to women enrolled in a UK pregnancy cohort, and to identify factors associated with this exposure.

3. To explore home smoking experiences, behaviours and beliefs among a group of women whose infants are currently less than 24 months of age, and who quit smoking during pregnancy but have returned to smoking in the 3 months after the birth of their baby.

1.8.3 Outline of thesis chapters

Chapter 2 identifies, through a systematic review of the literature, the factors that are associated with children's SHS exposure in the home, determined by parent or child reports and/or biochemically validated measures including nicotine, carbon monoxide or home air particulate matter. (Objective 1)

Chapter 3 is a methods chapter. This describes the methods used to assemble a contemporary pregnancy cohort, the Pregnancy Lifestyle Survey (PLS), used for analysis in this thesis. This chapter further describes the sociodemographic characteristics of cohort participants and a comparison to other UK pregnancy cohorts.

Chapter 4 uses data from the PLS described in Chapter 3 to estimate the maternal self-reported prevalence of SHS exposure amongst young infants (≤3 months old), and to identify factors associated with this exposure. (Objective 2)

Chapter 5 describes qualitative interviews conducted with participants recruited from the PLS cohort, which explore home smoking experiences, behaviours and beliefs among a group of women whose infants were currently less than 24 months of age, and who quit smoking during pregnancy but returned to smoking in the 3 months after the birth of their baby. (Objective 3)

Chapter 6 summarises the key findings from the research, highlights the implications for the development of future interventions to prevent or reduce infant and child SHS exposure and suggests directions for future research.

CHAPTER 2 PREDICTORS OF CHILDREN'S SECONDHAND SMOKE EXPOSURE AT HOME: A SYSTEMATIC REVIEW AND NARRATIVE SYNTHESIS OF THE EVIDENCE

2.1 BACKGROUND

As previously discussed, the two main determinants of children's secondhand smoke (SHS) exposure in England have been reported to be smoking by parents or caregivers, and whether smoking occurs in the home.[13 73] Smoke-free legislations banning smoking in enclosed public places have been widely introduced, with a reported 109 countries having implemented legislations by 2012.[125] However, such legislations do not cover smoking in private residences.[29] Children who spend a large proportion of their time indoors[126] and in close proximity to smoking parents,[57 58] are particularly at risk of SHS exposure in the home. In the UK, around two million children are estimated to be exposed to SHS in the home,[29] with 38.7% of children in England who live with one or more smoking parents being regularly exposed.[5] Similar findings were reported in the 2006 Global Youth Tobacco Survey, where internationally 46.8% of never smoking young people aged 13-15 years were exposed to SHS in the home in the last seven days, with the highest level of exposure observed in Europe at 71.5%.[127]

Studies which aim to understand the factors or characteristics associated with children's SHS in the home have not been previously reviewed. Consequently, such a review of relevant studies conducted in children aged ≤18 years, examining factors associated with home SHS exposure was undertaken. This review aimed to identify factors, such as environmental or socioeconomic (SES) characteristics, which have been shown to be independently associated with children's SHS exposure in the home, and to determine potential characteristics that may be important for the development of effective future SHS and smoke-free home (SFH) interventions. The findings from this systematic review will be used to inform the data analysis conducted in Chapter 4.

This study was published online in PLoS One in October 2014 and is attached in Appendix 7.1.1.

2.2 METHODS

This systematic review was conducted and reported in accordance with the PRISMA guidelines (Appendix 7.1.1.1).[128]

2.2.1 Systematic review methods

Electronic databases MEDLINE, EMBASE, PsychINFO, CINAHL and Web of Knowledge were searched to the end of July 2014 without date restrictions, using combinations of the following key words: *secondhand smoke, environmental tobacco smoke, passive smoke/smoking, smoking in the home, smoke-free home, smoking rules, child, children, school child*, infant, baby, babies, parent, mother, father, predictor, association, factors, determinants.*

The reference lists of papers identified as being relevant in the above electronic searches were also hand searched.

2.2.1.1 Inclusion and exclusion criteria

Titles and abstracts identified from the searches were reviewed, and all studies meeting the following inclusion criteria identified:

(a) English language studies examining the factors associated with SHS exposure in children aged ≤18 years.

(b) Reported a measure of child SHS exposure (e.g. parent reported exposure in the home; child self-reported exposure in the home; objective measures, biochemically validated exposure such as cotinine, carbon monoxide; home air particulate matter),

(c) Examined potential factors/associations for child SHS exposure (e.g. demographic, social/environmental, pregnancy factors, post-partum factors, health/emotional, tobacco related, smoking in pregnancy behaviours).

The age cut-off of ≤18 years for childhood was chosen to reflect variation in the legal age of adulthood across countries, with the majority of countries considering those aged 19 to be adults, and was considered appropriate as it is also the upper-limit at which adolescents are likely to remain in compulsory full-time education.

Whilst biomarkers are able to provide a quantitative measure of SHS exposure, this may reflect exposure in both the home and elsewhere. However, there is strong evidence to suggest that biomarkers can be used as an appropriate measure for children's home SHS exposure. Research has shown that children spend the largest proportions of their time either in school attendance or as leisure time inside the home,[129] with a reported 75-80% of their time spent in the home.[130 131] This, coupled with the widespread implementation of smoking bans in enclosed public places, makes the home the primary source of SHS exposure.[13 73]

Furthermore, as described previously in Chapter 1(1.1.1.1), research has found biomarkers and reported child SHS exposure specifically in the home to have moderate correlations across a range of ages.[8-10] Similarly, papers that used self-reported measures of indoor SHS exposure, for example, smoking in the same room as children, were included in this review on the assumption that most of this indoor exposure would occur in the home.

Papers that did not use quantitative methodologies were excluded. There is growing recognition of the potential to synthesise quantitative and qualitative data within a systematic review,[132] however this is typically useful when understanding participant experiences or views is of relevance.[133] This was considered inappropriate as the primary purpose of this review was to objectively identify the factors associated with childhood SHS exposure in the home to inform the analysis conducted in Chapter 4. Papers exploring associations with parental reported 'smoke-free homes' (e.g. their child was NOT exposed to SHS in the home) were also excluded; creating 'smoke-free homes' is an active behaviour change, and in some studies one that was instigated through participation in an intervention, and thus it is likely that there are a number of complex reasons, barriers or facilitators related to implementing home smoking bans. The factors associated with these are therefore potentially different to those associated with children's SHS exposure in the home.

Following the title and abstract review, SO (first author) independently reviewed the full texts. A summary of each of the included studies is presented in Table 2-1. The significant associations (using the significance level adopted by each individual study) and adjusted sizes of effect of associations in each study were further compiled into a separate table (Table 2-2). In papers using numerous measures of SHS of exposure, the outcome that related specifically to home SHS was used where possible. The purpose of this review was to identify, rather than quantify, the factors and characteristics associated with children's SHS exposure in the home; a meta-analysis was therefore considered inappropriate and data were synthesised in a narrative review.

2.2.2 Assessment of methodological quality

Studies that met the inclusion criteria were assessed for quality using a modified version of the Cochrane Collaboration Non-Randomized Studies Working Group recognised Newcastle-Ottawa Quality Assessment Scale.[134 135] Herzog and colleagues[135] modified the original Newcastle-Ottawa Quality Assessment Scale for use when assessing the quality of cross-sectional studies. The studies in this review were all cross-sectional in design and so using these criteria, studies were critically appraised and awarded a quality rating score out of a maximum of 10 (Table 2-1). An a priori cut off point of seven points out of 10 was used to identify papers considered to be of higher methodological quality, as has been used previously with the comparable original scale.[28 136 137] However, all studies of both low and high quality were included in the review, with study quality used to inform the results and conclusions drawn throughout.

2.3 RESULTS

There were 4,013 papers identified through the systematic literature searches. After removal of duplicates, a further 2,316 articles were excluded based on title and abstract review. These included intervention studies to reduce child SHS exposure, studies examining the health risks associated with child SHS exposure and editorial papers. Sixty-five papers were considered as potentially eligible based on title and abstract review, and full-texts were obtained. Following the evaluation of full-texts, 41 of these papers were included in the final review (Figure 2-1).

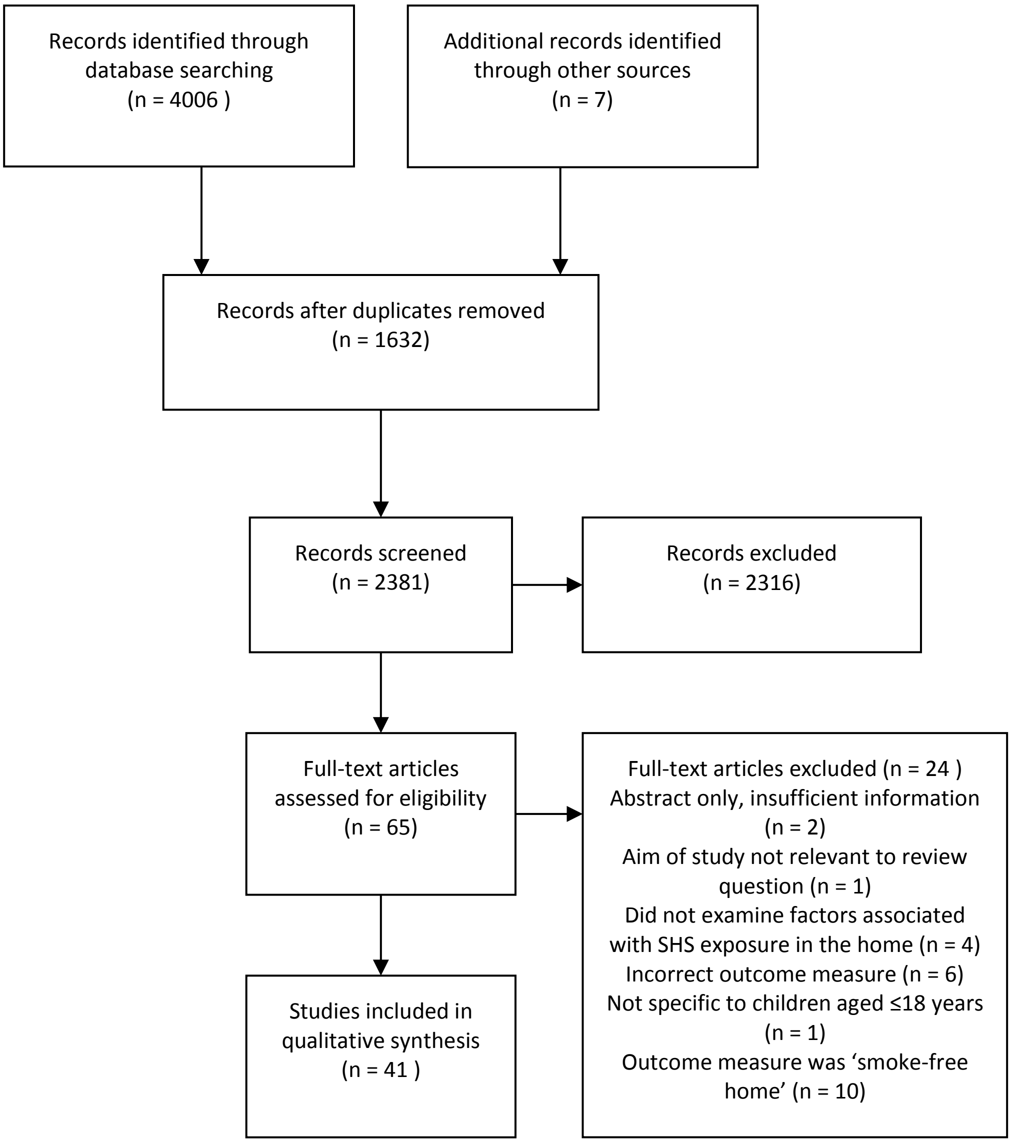

Figure 2-1 Systematic search results flow diagram of included and excluded studies

2.3.1 Included studies

2.3.1.1 Location

Ten of the 41 studies were conducted in the UK (England,[13 44 80 138] Scotland,[55 79 85 86] Wales,[84] England and Wales[77]), eight in the USA,[23 46 54 75 78 139-141] three in Germany[50 56 74], three in Greece,[45 51 53] two in Korea[76 142] and one each in Denmark,[81] Sweden,[62] Finland,[48] Norway,[143] Italy,[52] Spain,[144] Puerto Rica,[145] Australia,[146] Malaysia,[147] Mongolia,[49] South Africa,[47] India,[148] Taiwan,[82] Thailand[149] and Tehran.[83]

2.3.1.2 Study design

Thirty of the papers reported studies which were of cross-sectional design,[23 44 46 51-54 62 74-77 79-82 139 140 142-149] six were reports of repeated cross-sectional designs[13 48 78 84-86] and three studies were cross-sectional using samples recruited as part of intervention studies.[50 55 83]

2.3.1.3 Assessment of quality

Using the modified Newcastle-Ottawa Quality Assessment Scale,[134 135] the median quality score of studies included was seven points (range 2-9). Twenty-two papers[13 44 45 47 51-55 62 76 77 79 83-86 138 144 146 147 149 150] were considered to be of higher quality (Table 2-1). The remaining studies were of lower quality, primarily due to reduced representativeness of study samples, low study power or limited control of potentially confounding factors within analysis.

2.3.1.4 Ages of children included

The majority of studies focused on school-age children of approximately 5-18 years,[13 44 45 47-49 52 54 56 74-79 82 84-86 138 141 147] or a broader age range to include both preschool and school-aged children (≤18 years).[46 51 53 80 81 139 140 142 146 150] Eight studies focused on SHS exposure in younger children; five[50 55 62 143 144] of these examined SHS exposure in preschool-children aged less than 5 years, and only three[23 83 149] focussed on SHS exposure specifically in infants or young children under 2 years of age.

2.3.1.5 Measures of SHS exposure

Eighteen studies used the following validated measures of child SHS exposure: salivary cotinine,[13 44 55 77 79 84-86 147] urinary cotinine,[51 52 56 62 75 76 83 138 144 150] serum cotinine[54] or airborne particulate matter less than 2.5 micrograms per cubic meter [$PM_{2.5}$].[55] Some of these studies also included self-report measures, such as parents'/carers'[13 51 55 56 62 76] or children's[84 85]reports of home SHS exposure, or parent[75 77] or child[86] reported SHS exposure outside of the home.

A number of other studies used self-report measures such as parental[46 50 53 74 78 80-82 139-143 146 149] or child (11-17 years of age)[45 47 148] reported exposure in the home. Two studies used parental/respondent[23] or child self-reported[48] smoking in the same room as children, and a further study[49] used child-reported SHS exposure in the home and elsewhere. As can be seen in Table 2-1, different definitions of reported child SHS exposure were used across the studies.

These included reported home smoking restrictions or location of smoking at home,[46 50 74 80-82 139 140] hours per day child exposed,[23 48] number of days per week child exposed,[47 78 148] number of cigarettes child exposed to,[142] exposure to cigarettes in given time periods (i.e. 12 months[141 146];7 days[49 149]), smoking in the home in front of children,[45 53 143] or any smoking in presence of children.[76]

2.3.2 Factors associated with child SHS exposure

Of the 41 included studies, the associations between 90 different variables and child SHS exposure were identified. These were grouped into five conceptually similar categories: (1) socioeconomic status (SES) (including composite measures of SES, income, employment and health insurance type); (2) parental characteristics (education, age, race/ethnicity); (3) family and home characteristics (family size, family structure, home environment); (4) child characteristics (age, gender); and (5) parental smoking characteristics (smoking behaviour, attitudes and self-efficacy). The size of effect of statistically significant associations reported between variables and SHS exposure in the home (using significance level reported by individual studies) are presented in Table 2-2.

2.3.2.1 Socioeconomic status

The relationship between child SHS exposure and proxy measures of SES were examined in 11 studies; measures of SES used were the Registrar General's Social Class system,[13 77 79 83 86 151] area level deprivation indicators,[76 146] the Family Affluence Scale,[84-86 152] the Townsend score[44 153] and wealth.[149] In 10 out of 11 studies[13 44 76 77 79 83-86 146] there were significant associations between low SES and increased SHS exposure. This was observed both in studies using biomarkers as an outcome measure,[13 44 76 77 79 83-86] and self-reported exposure.[146] Children of parents in lower SES groups were up to three times more likely to be exposed to SHS, with the odds ratios (OR) from individual studies ranging from 1.1 to 3.3. The majority of studies reporting this were of higher methodological quality.[13 44 76 77 79 83-86]

Seven studies, reporting mixed findings,[74-76 82 139 141 147] investigated whether there was an independent relationship between income and child SHS exposure. Overall, a significant association was reported in three studies.[74-76] Two studies[75 147] used biomarkers as outcome measures, with just one of these[75] reporting a significant association. Five studies[74 76 82 139 141] that relied on self-reported exposure as an outcome measure examined income, with two[74 76] reporting a significant association between low income and child SHS exposure in the home. This finding did not differ according to study quality.

There was similarly inconsistent evidence for a link between employment status or occupation and child SHS exposure. Three studies found a significant association between employment and exposure to SHS in the home; in one study,[13] which used biomarkers as an outcome measure, children whose parents' employment status was 'other' (including looking after the home) had significantly higher salivary cotinine levels; however, those with unemployed parents did not. A second study[74] that used self-reported exposure as an outcome measure found a significant association between parental unemployment or part-time employment and increased child exposure. A third study,[50]also using self-reported exposure as an outcome measure, found children of households where only one parent was employed were at an increased risk of exposure. No significant association was observed in four studies.[46 80 149 150] These findings did not vary according to study quality. There was also little indication of a relationship between type of occupation and child SHS exposure, with just one study[147] reporting that children whose fathers were in the armed forces had higher levels of salivary cotinine compared to children whose fathers were in managerial or professional roles.

2.3.2.2 Parental characteristics

Twenty-six studies[13 23 46 48 50-54 56 74-76 78 80-83 140-144 147 149 150] investigated the relationships between parental or highest level of education within the household and child SHS exposure at home, with 18[13 23 50-52 54 74-76 78 80 81 140 141 143 144 147 149] reporting a significant association between low education and increased risk of exposure. In one study[144] there was a significant association between paternal education and child exposure, but no significant association with maternal education. Although there was variation in how parental education was measured and categorised, children whose parents had the lowest levels of education were up to 10 times (OR range 1.08 to 10.4) more likely to be exposed to SHS in the home. These findings did not differ according to study outcome measure or quality; of those reporting a significant association between parental education and child SHS exposure in the home, seven[13 51 52 54 75 144 147] used biomarkers as an outcome measure compared to 11 studies[23 50 74 76 78 80 81 140 141 143 149] using self-reported exposure. Of the high quality studies, three[53 83 150] found no significant association of education on exposure, whilst eight found a significant association.[13 51 52 54 76 144 147 149]

Parental race or ethnicity was examined in nine studies,[13 23 54 56 62 78 138-140] with a significant association found in eight[13 23 54 56 78 138-140] of these. In the UK, children of white parents had significantly higher SHS exposure, as measured by biomarkers, than children from other ethnicities.[13 138] The association between race or ethnicity in USA based studies was less clear; there was some evidence that children of white parents were at an increased risk of SHS exposure[23 78 140]; however, other studies found significant associations between SHS exposure and other races/ethnicities.[54 78 139 140] A German based study found children of non-German nationality to have significantly higher urinary cotinine levels.[56] One further study[149] found children of Muslim fathers to be significantly more likely to be exposed to SHS in the home. The outcome measure used across studies did not influence whether a significant association was observed, with four studies[13 54 56 138] that used biomarkers as an outcome, and four[23 78 139 140] that used self-reported exposure finding a significant association. However, five[23 56 78 139 140] of the studies reporting a significant association between ethnicity and child SHS exposure in the home were of lower quality.

Parental age was not shown to be linked to child SHS exposure; eleven studies[23 46 53 55 80-83 139 149 150] explored this relationship; however, only two[23 55] found significant associations between lower parental age and measures of SHS exposure, and one[149] found a significant association but with no clear direction of effect. This finding did not differ according to study outcome measure or quality.

2.3.2.3 Parental smoking behaviour and attitudes

Of the 18 studies[13 44-50 52 53 55 56 79 85 139 142 144 147] that investigated parental or household member cigarette smoking status, 15[13 44-50 52 53 56 79 85 142 147] identified a significant association between this and children's SHS exposure in the home. Children of smoking mothers were up to seven times (OR range 2.1 to 6.9) more likely to be exposed in the home, and children whose parents both smoked were up to 13.5 times (OR range 2.9 to 13.5) more likely to be exposed in the home. This was observed both in studies using biomarkers as an outcome measure,[13 44 52 56 79 85 147] and self-reported exposure.[45-50 53 142] These findings did not differ according to study quality.

Eight studies examined an association between the number of cigarettes smoked by parents either per day[51-53 62 81-83] or per week[46] and child SHS exposure. In four of these[51-53 62] a significant association was observed; children whose parents had a higher level of cigarette consumption were more likely to be exposed to SHS. One study[53] observed a significant association with increased number of cigarettes smoked per day by the mother, but not the father. Two further studies[81 82] looked at the effect of respondents being a daily smoker; however, no significant association was reported. Significant associations between parental cigarette consumption and child SHS exposure was more frequently observed in studies using objective outcome measures[51 52 62] and in studies of high quality.[51-53 62]

The number of cigarettes smoked in the home was explored in a further four studies,[54-56 144] all of which used objective measures of SHS exposure. In three of these,[54-56] there was a significant relationship between more cigarettes smoked in the home and child SHS exposure; however, this was only investigated in a univariate analysis which means that this finding may not be independent of other confounding factors.

Four studies[55 78 82 143] measured and reported significant associations between parental attitudes towards smoking and SHS exposure. These studies used self-reported exposure[78 82 143] and home airborne particulate matter [$PM_{2.5}$][55] as outcome measures. Although the measurement of attitudes varied across the studies, generally more negative attitudes towards SHS exposure were related to lower exposure. In three studies[78 82 143] there was an association between negative opinions towards SHS and reduced risk of exposure. In one study,[78] agreement that SHS was harmful to health was associated with reduced risk of child SHS exposure in the home. One study[143] developed a scale of six questions measuring attitudes towards statements about the rights of adults to smoke in their own homes, the rights of children to live in SFHs and the safety of SHS exposure; those with lower scores (reflecting negative attitudes towards child SHS exposure) were less likely to smoke in the home.[143] One study[82] found that those who agreed more with their family's anti-smoking reactions to smoking in the home were less likely to expose their children to SHS. A further study[55] observed lower maximum indoor particulate matter ($PM_{2.5}$) concentrations and child salivary cotinine among those mothers who strongly agreed that they would ask a smoker to smoke outside their house; however, this was only found in univariate analysis and there was no significant effect for other attitudinal questions. Three of the studies[78 82 143] reporting a significant association between parental attitudes and child SHS exposure in the home were of lower quality. Two further studies[47 148] found child attitudes towards the harmfulness of SHS was associated with exposure in the home, however the direction of this association was unclear.

2.3.2.4 Family and home characteristics

Thirteen studies[23 46 48 74-76 79 82 139-142 150] looked at a link between marital status or family structure and child SHS exposure. In five studies[74 75 79 140 150] being a single parent was associated with children's SHS exposure. Further associations were found for exposure among children whose mothers were unmarried,[23] who were separated[48] or part of a step-family,[140] with children from these families being up to twice as likely (OR range 1.1 to 2.1) to be exposed to SHS. These findings did not differ between outcome measures used; significant associations between marital status and family structure were observed both in studies using biomarkers as an outcome measure[75 79 150] and self-reported child SHS exposure in the home[23 48 74 140] However, five of the studies[23 48 74 75 140] reporting an association were of lower quality.

There was no clear relationship between family size and exposure, which was investigated in 11 studies.[23 50 53 54 74 76 79 83 141 146 149] In studies using biomarkers as an outcome measure, three[54 76 83] found no association, whilst one study[79] reported child SHS exposure to decrease with increasing number of children in the family. There were mixed findings in studies using self-reported exposure; in three studies child SHS exposure in the home[23 50 146] was associated with 20-72% (OR range 1.2 to 1.72) increased odds of SHS with one or more siblings, or a larger family size, whilst in one study exposure decreased with increasing number of children in the family.[74] A further three studies found no significant association.[53 141 149] Those reporting a significant association tended to be of lower quality.[23 50 74 146]

There was some evidence for an association with accommodation size or characteristics. Seven studies[13 50 52 56 79 83 144] looked at crowding, defined as number of people per bedroom; four studies[13 52 56 79] all using biomarkers as outcome measures found a significant relationship between more crowded homes and increased SHS exposure. The only study[50] to use self-reported exposure as an outcome measure found no significant association between child SHS exposure in the home and crowding; however, this study was also of lower quality. There was no evidence that this was influenced by study quality. There was similarly some evidence for a relationship between size of home and exposure, which was only measured in studies using biomarkers as outcome measures. Increased home floor surface area was significantly associated with lower SHS exposure in two studies,[51 56] and fewer rooms being associated with an increased risk of exposure in a third study.[54] No association with accommodation size was found in a further study.[62] Other significant relationships included the use of air conditioning in the home[147] and the availability of outside space[50 139] both of which were associated with reduced child exposure. These findings did not differ according to study quality.

2.3.2.5 *Child characteristics*

The association between child age and exposure was explored in 19 studies.[13 44 45 47 49 51-55 77 80 83 139 140 142 144 148 150] Nine of these[13 44 51 53-55 77 139 150] found younger children to be significantly more likely to be exposed to SHS in the home, or to have higher exposure. The studies reporting this association tended to use objective outcome measures,[13 44 51 54 55 77 150] and to be of higher quality[13 44 51 53-55 77 150] than those finding no significant association. Three studies[45 49 83] found the opposite association; one study[83] found urinary cotinine to increase significantly per 1 month increase in age among infants aged under 1 year, and two studies[45 49] found older teenagers to be more likely to report SHS exposure in the home than younger teenagers. These findings did not differ according to study quality.

Nineteen studies[13 45 47 49 51-56 76 77 79 83 140 144 147 149 150] looked at child gender and SHS exposure, with limited support for an association. Significantly higher salivary[13 77 79] and urinary cotinine[51] in females was observed in four studies. A further study[45] found female adolescents to be more likely to report smoking in their homes, however the remaining studies[47 49 52-56 76 83 140 144 147 149 150] found no significant association. These findings did not differ according to study quality

2.4 DISCUSSION

Children whose parents were smokers, of low SES or less educated were at an increased risk of SHS exposure in the home. There was also some evidence that children whose parents held more negative attitudes towards SHS were less likely to be exposed. Associations were strongest for parental cigarette smoking status; compared to children of non-smokers, those whose mothers or both parents smoked were between two and 13 times more likely to be exposed to SHS at home. A novel finding from this review was the association between child age and SHS exposure in the home, with high-quality papers reporting that younger children are more likely to be exposed to SHS. These findings will be used to inform the data analysis conducted in Chapter 4. These findings suggest that the best way to prevent child SHS exposure in the home is by encouraging smoking parents to quit, or for those parents who cannot, or are not yet ready quit, to make their homes smoke-free.

2.4.1 Limitations

Literature in this review was synthesised narratively, which may introduce some bias if findings of one study are given inappropriate weight compared to others.[154] However, efforts were made to avoid such biases through methodically identifying papers, data extraction, and quality assessments of studies informing the synthesis of findings. It is further acknowledged that only one author (SO) reviewed and extracted data from papers. Previous research has reported single-reviewer data extraction to be at greater risk of error compared to multi-reviewer extraction.[155] However, this was found using reviewers who were unfamiliar with the topic area, and errors identified were found to be minimal and to have no significant impact on findings.[155] Papers using biomarkers as an outcome measure were included in this review; biomarkers are not able to identify the location in which exposure occurs, and it is therefore not possible to rule out that some exposure in these studies occurred in locations outside of the index home, such as in other people's homes and private vehicles. However, there is evidence of moderate correlations between biomarkers and self-reported SHS exposure in the home,[8-10 156] so it is likely that associations between characteristics identified in this review and biomarkers are principally determined by home exposure.

There were a number of limitations inherent in the studies included in the review. Using a modified Newcastle-Ottawa Quality Assessment Scale,[134 135] 19 studies were considered of lower quality, primarily due to reduced representativeness of study samples and limited control of potentially confounding factors within analysis. Some studies were also at risk of low power and chance findings, whereby the authors used small sample sizes and examined multiple risk factors within their analyses. Furthermore, the studies included in this review were carried out in a range of different countries and settings, and so there are likely to be cultural differences. These limitations may explain disparities in associations observed across studies, and should be taken into consideration when interpreting the findings of this review.

2.4.2 Comparison to previous research and implications

The greatest observed risks in this review were for children whose mothers[13 44 46 48 49] or both parents[13 48 49] were smokers. This finding has particular implications for children of pre-school age, who spend an increased proportion of their time at home with parents compared to school-aged children.[57 58] A key novel finding of this review was that younger children may be at an increased risk of SHS exposure in the home, which was found in some high quality papers using biomarkers as outcome measures of SHS exposure. Research has found no significant differences in the elimination half-life of urinary cotinine between younger and older children, suggesting that higher cotinine levels observed in younger children are likely to be due to increased exposure.[110]

Future research is needed to explore SHS exposure specifically in young infants; just three studies in this review explored factors associated with SHS exposure in this age group. Although other studies included infants or young children of less than 2 years of age within their samples, this younger age group was not considered or reported independently of older children. As discussed in Chapter 1, infants and young children under 2 years of age may be particularly susceptible to the risks of SHS exposure due to their higher respiration rate,[70 106] and developing lungs,[107 108] resulting in increased vulnerability to infections requiring hospitalisation,[112] poorer respiratory health,[114 115] and increased risks of sudden unexpected death in early infancy.[29] The findings of this review suggest that younger infants could be at an increased risk of SHS exposure, though it is not possible to generalise other observed associations to young infants based on the currently available literature.

Lower SES is frequently reported to be associated with poorer health outcomes, and increased health morbidity and mortality.[157] Those with lower education have similarly been found to engage in fewer health promoting behaviours,[157 158] and have a higher smoking prevalence than more educated populations.[159 160] There was some evidence in this review that children whose parents were single, separated or divorced were at an increased risk of SHS exposure in the home; children from single parent families,[161-163] or whose parents/carers are unmarried[164] have also been shown to have worse health outcomes compared to those from traditional nuclear families. Previous research has shown single mothers to be more likely to return to smoking after pregnancy,[165] and unmarried or divorced adults to be more likely to be daily smokers[166] or heavier smokers.[167]

Whilst the demographic characteristics found to be associated with children's SHS exposure in the home are not easily modifiable,[168] they may help to inform which children, parents or families are best targeted in future interventions. For example, this review suggests that interventions targeted towards low SES groups aiming to promote smoking cessation may have a positive impact on children's exposure in the home. Where parents are unable or unwilling to quit smoking, making the home smoke-free is the next most effective way to protect children from SHS exposure.[20 60-62]

This review found some evidence that parental attitudes towards child SHS may be associated with exposure in the home. The way in which attitudes were measured differed across the reviewed studies, and it is often difficult to distinguish between attitudes and knowledge or awareness about the risks of childhood SHS exposure. However, interventions targeting attitudes towards SHS by supporting parents to recognise the benefits of protecting their children from SHS could be useful to promote SFHs;

attitudes are an important construct in many behaviour change theories,[169] however these do not operate in isolation. Components in behaviour change theories attempt to recognise the complexity of interrelated factors that might influence behaviour, and such theories can only be used as a guide towards identifying how behaviour change might be achieved. It is not possible, therefore, to identify that manipulation of any one behaviour change theory component (e.g. attitudes) will result in behaviour change.[169] The findings of this review and behaviour change theories,[169] however, indicate that attitude manipulation might be a good starting point in achieving behaviour change. Previous research has shown home smoking behaviours to be complex and fluid among a group of disadvantaged parents.[97] A combined approach that targets attitudinal change, or education about the risks of SHS exposure, and provides practical context specific advice to parents, for example balancing child safeguarding with smoking outside of the home or negotiation with other household smokers, may be helpful.

2.4.3 Conclusions

Children whose parents are smokers, are of low SES, less educated, or hold less negative attitudes towards SHS are at an increased risk of SHS exposure in the home. The largest observed risks were for children living in households with smokers; the best way to reduce child SHS exposure in the home therefore is for smoking parents to quit. There was also evidence from some high-quality papers that younger children experience increased SHS exposure in the home. These findings will be taken forward to inform the analysis conducted in Chapter 4. These findings also have wider implications; if parents are unable or unwilling to stop smoking, they should aim to initiate and maintain SFHs. Interventions targeted towards socially disadvantaged parents aiming to change attitudes to smoking in the presence of children, and providing context specific practical support to help parents overcome barriers to smoking outside the home may reduce children's home SHS exposure.

Table 2-1 Systematic review study characteristics

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure (for purposes of review)	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses († univariate analysis only)
Abidin et al. 2011[147] Malaysia Quality rating: 8	Cross sectional survey April – September 2009	Children from a minimum of 2 classrooms from years 4 and 5 within 24 National Schools across Kuala Lumpur and 3 rural districts in Negeri Sembilan invited to participate. Saliva samples collected from 38.3% of invited participants	N = 1064 10-11 years of age	Salivary cotinine	Location (rural/urban)* Parental cigarette smoking status* Parental reported exposure* Child gender Paternal education (diploma/technical certificate, degree/college)* Paternal occupation (armed forces, manager/professional)* Family income (low, middle, high) SHS in household (non-smoking, smoking) Child's sleeping area (own room/share with siblings, living room, share with parents/adults) Use of air conditioner* Use of exhaust system Smoking restriction in home (total, partial, none)	Log salivary cotinine used. Chi square tests Multiple linear regression	Location (rural/urban) Parental cigarette smoking status Paternal occupation Paternal education Parental reported exposure Use of air conditioner in home
Akhtar et al. 2010[86] Scotland Quality rating: 9	Repeated cross sectional survey Jan 2006 – Jan 2007	CHETS study (Changes in Child Exposure to Environmental Tobacco Smoke)[170], Two nationally representative primary school classes in the same schools pre and post smoke-free legislation. 2006: 86% response rate. > 95% valid cotinine sample. 2007: 85% response rate. > 95% valid cotinine sample.	Questionnaire: 2006 N = 2532 2007 N = 2389 Saliva samples available for: 2006 N = 2403 2007 N = 2270 Approximately 11 years of age	Salivary cotinine. Child reported parental cigarette smoking status: 'do any of the following people smoke? Father, mother, stepfather, stepmother. Parental figures classes as smokers when described as smoking 'every day' or 'sometimes'. Children then classified as living with 'none', 'one (father figure only), one (mother figure only) or 'two' smokers.	Family socioeconomic classification (parental occupation coded into 1: I professional occupations & II managerial & technical. 2: IIIN skilled non-manual and IIIM skilled manual. 3: IV partly skilled and V unskilled. 4: economically inactive) Family affluence scale (FAS) Analysis controlled for: Child age Number of parents who smoke	Log salivary cotinine used. Chi square tests ANOVA Linear regression	Socioeconomic status Family affluence Year (pre/post legislation)

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Akhtar et al., 2009[85] Scotland Quality rating: 9	Repeated cross sectional survey Jan 2006 – Jan 2007	Recruited through the CHETS study (changes in child exposure to environmental tobacco smoke),[170] Two nationally representative primary school classes. 2006: 86% response rate, > 95% provided valid cotinine sample. 2007: 85% response rate, > 95% Provided valid cotinine sample.	Questionnaires: 2006 N = 2559 (86%) 2007 N = 2424 (85%) After exclusion for missing data, final questionnaire data sets were: 2006 N = 2532 2007 N = 2389 Saliva samples available for: 2006 N = 2403 2007 N = 2270 Approximately 11 years of age	Salivary cotinine. Child reported parental cigarette smoking status: 'do any of the following people smoke? Father, mother, stepfather, stepmother. Parental figures classes as smokers when described as smoking 'every day' or 'sometimes'. Children then classified as living with 'none', 'one (father figure only), one (mother figure only) or 'two' smokers. Child reported smoking restrictions in the home. 'Is smoking allowed inside your home' (categorised as complete restrictions, partial restrictions or no restrictions).	Number of parents smoking Family affluence (Family Affluence Scale) Analysis controlled for: Age Family SES	Log salivary cotinine used. Chi square tests Multinomial logistic regression Linear regression analysis	Parental smoking Time (pre/post legislation) Child reported type of home smoking restrictions Family affluence Home smoking restriction type and survey year interaction Home smoking restriction type and presence of parental smokers interaction
Alwan et al. 2010[80] England Quality rating: 6	Cross sectional survey June 2008	Sampled natural community neighbourhoods within Leeds, England. Sampled consecutive houses within these areas until over 310 households with children aged 0-16 years had completed the survey. Response rate 50.9%.	318 households < 16 years of age	Home smoking restrictions: 'if there are smoker(s) in your household, where does smoking take place?' 1) in the presence of children, 2) any part of the house, 3) in the house but only if windows are open, 4) inside the house but only in a specific room, 5) only in a specific rooms with the windows open in that room, 6) only outside the house.	Head of household characteristics: Age* Male gender Employment status (unemployed)* Education (qualification)*	Chi-squared test Multiple Logistic regression	Unemployed Education (qualification below A-level)

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Anuntaseree et al. 2008[149] Thailand Quality rating: 7	Cross sectional October 2001 – August 2003	Data collected as part of the Prospective Cohort Study of Thai Children. Cohort of infants born over a 1 year period in each of the 5 regions of Thailand recruited. Response rate 76.7%	N = 3256 1 year of age	Respondent reported: 'in the preceding week, did anyone in the household smoke in the same room as the infant?' If yes, 'did the father smoke in the same room as the infant, did the mother smoking in the same room as the infant, did any other family member smoke in the same room as the infant?'	Paternal age* Paternal education (primary school, secondary school, college or university)* Religion (Buddhist, Muslim, Christian, Other)* Occupation (professional, non-professional, unemployed)* Economic status (poor, sufficient, wealthy)* Child gender Birth weight Parity*	Chi-squared test Multiple logistic regression	Paternal age Paternal education Religion
Baheiraei et al. 2010[83] Tehran Quality rating: 7	Cross sectional. Data from RCT. 2008	Smoking households attending a health centre in southern Tehran Response rate not reported	N = 130 <1 year of age	Urinary cotinine ($\geq$30 ng/ml indicating SHS exposure)	Infant age* Infant gender Infant weight Breastfeeding Maternal age Paternal age Maternal education (none/elementary, middle/high school, diploma or higher) Paternal education (none/elementary, middle/high school, diploma or higher) Maternal occupation (housewife, employed) Social status (employer and junior employees or lower, skilled workers, semiskilled or unskilled worker* Type of housing (homeowner, rent, other) Car ownership Number of children Crowding index Access to outdoor area Separate room for infant Daily number of cigarettes smoked Parental report of infant SHS exposure Day of urine collection Nicotine dependence (Fagerstrom test) Smoking restrictions at home*	Multiple logistic regression	Infant age Social status

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Bakoula et al. 1997[51] Greece Quality rating: 8	Cross sectional Nov 1991 – April 1992	Over a 6 month period, every fourth child that contacted the out-patient clinic of the Children's University Hospital enrolled. Response rate 99.7%. Invalid urinary cotinine samples N = 4.	N = 2108 children ≤14 years of age	Urinary cotinine Parental reported number of cigarettes smoked in an average day while the child is at home, by either or both parents.	Child age* Child gender* Day of week cotinine sampled* Floor surface area* Central heating* Maternal education (years)* Paternal education (years)* Parental smoking per day* Precautions taken*	Log urinary cotinine used Multiple linear regression	Child age Gender Day of the week Floor surface area Central heating Maternal education Paternal education Parental smoking (cigarettes per day) No smoking precautions
Bleakley et al. 2014[139] USA Quality rating: 6	Cross sectional survey May – June 2012	Random digit dialling of households in low-income areas in Philadelphia USA, identified to have child under the age of 13. Response rate 25.3%	N = 456 <13 years of age	Parental reported child SHS exposure in the home: full smoking ban, no smoking in the presence of children, no ban/smoking allowed in the presence of children.	Race* Income* Gender* Age* Marital status (married/other)* Child under 5 years* Child ever diagnosed with asthma* Number of smokers in household* Who smokes in household (mother, father, other)* Number of rooms* Outdoor space available* Who in the home is a smoker (father, mother, both parents, other)* Exposure to anti-smoking advertisements* Knowledge about the effects of SHS* Smoking norms (friends of respondents who are smokers)*	Multinomial logistic regression	No home smoking ban, but smoking in the presence of children restricted: Race Child under 5 years Child ever diagnosed with asthma No home smoking ban, smoking allowed in the presence of children: Race Child under 5 years Outdoor space available
Bolte & Fromme, 2009[74] Germany Quality rating: 5	Cross sectional survey Wave 1: 2004-2005 Wave 2: 2005-2006	Data collected during compulsory school entrance health examinations in three rural and three urban regions of Germany. Response rate wave 1: 78% Response rate wave 2: 73%	N = 12422 children 5-7 years of age	Parental reported child exposure at home, in cars and at hospitality venues. 'Is there smoking in the flat where your child lives?' 1)yes, inside the flat, 2) yes, but exclusively on the balcony or terrace, 3) no	Family size* Single-parent family* Nationality of child* Parental education (very high, high, middle, low)* Parental employment status* Household equivalent income* Study region*	Multiple Logistic regression	Family size Single parent family Nationality of child Parental education Parental employment status Household equivalent income Study region

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Bolte & Fromme, 2009[74] continued				Average number of cigarettes smoked daily by mother, father and other persons in the flat (including balcony or terrace)			
Chen et al.2011[75] USA Quality rating: 6	Cross sectional October 2006 – March 2008	Recruited from outpatient clinics in Michigan, USA. For mothers with more than one child, child selected for participation on mother's preference. Response rate = 80%	N = 397 6-10 years of age	Urinary cotinine(≥10 ng/ml indicating SHS exposure) Maternal reported child SHS exposure and duration in enclosed spaces	Marital status (single, not single) Maternal education (≤high school, > high school) Household income (≤ $2500, ≥$2501) Number of prenatal check-ups (≤12, 13-14, ≥15) Parental satisfaction (satisfied, not satisfied) Controlled for maternal age, age of children, maternal race, child's birth order	T tests ANOVA Chi square tests Multiple logistic regression	Urinary cotinine: Marital status Maternal education (≤high school, > high school) Household income (≤ $2500, ≥$2501) Parental satisfaction
Cook et al.[77] England and Wales Quality rating: 8	Cross sectional survey January – July 1990	10 towns in England and Wales selected (5 with high adult cardiovascular mortality, 5 with low adult cardiovascular mortality). 10 schools in each town recruited from. Response rate with complete data 52.2%	N = 2721 5-8 years of age	Salivary cotinine Parental reported current smoking habits	Child gender Child age Day of week saliva sample taken Social class (Registrar General's classification) Town Adjusted for mother's smoking habits, father's smoking habits, smoking by other household members	Geometric mean salivary cotinine used Cross tabulations Multiple linear regression	Child gender Child age Day of week saliva sample taken Social class
Dell'Orco et al. 1995[52] Italy Quality rating: 8	Cross sectional 1990 – 1991	Children attending 5th grade in 7 randomly selected primary schools and all children attending secondary schools in the Latium region invited to participate.	N = 1199 12-15 years of age	Urinary cotinine	Child gender Child age Paternal education (years)* Paternal occupation (non-manual, manual, not employed) House size (rooms) Household crowding (inhabitants per room)* Parental smoking (maternal and paternal cigarettes/day)* Other smokers in home* Day of examination* Hours of exposure to smoking outside home in preceding days*	Geometric mean urinary cotinine used ANOVA Multiple linear regression	Current parental smoking Other smokers in household Household crowding paternal education Day of examination Hours of exposure outside home

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Delpisheh et al. 2006[44] England Quality rating: 8	Cross sectional 1993-2001	Systematic recruitment of children on class registers at 10 primary schools in low socioeconomic areas of Merseyside.	N = 245 5-11 years of age	Salivary cotinine (≥1 ng/ml indicating SHS exposure)	Maternal cigarette smoking* Presence of a smoker in the household* Child age (<7 years)* Deprivation (Townsend score > +6)*	Chi square test Analysis of variance Backward stepwise logistic regression	Maternal cigarette smoking Presence of a smoker in the household Child age (<7 years) Deprivation (Townsend score > +6)
Gonzales et al., 2006[46] USA Quality rating: 5	Cross sectional survey Nov 2003 – April 2004	Recruited from waiting rooms of a paediatric emergency room/urgent care clinic, a family practice and paediatric health care facility, and a special supplemental nutrition program for women infants and children clinic. Overall response rate 75.4%.	N = 269 mothers. 2-12 years of age	Parental reported home smoking restrictions: 'Would you say family members and visitors can: a) smoke wherever they want in your home, b) smoke in certain rooms only, c) not smoke anywhere inside your home.	Maternal's country of birth* Maternal current cigarette smoking status* Marital status* Maternal age Education (qualification) Employment % of US federal poverty threshold Current cigarette smoking status Cigarettes smoked per week Proportion of friends who smoke Other adult smoker in home	Chi squared test Multiple logistic regression models using non-automated stepwise modelling techniques Significance level $p < 0.05$, however variables reaching $p \leq 0.25$ in univariate analysis were also included in multivariate analysis.	Mother's country of birth (Mexico/USA) Mother's current cigarette smoking status Other adult smokers in the home Marital status Complete home smoking ban
Hawkins & Berkman, 2013[23] USA Quality rating: 5	Population-based cross sectional survey 2000-2003	Pregnancy Risk Assessment Monitoring System (PRAMS) data. Used data from 2000-2003. Response rate not reported.	N = 135278 mothers Approximately 4 months of age	Parental reported child exposure: 'about how many hours a day, on average, is your new baby in the same room with someone who is smoking?' (coded 0 or 1+)	Number of children in household* Maternal race/ethnicity* Maternal education (years)* Maternal age* Marital status* On WIC during pregnancy*	Chi square test Multiple logistic regression	Exposure in household (Similar sig. associations found for 2 analyses: mother a current smoker/mother non-smoker) Number of children in household Maternal race/ethnicity Maternal education Maternal age Marital status On WIC during pregnancy

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Hughes et al. 2008[142] Korea Quality rating: 6	Cross sectional 2002	Random sampling of residential telephone numbers	N = 207 <18 years of age	Based on child whom respondent thought had the highest exposure. Respondent reported number of cigarettes child exposed to per week at home and in other locations.	Respondent gender Respondent age* Marital status (married, not married) Job class (at home, white collar, blue collar) Education (≤ high school, ≥ college) Cigarette smoking status* Spouse cigarette smoking status* Respondent's parental cigarette smoking status* Respondent friend's cigarette smoking status Smoking policy in the home (allowed, not allowed)* Children <6 years in household Number of anti-secondhand smoke message sources aware of Number of groups discouraging smoking aware of Spouse discourages smoking Siblings discourage smoking Confidence in protecting child from SHS (low/medium, high)	Chi-square test Multiple logistic regression Initial multivariate model included all variables that reached $p < 0.15$ significance in bivariate analysis.	Respondent/spouse being a current smoker Respondent's parent's smoke Home smoking ban
Jarvis et al. 1992[79] Scotland Quality rating: 7	Cross sectional September 1986	One third of primary schools in Edinburgh, Scotland chosen at random, and parents of all children in grade three contacted by postal questionnaire. Response rate: 67%	N = 734 6-7 years of age	Salivary cotinine	Number of smokers in household* Home ownership* Single parent household* Social class (British Registrar General's classification)* Month of examination* Number of children in household* Crowding (persons per room)* Gender* Day of examination*	Log transformed salivary cotinine used Multiple linear regression	Number of smokers in household Home ownership Single parent household Social class (British Registrar General's classification) Month of examination Number of children in household Crowding (persons per room) Gender Day of examination

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Johansson et al. 2004[62] Sweden Quality rating: 9	Cross sectional cohort survey April 2001 – January 2003	All Babies in South East Sweden (ABIS). Cohort comprises 17055 (78.6%) of the children born in the South East region of Sweden between Oct 1997 – Sept 1999. Response rate 84% (n = 578) responded Urine sample was received from 63.3% of these (n = 366). These were age-matched with controls from non-smoking cohort members (n = 433)	N = 799366 ETS exposed. 2.5-3 years of age	Urinary cotinine (above or below quantification level, 6 ng/ml) Parental reported smoking in the home: -Outdoors -Open door and outdoors -Kitchen fan and outdoors -Mixers (smoked close to the kitchen fan or near an open door, or outdoors with the door closed. -Indoor smoking Dependent variables dichotomized as smoking indoors or outdoors, and urine CCR as above or below quantification level (6 ng/ml)	Cigarettes per day* Family situation (nuclear/broken)* Ethnicity* Which parent smokes* Exposure outside of home* Size of dwelling*	Mann-Whitney U test. Spearman's correlation Multiple logistic regression	Family situation (broken home) Smoking behaviour Cigarettes per day
Jurado et al. 2004[144] Spain Quality rating: 8	Cross sectional April – May 1999	2 stage cluster sampling of 25 primary schools, and children within those schools Response rate = 69.3%	N = 115 3-6 years of age	Urinary cotinine	Child age Child gender Paternal education (primary, secondary, technical, university)* Maternal education (primary, secondary, technical, university)* Index of crowding* Day of week urine sample collected* Number of cigarettes smoked at home Paternal cigarette smoking status Maternal cigarette smoking status* Number of smoking parents* Location of parental smoking in the home Parental perception of smokiness at home*	Log transformed urinary cotinine used ANOVA Multiple linear regression	Paternal education Day of week sample collected Parental perception of smokiness at home

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Liao et al.2013[82] Taiwan Quality rating: 5	Cross sectional survey 2010	Quota sampling to divide counties and cities of Taiwan into 4 regions, according to their level of urbanisation and access to resources. 5 primary schools, and 2 classes selected at random at each school, which were than randomly assigned to cluster invite either fathers or mothers of the students to participate in study. Current smokers included in analysis (smoked more than 100 cigarettes in their lifetime and smoking on more than one day during the preceding month). Response rate 86%.	N = 307 Primary schools, grade 1-6 (ages 6 – 12 years of age)	Parental reported home smoking bans (dichotomous variables): 'do you have smoking bans at home?' 'does your family consistently enforce smoking bans at home?'	Demographic characteristics: Gender Parental Age Marital status Parent who smoked education (qualification)* Occupation Family type (nuclear/mixed) Annual income* Grades of children Region of Taiwan Smoking variables: Daily smoker* Cigarettes per day* Age smoked first cigarette Ever considered quitting* Attempting to quit in preceding year Advised to quit by health care professional Agreed with home smoking bans* Had smoking bans at home* Enforcement of smoking bans at home Perceptions of smoking in the presence of their children* Evaluations of the consequences of smoking in the presence of children* Family's anti-smoking responses to parental smoking in the presence of children* Smoker's reaction to family's antismoking responses*	Chi square test Hierarchical logistic regression models	Agreed with home smoking bans Had smoking bans at home

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Longman & Passey, 2013[146] Australia Quality rating: 6	Cross sectional survey April – Sept 2010	National drug strategy Household Survey, conducted every 3 years by the Australian institute of Health and Welfare. Multistage random sample of households stratified by region with some oversampling in certain states and territories. Response rate not reported.	N = 4669 households <15 years of age	Parental reported home secondhand smoke exposure: 'in the last 12 months, have you or any other member of your household smoked at least one cigarette, cigar or pipe of tobacco per day in the home?' 1) yes, smokes inside the home, 2) no does not smoke inside the home (no, only smokes outside the home, or no-one at home regularly smokes).	Rurality* Socioeconomic status (area level socioeconomic index – SEIFA, based on income, education, employment, occupation and housing)* Household size* Household structure*	Chi square test Multiple logistic regression. All variables with $p < 0.25$ in univariate analyses were included in the models, with stepwise removal of variables with variables with $p < 0.1$ retained in model	Rurality Socioeconomic status Household size Household structure
Mannino et al. 2001[54] USA Quality rating: 8	Cross sectional survey 1988 – 1994	Third National Health and Nutrition Examination Survey (NHANES III), conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention, Atlanta. Stratified, multistage, clustered probability design to select representative sample of US population. Limited analysis to children aged 4-16 years with valid serum cotinine levels.	N = 5653 4-16 years of age	Serum cotinine	Child age* Child gender* Region* Parental education* Race/ethnicity* Family poverty index (below or at poverty line, above poverty line, unknown)* Family size (≤4, ≥5)* Number of rooms Number of cigarettes smoked in home*	Log transformed serum cotinine used. Used sampling weights to account for non-response Multiple linear regression	Child age Parental educational level Race/ethnicity Number of rooms Number of cigarettes smoked in the home

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Mantziou et al. 2009[53] Greece Quality rating: 7	Cross sectional September – December 2004	Recruited from emergency departments of two paediatric hospitals in Athens. Response rate = 100%	N = 662 <12 years of age	Parental reported child SHS exposure (smoking in the home in front of children)	Child gender* Child age* Paternal age Maternal age Number of smokers in the house Number of children* Paternal cigarettes per day* Maternal cigarettes per day* Child gender* Housing (apartment building/freestanding) Maternal education (lower/higher)* Paternal education (lower/higher)* Friends/relatives smoke at home* Bothered if child became smoker*	T-test Chi-square Backward stepwise logistic regression model	Paternal cigarettes per day Child age
Mills et al. 2012[55] Scotland Quality rating: 7	Intervention study July 2010 – March 2011	REFRESH intervention. Potential participants identified through GP records by the Scottish Primary Care Research Network. Response rate: 3.1% of invite letters sent.	N = 54 1-5 years of age	Airborne particulate matter Salivary cotinine Parental reported smoking restrictions: 1)not allowed inside the home, 2) child based restrictions, e.g. no smoking in a room when a child is present, 3) room based restrictions, 4) no restrictions Restrictions on smoking in the car: 1) not allowed, 2) partial restrictions, e.g. no smoking if a child or non-smoker was present, 3) no restrictions, 4) no car	Number of cigarettes smoked at home by mother* Child age* Maternal age* Child gender* Scottish Index of multiple deprivation (SIMD)* Accommodation type* Number of smokers in household* Maternal attitudes to SHS exposure Household smoking restrictions* Smoking restrictions in the car*	Skewed data log transformed T test Chi square test Stepwise multiple linear regression analysis to identify factors associated with airborne particulate matter levels and saliva cotinine.	Air quality: Number of cigarettes smoked at home Salivary cotinine: Child age Maternal age Household smoking restrictions Maternal attitudes to SHS exposure

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Moore et al. 2011[84] Wales Quality rating: 8	Repeated cross sectional survey 31st January 2007 – 30th March 2007 31st January 2008 – 28th April 2008	CHETS Wales study (Changes in Child Exposure to Environmental Tobacco Smoke).[16] Recruited across 75 state primary schools in Wales. Pre-legislation, 91.5% response rate, 82.2% valid cotinine samples. Post legislation, 90.4% response rate, 82.3% valid cotinine samples.	Pre-legislation N = 1611 (91.5%) of students completed questionnaire Post legislation N = 1605 (90.4%) completed questionnaire Cotinine available: Pre-legislation N = 1447 (82.2%) Post legislation N = 1461 (82.3%) 10-11 years	Salivary cotinine Child reported parental smoking in the home. Subsequently categorised depending on which parental figures smoked in the home (neither, father figure only, mother figure only or both) Child reported SHS exposure in cars (response to question 'while you were in the car yesterday, was anyone smoking there?')	Socioeconomic status (Family Affluence Scale) Analysis controlled for: Age Year of data collection Time of data collection	Salivary cotinine levels divided into tertiles (low, <0.10 ng/ml; medium, 0.1-0.5 ng/ml and high, >0.5 ng/ml) Multinomial regression analysis.	Family affluence Interaction between FAS and survey year on child salivary cotinine Interaction between SES and survey year on child reported parental smoking in the home
Peltzer, 2011[47] South Africa Quality rating: 7	Cross sectional 2008	Global Youth Tobacco Survey Two-stage cluster sample design; schools selected with probability proportional to enrolment size. Classes within these schools were then randomly selected. Response rate 77.9%	N = 6412 11-18 years of age	Child reported exposure to SHS at home and SHS exposure: 'During the past 7 days, on how many days have people smoked in your home, in your presence?' 'During the last 7 days, on how many days have people smoked in your presence, in places other than your home?'	Child gender* Child age* Parental cigarette smoking status* Friends cigarette smoking status* Child attitudes towards SHS exposure*	Univariate logistic regression Multiple logistic regression	Parental cigarette smoking status Friend cigarette smoking status Child attitudes towards SHS exposure
Pisinger et al. 2012[81] Denmark Quality rating: 3	Cross sectional survey 2007 and 2010	'Health profiles of the capital region' survey of 2007 and 2010. Random samples of all citizens drawn from the civil registration system using random numbers. Includes participants of the survey who completed the question 'does smoking take place indoors in your home?' Response rate 52.3% in both survey years.	2007 N = 9289 2010 N = 12696 <15 years of age	Parental reported smoking in the home: 'does smoking take place indoors in your home?' Dichotomised as 1) no (never or almost never/less than weekly), 2) yes (weekly/daily)	Respondent gender* Age* Daily smoker Tobacco consumption Education (very low, low, medium, high – taken as a measure of socioeconomic status)	Weighted for size of municipality and non-response Multiple logistic regression	Education level

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Preston et al. 2001[150] Puerto Rica Quality rating: 7	Cross sectional August 1993 – November 1996	Recruited at routine appointments at Paediatric Primary Care Clinic	N = 606 2-12 years of age	Urinary cotinine	Child age* Child gender Maternal age* Maternal civil status (living with partner, living alone)* Receiving food stamps Maternal education (> 8^{th} grade, 0-8^{th} grade)* Maternal employment (employed, unemployed and/or housewife)* Season of year (summer, winter)*	Log transformed urinary cotinine was used. F-test Kruskal-Wallis tests Multiple linear regression	Maternal civil status (living with partner, living alone) Receiving food stamps Child age
Rachiotis et al. 2009[45] Greece Quality rating: 7	Cross Sectional 2004 – 2005	Analysis of the Global Youth Tobacco Survey, Greece. Two-stage cluster sampling. 25 schools from each region containing the middle-school grades in Greece selected. Classes within selected schools randomly sampled.	N = 5179 11-17 years of age	Child reported exposure to SHS at home and SHS exposure: 'How often do you see your father/mother/sister/friend/other people smoking in your home?' Don't have/don't see this person; about every day; sometimes; never.	Child age* Child gender* Parental cigarette smoking status* Friends cigarette smoking status*	Multiple logistic regression	Child age Child gender Parental cigarette smoking status Friends cigarette smoking status
Raisamo et al. 2013[48] Finland Quality rating: 5	Repeated cross sectional survey 1991-2009	Adolescent health and lifestyle survey', conducted biennially. Population register sampled on the basis of particular dates of birth. Response rate ranged from 77% (1991) to 56% (2009).	N = 72726 12-18 years of age	Child reported daily exposure to SHS: 'about how many hours a day do you spend in rooms where people smoke?' Dichotomised as 1) exposed to environmental tobacco smoke <1 hour per day, 2) exposed to environmental tobacco smoke for an average of 1 hour a day or more.	Paternal education (high, middle, low) Maternal education (high, middle, low) Family structure (intact family/other) Child's School performance Child's School attended Parental cigarette smoking status Analysis controlled for: Age Gender Study period	Multiple logistic regression	Parental smoking

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Raute et al. 2012[148] India Quality rating: 6	Cross sectional July – September 2010	Mumbai Student Tobacco Survey Two stage cluster sampling design across 26 schools in Mumbai region.	N = 1511 11-17 years of age	Child reported SHS exposure: 'during the past seven days, on how many days have people smoked in your home, and in your presence?'	Child tobacco use* Child age* Gender* Parent's tobacco use* Close friends smokers* Awareness about current ban in public places* Awareness about harmfulness of exposure to SHS from other people* Transport to school*	Multiple logistic regression	Child tobacco use Parents smokers Close friends smokers Awareness about harmfulness of exposure to SHS from other people Transport to school
Ren et al. 2012[141] USA Quality rating: 2	Cross Sectional October 2006 – March 2008	Recruited in General Paediatric Clinic at Children's Hospital of Michigan in Detroit. Mothers accompanying one or more children aged 7-10 years eligible. Response rate 80%	N = 399 7 – 10 years	Maternal reported child SHS exposure: 'During the past year, how many smokers lived in or frequently visited your home?' 'How many of them are daily smokers?' 'Among these daily smokers, how many smoked when the (index child) was around?' Child defined as exposed to SHS if exposed to at least one daily smoker in previous year.	Pregnancy unplanned Maternal education (≤ High school, ≥ college)* Marital status (married/not married) Parenting satisfaction (strongly satisfied, satisfied, dissatisfied)* Number of children (1-2, 3-4, 5+) Monthly family income ($200-$1000; $1001 - $2000; $2001 - $3000; $3001+)	Chi square test Multiple logistic regression	Among non-smoking mothers: Pregnancy unplanned Maternal education
Rise & Lund, 2005[143] Norway Quality rating: 3	Cross sectional May 1995 and August 2001	Postal survey sent to stratified random sample of 1000 households with 3 year old children, drawn from Central Office of Population Records.	1995 N = 212 2001 N = 2001 3 years of age	Parental reported child SHS exposure: 'is your child present when someone smokes – in the car, sleeping room, TV-room, dining rooms, elsewhere at home'.	Household education (years) Awareness of smoking risks Attitudes towards SHS	Regression	Education Attitudes towards ETS

Author, year, location, Newcastle-Ottawa quality rating^	**Design, Data collection years**	**Recruitment, response rate**	**Sample size, age range of children**	**Main outcome measure**	**Associated factors examined in analysis *confounders controlled for**	**Analysis ****	**Significant associations identified in multivariate analyses**
Rudatsikira et al. 2007[49] Mongolia Quality rating: 5	Cross sectional 2003	Global Youth Tobacco Survey Two stage cluster sampling; schools selected with probability proportional to enrolment size, and classes within these schools randomly selected.	N = 3507 13-15 years of age	Child self-reported SHS exposure: had people smoke in their presence on one or more days in the previous 7 days (both at home or outside of the home)	Child age Child gender Parental smoking Friends smoking Confounders controlled for – not known	Logistic regression (not known if multiple logistic regression conducted)	Child age Parents smoking Friends smoking
Scherer et al. 2004[56] Germany Quality rating: 4	Cross sectional 1996 – 1998	All school-entrance children in Augsburg, Southern Germany, invited to take part in Multicentric International Study for Risk Assessment of Indoor and Outdoor Air on Allergy and Eczema Morbidity (MIRIAM). Children who had valid urine sample for both 1996-1998 were eligible for inclusion.	N = 258 6-7 years of age	Urinary cotinine	Parental smoking Number of smokers in household Cigarettes per day smoked in home Child gender Nationality Parental education (elementary school or less, intermediate high school, high school, University) Bedroom sharing Size of flat Leisure time activity (preferred place of stay during free time, regularly exercising, free time spent watching TV)	Log transformed urinary cotinine used. Linear regression	Parental smoking Number of smokers in household Cigarettes per day smoked in home Nationality Bedroom sharing Size of flat Leisure time activity (regularly exercising, free time spent watching TV)
Sims et al. 2010[13] England Quality rating: 8	Repeated cross sectional survey 1996 to 2006	Health survey for England, 1996-2006 (excluding 1999, 2000 and 2004 when cotinine samples were not available). 70.1% of sample returned valid salivary cotinine sample (83.5% in 1996, 58.3% in 2006).	N = 9289 children 4-15 years of age	Salivary cotinine Parental cigarette smoking status (positive response to questions 'do you smoke cigarettes at all nowadays?') SHS exposure (positive response to 2 questions: whether 'someone smokes inside the home most days', whether 'children were looked after for more than 2 hours per week by someone who smokes whilst looking after them')	Study year* Child age* Child gender* Social class of head of household, Registrar General's Social Class(I, professional; II managerial and technical; III skilled non-manual and manual; IV semi-skilled manual; V unskilled manual)* Head of household employment status* Education status of parents (highest qualification of either parent) Crowding (people per bedroom) Ethnicity* Parental cigarette smoking status* Smoking in the home* Carer smoking (> 2 hours per week)*	Log transformed salivary cotinine used. Child salivary cotinine: Linear regression, adjusted for survey year and age. Multivariate linear regression: Backward selection procedure using mean log cotinine	Year (pre/post legislation) Child age Gender (only in 4-12 year olds) Social class Employment status Education Ethnicity Parental cigarette smoking status Smoking in the home Crowding (people per bedroom)

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Singh et al. 2010[140] USA Quality rating: 5	Cross sectional April 2007 – July 2008	National Survey of Children's Health & Current Population Survey – Tobacco Use Supplement Random digit dial survey	N = 90853 ≤17 years of age	Parental reported smoking in the home: 'does anyone in your household use cigarettes, cigars or pipe tobacco?' 'Does anyone smoke inside child's home?'	USA State* Child age* Child gender* Race/ethnicity* Household composition (two parent biological, two parent step family, single mother, other family type)* Place of residence (metropolitan, non-metropolitan)* Primary language spoken at home (English, other)* Household poverty status* Highest household/parental education level*	Chi square test Multiple logistic regression	USA state Race/ethnicity Household composition Place of residence (metropolitan/non metropolitan) Primary language spoken at home Household poverty status Highest household/parental education level
Soliman et al. 2004[78] USA Quality rating: 4	Repeated cross sectional survey 1992 and 2000	1992 and 2000 National Health Interview Survey (NHIS). Multistage area probability sampling design. Response rate not reported.	15,601 families ≤18 years of age	Number of days per week someone smoked in the home.	Region* Race/ethnicity* Maternal education (qualification)* Attitudes towards SHS (SHS harmful, not harmful, unsure)*	Multiple Logistic regression	Survey year Region Race/ethnicity Maternal education Attitudes towards SHS
Ulbricht et al. 2014[50] Germany Quality rating: 6	Cross sectional Up to January 2008	Recruited as part of home brief intervention trial. Recruited in rural region in German Federal State of Mecklenburg – West Pomerania. Self-reported currently smoking households with a child aged three years or younger included in sample. 71.5% response rate.	N = 917 ≤3 years of age	Respondent reported indoor smoking in homes: 'where in the private area of the household is smoking allowed?' 1) nowhere, 2) on balcony/terrace, 3) in specific rooms only, 4) everywhere. Smoking in home defined as smoking in specific rooms only or everywhere at home.	Nursery attendance by target child* Presence of balcony/terrace/garden* Household crowding (number of people per room: less than one person, one person, more than one person)* Number of children in household* Household highest education level. Low (secondary school certificate or no graduation), middle (intermediate general school certificate), high (qualification for university entrance)* Household employment (noun employment, part unemployment, full unemployment)* Household/parental cigarette smoking status* Number of respondent's two closest friends who smoked* *Controlled for child age in multivariate analysis	Univariate logistic regression Multivariate logistic regression	Nursery attendance by target child Presence of balcony/terrace/garden Household crowding Number of children in household Household highest education level. Household employment Household/parental cigarette smoking status Number of respondent's two closest friends who smoked

Author, year, location, Newcastle-Ottawa quality rating^	Design, Data collection years	Recruitment, response rate	Sample size, age range of children	Main outcome measure	Associated factors examined in analysis *confounders controlled for	Analysis **	Significant associations identified in multivariate analyses
Whitrow et al. 2010[138] UK Quality rating: 7	Cross sectional 2003-2004	Sample recruited from 51 schools in 10 inner London Boroughs with high proportions of the main ethnic minority groups. All pupils aged 11-13 years in randomly selected mixed ability classes invited to take part. Response rate 81%	N = 3468 11-13 years of age	Salivary cotinine	Ethnicity (white, black Caribbean, black African, Indian, Pakistani, Bangladeshi) Adjusted for age, sex, day of week sample taken	Log transformed salivary cotinine used Multiple linear regression	Ethnicity
Yi 2012[76] Korea Quality rating: 7	Cross sectional cohort survey 2008	Children's health and environmental research (CHEER).[171] Parents of school-aged children from 33 schools in 10 representative cities invited to participate. Response rate not reported.	N = 7059 children 6-10 years of age	Parental report child exposure: 'has your child ever been exposed to smoke from tobacco in the household?' Urinary cotinine	Child gender† Marital status*† Family size*† Type of accommodation*† Maternal education (years)*† Paternal education (years)*† Household income*† Parental reported SHS exposure† Deprivation (Carstairs index measuring area-based deprivation, using low social class, lack of car ownership, overcrowding and male unemployment to categorise geographical areas)*† Parental SES and deprivation interaction *controlled for in parental reported SHS exposure analysis †controlled for in child cotinine level analysis	Log transformed urinary cotinine used. Simple logistic regression Multiple logistic regression	Parental reported child SHS exposure: Type of accommodation Maternal education Paternal education Household income Deprivation Deprivation X paternal education interaction Child serum cotinine levels: Deprivation area Environmental tobacco smoke Type of accommodation

^ Quality assessment using the modified Newcastle-Ottawa Quality Assessment Scale,[134 135] maximum score 10, higher score reflecting higher quality

** Significance level used in individual studies taken to be $p < 0.05$ unless otherwise stated

Table 2-2 Associations identified and strength of effect in included studies

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Socioeconomic status			
Cook et al.[77]	Registrar General's Social Class system	A	T Test for trend = 11.5, p = 0.0001 (trend for higher geometric mean cotinine with decreasing social class)
Delpisheh et al.[44]	Townsend score	A	Townsend score > +6 OR = 1.2 (95% CI 1.0-1.4)
Jarvis et al.[79]	Registrar General's Social Class system	A	B = 1.19 (95% CI 1.11-1.27) (lower social class experience more exposure)
Moore et al.[84]	Family Affluence Scale (FAS)	A	Risk ratio (RR) of a child's sample containing low level of cotinine (< 0.10 ng/ml) RR =1.16 (95% CI 1.10-1.22) RR of sample containing high level of cotinine (> 0.50 ng/ml) RR = 0.82 (95% CI 0.77-0.88) RR of Child providing a saliva sample with a low cotinine sample (< 0.10 ng/ml) post legislation: Low SES households, ref p > 0.05 Medium SES households RR = 1.66 (95% CI 1.20-2.3) High SES households and RR = 1.44 (95% CI 1.04-2.0)
Sims et al.[13]	Registrar General's Social Class system	A	4-15 year olds I and II (professional, managerial and technical) – (ref) III (skilled non-manual and manual) β 0.133 (95% CI 0.084–0.181) IV and V (semi-skilled and unskilled manual) β 0.253 (95% CI 0.189-0.316)
Akhtar et al.[85]	Family Affluence Scale (FAS)	A	Low β 0.41 (95% CI 0.29-0.5) Medium β 0.08 (95% CI -0.5-0.2) High – ref
Akhtar et al.[86]	Registrar General's Social Class classification system Family Affluence Scale (FAS)	A	Family SEC (ref: SEC 1): SEC 2 β 0.32 (95% CI 0.17-0.47) p <0.001 SEC 3 β 0.45 (95% CI 0.26-0.65) SEC 4 β 0.82 (95% CI 0.60-1.04) Family affluence scale (FAS) (ref: high FAS): Medium FAS β 0.15 (95% CI 0.01-0.29) p <0.001 Low FAS β 0.41 (95% CI 0.27- 0.55)
Baheiraei et al.[83]	Registrar General Model of Social Class	C	Employer, junior employee or lower OR 9.84 (95% CI 2.33-41.46) Skilled workers OR 2.14 (95% CI 0.8-5.73) Semi-skilled or unskilled workers – ref
Yi et al.[76]	Area level deprivation	E	Most deprived (>75%) OR 1.34 (95% CI 1.06-1.69) 25%–75% OR 1.19 (95% CI 1.02-1.39) Least deprived (<25%), Ref.

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Socioeconomic status continued			
Longman & Passey[146]	Area-level socioeconomic index	E	1 (lowest), ref 2,OR 0.55 (95% CI 0.41-0.74) 3, OR 0.52 (95% CI 0.38-0.70) 4, OR 0.27 (95% CI 0.19-0.38) 5 (highest), OR 0.25 (95% CI 0.17-0.37)
Income			
Chen et al.[75]	Household income	B	≤ $2500 OR 2.32 (95% CI 1.47-3.68) ≥ $ 2501 – ref
Bolte & Fromme[74]	Household equivalent	E	>median, ref 60% of median-media, OR 1.29 (95% CI 1.13–1.46) <60% median (relative poverty), OR 1.45 (95% CI 1.21–1.74) Not indicated/refused, OR 0.92 (95% CI 0.82–1.03)
Singh et al.[140]	Household poverty status (ratio of family income to federal poverty guidelines)	E	< 100% OR 3.02 (95% CI 2.41–3.78) 100% - 199% OR 2.61 (95% CI 2.1–3.24) 200% - 399% OR 1.86 (95% CI 1.52–2.28) ≥ 400% - ref
Yi et al's.[76]	Combined household annual	E	<$1,800, OR 1.28 (95% CI 1.10-.49) $1,800–2,700, OR 1.08 (95% CI 0.95-1.24) ≥$2,700, ref.
Employment status			
Sims et al.[13]	Head of household	A	4-15 year olds: Employed (ref) Unemployed β 0.914 (95% CI 0.810-1.018) Other β 0.914 (95% CI 0.839-0.990)
Bolte& Fromme[74]	Parental employment	E	Parental reported child SHS exposure in home At least one parent employed, ref Both parents only marginally employed or unemployed, OR 1.88 (95% CI 1.60–2.21)
Ulbricht et al.[50]	Household employment	E	No employment – ref Partial employment (one parent works), OR 2.38 (95% CI 1.54–3.68), p = 0.01

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Occupation			
Abidin et al.[147]	Paternal occupation (armed forces, manager/professional)	A	Manager/professional – ref Armed forces standard β = 0.16, p < 0.0001
Other socioeconomic			
Jarvis et al.[79]	Home ownership	A	Own home β = 1.42 (95% CI 1.16-1.72)
Hawkins & Berkman[23]	WIC use during pregnancy	F	Smoking mothers: WIC during pregnancy OR 1.41 (95% CI 1.26-1.57)
Parental characteristics			
Parental education			
Abidin et al.[147]	Paternal education (diploma/technical certificate, degree/college)	A	Degree/college – ref Diploma/technical certificate standard β = 0.08, p = 0.021
Sims et al.[13]	Highest qualification of either parent	A	4-15 year olds: Higher education qualification – ref School level (or other) β 0.665 (95% CI 0.613-0.717) No qualifications β 1.308 (95% CI 1.227-1.390)
Chen et al.[75]	Maternal	B	≤ High school OR 2.32 (95% CI 1.47-3.68) >High school – ref
Dell'Orco et al.[52]	Paternal education (years)	B	>13 years – ref 9-13 ratio 1.24 (95% CI 1.01-1.52) 6-8 ratio 1.38 (95% CI 1.13-1.68) <6 ratio 1.34 (95% CI 1.09-1.64) Unknown ratio 1.31 (95% CI 0.86-2.01)
Jurado et al.[144]	Paternal education (primary, secondary, technical, university)	B	r-partial -0.208 (p = 0.05) Higher education associated with lower child cotinine
Mannino et al.[54]	Parental education (years)	C	Years, mean increase in log cotinine, ng/ml < 12 or unknown – 0.39 (95% CI 0.21-0.58) 12 – 0.32 (95% CI 0.2-0.44) > 12 – ref
Anuntaseree et al.[149]	Paternal education (primary, secondary, college/university)	E	Primary OR 2.1 (95% CI 1.5-3.0) Secondary OR 1.7 (95% CI 1.2-2.5) College or university – ref

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Parental education continued			
Bolte & Fromme[74]	Parental education (very high, high, middle, low)	E	Very high – ref High, OR 2.52 (95% CI 2.18–2.93) Middle, OR 2.37 (95% CI 2.09–2.68) Low, OR 3.94 (95% CI 3.46–4.49)
Pisinger et al.[81]	Respondent education (very low, low, medium, high)	E	2010 (95% CI not reported) High – ref Medium OR 2.2 Low OR 4.6 Very low OR 10.4
Ren et al.[141]	Maternal education (≤ high school, ≥ college)	E	Mothers who did not smoke: P < 0.01
Rise & Lund[143]	Household education (years)	E	1995: B = 0.17, p < 0.05 2001: β = 0.16, p < 0.05
Singh et al.[140]	Highest household education (years)	E	<12 OR 3.56 (95% CI 2.72-4.66) 12 OR 2.93 (95% CI 2.41-3.56) 13-15 OR 2.32 (95% CI 1.92-2.81) ≥16 – ref
Soliman et al.[78]	Maternal qualification	E	High school dropout OR 1.18 (95% CI 1.03-1.35) High school graduate – ref Some college OR 0.64 (95% CI 0.57-0.71) College OR 0.36 (95% CI 0.3-0.43) Postgraduate OR 0.28 (95% CI 0.21-0.37)
Ulbricht et al.[50]	Highest household	E	Low – ref Middle OR 0.52 (95% CI 0.32-0.86), p = 0.01 High OR 0.30 (95% CI 0.17-0.54), p < 0.0001
Yi et al.[76]	Maternal and paternal (years)	E	Maternal: <12 years, OR 1.23 (95% CI 0.88-1.72) 12 years, OR 1.28 (95% CI 1.12-1.47) >12 years – ref. Paternal: <12 years, OR 1.81 (95% CI 1.30-2.54) 12 years, OR 1.42 (95% CI 1.24-1.63) >12 years – ref.

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Parental education continued			
Hawkins & Berkman[23]	Maternal education, years	F	Smoking mothers: 0–11 ref 12 OR 1.00 (95% CI 0.88-1.12) 13–15 OR 0.80 (95% CI 0.68-0.95) 16+ OR 0.59 (95% CI 0.45-0.77)
Raisamo et al.[48]	Maternal and paternal education (high, middle, low)	F	12–14-year-olds: Paternal education High – (ref) Middle OR 1.6 (95% CI 1.1-2.8) Low OR 2.3 (95% CI 1.1-2.8) Maternal education High – (ref) Middle OR 1.4 (95% CI 1.1-1.9) Low OR 2.4 (95% CI 1.1-3.1) 16-18 year olds Paternal education High – (ref) Middle OR 1.3 (95% CI 1.1-1.4) Low OR 1.7 (95% CI 1.1-1.9) Maternal education High – (ref) Middle OR 1.4 (95% CI 1.1-1.6) Low OR 1.9 (95% CI 1.1-2.1)
Alwan et al.[80]	Head of household qualification	E	Qualification below A-level OR 2.20 (95% CI 1.08-4.47) p = 0.03
Liao et al.[82]	Parent who smoked, qualification	E	≥Baccalaureate – ref High School 1.97 (95% CI 1.16-3.33) Junior high 2.44 (95% CI 1.14-5.25)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Parental age			
Mills et al.[55]		A	β = .0284, p < 0.05
Anuntaseree et al.[149]		E	Paternal age: 15-24 years – ref 25 – 34 years OR 1.6 (95% CI 1.2-2.2) 35 – 44 years OR 1.3 (95% CI 0.9-1.9) >44 years OR 2.3 (95% CI 1.1-4.6)
Hawkins & Berkman[23]		F	Smoking mothers: <17–19 – ref 20–24 OR 0.94 (95% CI 0.82-1.09) 25–29 OR 0.83 (95% CI 0.71-0.98) 30–34 OR 0.79 (95% CI 0.66-0.96) 35+ OR 0.82 (95% CI 0.65-1.03)
Race/ethnicity			
Sims et al.[13]		A	4-15 year olds: White – ref Black/Asian β -0.183 (95% CI -0.260-0.105)
Scherer et al.[56]		B	† Nationality % explained by variance (R^2) = 4.6, p < 0.001 German geometric mean = 27.2 Non-German geometric mean = 34.1
Whitrow et al.[138]		B	Cotinine ng/ml (95% CI), p White UK – (ref) 0.71 (95% CI 0.62-0.82) Black Caribbean 0.3 (95% CI 0.44-0.36), p < 0.05 Black African 0.29 (95% CI 0.26-0.33), p < 0.05 Indian 0.27 (95% CI 0.23-0.31), p < 0.05 Pakistani 0.32 (95% CI 0.27-0.37), p < 0.05 Bangladeshi 0.5 (95% CI 0.41-0.6), p < 0.05
Mannino et al.[54]		C	Mean increase in log cotinine, ng/ml White – ref Black 0.10 (95% CI -0.06-0.26) Mexican-American -0.73 (95% CI -0.93 - -0.53) Other -0.29 (95% CI -0.61-0.03)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Race/ethnicity continued			
Bleakley et al.[139]		E	White – ref Black OR 7.08 (95% CI 2.92-17.16) Other OR 3.82 (95% CI 1.05-14.02)
Singh et al.[140]		E	Hispanic – ref Non-Hispanic white OR 2.02 (95% CI 1.47-2.76) Non-Hispanic black OR 3.63 (95% CI 2.6-5.09) American Indian OR 2.0 (95% CI 1.24-3.25) Asian OR 1.85 (95% CI 0.92-3.75) Hawaiian/Pacific Islander OR 0.35 (95% CI 0.16-0.79) Non-Hispanic mixed race OR 2.45 (95% CI 1.66-3.63) Other OR 3.09 (95% CI 1.55-6.14)
Soliman et al.[78]		E	White – ref Hispanic OR 0.36 (95% CI 0.32-0.42) African American OR 0.74 (95% CI 0.65-0.84) Native American OR 1.12 (95% CI 0.74-1.69) Asian OR 0.57 (95% CI 0.41-0.8)
Hawkins & Berkman[23]		F	Smoking mothers: White – (ref) Hispanic OR 0.34 (95% CI 0.26-0.45) Black OR 0.67 (95% CI 0.58-0.78) Other OR 0.54 (95% CI 0.42-0.70)
Anuntaseree et al.[149]	Religion	E	Buddhist – ref Muslim OR 6.7 (95% CI 4.8-9.4) Christian OR 1.2 (95% CI 0.7-20.8) Other OR 1.5 (95% CI 0.5-4.5)
Parenting			
Chen et al.[75]	Parental satisfaction	B	Satisfied OR 0.57 (95% CI 0.36-0.91) Not satisfied – ref
Ren et al.[141]	Pregnancy unplanned	E	Non-smoking mothers: Unplanned children more likely to be exposed to SHS in the home, p < 0.05

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Parental smoking behaviour and attitudes			
Parental cigarette smoking status/number of smokers in household			
Akhtar et al.[85]		A	At least one parent a smoker: Coefficient 1.2 (95% CI 0.99-1.42), $p < 0.001$
Delpisheh et al.[44]		A	Maternal cigarette smoking OR 2.5 (95% CI 1.8-3.4) Presence of a smoker in the household OR 2/3 (95% CI 1.2-4.4)
Jarvis et al.[79]		A	Smokers in household $\beta = 3.57$ (95% CI 3.2-3.98) (Exposure higher in households with more smokers)
Sims et al.[13]		A	4 – 15 year olds Parental cigarette smoking status: Neither parent smokes – ref Father only smokes regression coefficient = 0.3 (95% CI 0.2-0.39) Mother only smokes regression coefficient = 0.74 (95% CI 0.6-0.8) Both parents smoke regression coefficient = 1.08 (95% CI 0.99-1.17)
Abidin et al.[147]		A	Father only smoker std. beta 0.15, $p < 0.0001$ Father and family smoker std beta 0.09, $p = 0.01$ Neither parents smoke
Dell'Ocro et al.[52]		B	Other smokers in household (in addition to parental smoking) No – ref Yes – ratio = 1.4 (95% CI 1.18-1.67) Unknown – ratio = 0.97 (95% CI 0.78-1.21)
Scherer et al.[56]		B	† Parental cigarette smoking status: % variance explained (R^2) 39.5, $p < 0.001$ Geometric mean urinary cotinine None 10.3 Father only 29.1 Mother only 50.2 Both 48.4 Number of smokers in household: % variance explained (R^2) 38.9, $p < 0.001$ 0, geometric mean urinary cotinine = 10.2 1, geometric mean urinary cotinine = 34.4 2, geometric mean urinary cotinine = 45.4 3, geometric mean urinary cotinine = 56.6

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Parental cigarette smoking status/number of smokers in household continued			
Gonzales et al.[46]		E	Mother's current cigarette smoking status Non-smoker – ref Smoker OR = 3.31 (95% CI 1.47-7.46) Other adult smoker at home No – ref Yes OR = 2.18 (95% CI 0.92-5.14)
Peltzer[47]		E	Neither parent/guardian smokes – ref Both parents/guardians smoke OR 5.45 (95% CI 2.67-8.1) Father/male guardian smokes OR 4.25 (95% CI 3.41-5.3) Mother/female guardian smokes OR 6.62 (95% CI 4.09-10.71)
Rachiotis et al.[45]		E	Neither parent smoked – ref Both parents smoked OR 2.86 (95% CI 2.35-3.32) Father only smoked OR 2.08 (95% CI 1.76-2.46) Mother only smoked OR 2.34 (95% CI 1.87-2.94)
Raisamo et al.[48]		E	12-14 year olds: Neither parent smokes – ref Mother smokes OR 6.9 (95% CI 5.1- 8.2) Father smokes OR 5.8 (95% CI 5.1-6.7) Both parents smoke OR 13.5 (95% CI 11.1-15.5) 16-18 year olds: Neither parent smokes – ref Mother smokes OR 3.2 (95% CI 2.1-3.5) Father smokes OR 2.9 (95% CI 2.1-3.1) Both parents smoke OR 5.6 (95% CI 5.1-6.1)
Ulbricht et al.[50]		E	Two parent household – one smoker - ref Two parent household – two smokers OR 2.77 (95% CI 1.9-4.05), $p < 0.001$ Single parent household – one smoker OR 2.74 (95% CI 1.59-4.71), $p < 0.001$
Hughes et al.[142]		G	Respondent or spouse a smoker – yes OR 2.65 (95% CI 1.29-5.43)
Rudatsikira et al.[49]		G	Parents smoking None – ref Father only OR 3.65 (95% CI 3.1-4.3) Mother only OR 6.54 (95% CI 3.48-12.32) Both parents OR 5.85 (95% CI 3.83-8.92)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Number of cigarettes smoked			
Bakoula et al.[51]	Cigarettes per day	B	Increase of 10 cig/day = 37% increase (95% CI 32-43)
Dell'Orco et al.[52]	Cigarettes per day	B	None – ref Only father (1-10) ratio 1.36 (95% CI 1.14-1.63) Only mother (1-10) ratio 1.60 (95% CI 1.14-1.63) Both (1-10) ratio 2.17 (95% CI 1.62-2.90) Only father (> 10) ratio 1.99 (95% CI 1.77-2.24) Only mother (>10) ratio 2.44 (95% CI 1.93-3.09) Both (father (>10) and mother (1-10)) ratio 2.44 (95% CI 2.07-2.88) Both (father (1-10) and mother (>10)) ratio 2.37 (95% CI 1 69-3.31) Both (>10) ratio 2.97 (95% CI 2.49-3.53) Unknown ratio 1.60 (95% CI 1.26-2 02)
Mantziou et al.[53]	Paternal cigarettes per day Spouse non-smoker Maternal cigarettes per day	E, F	Paternal smoking in house in front of children B coefficient = 0.12, OR = 1.13 (95% CI 1.08-1.19) p < 0.001 B coefficient = -0.82, OR = 0.44 (95% CI 0.24-0.8), p = 0.007 Maternal smoking in the house in front of children B coefficient = 0.04, OR = 0.01 (95% CI 1.00-1.08), p = 0.019
Johansson et al.[62]	Cigarettes per day	E	OR 1.6 (95% CI 1.2-2.1), p < .01
Number of cigarettes smoked in the home			
Mills et al.[55]	Maternal cigarettes smoked in the home	 A D	† Salivary cotinine, p <.05 Time-weighted average $PM_{2.5,}$ p <.05 Maximum, p <.05 % time over 35 μg/m^3, p <.05
Scherer et al.[56]	Cigarettes per day smoked in home	B	† % explained variance (R^2) 0 or missing, geometric mean = 10.6, p < 0.001 5 geometric mean = 10.3 6-10 geometric mean =29.4 11-20 geometric mean = 38.0 21 geometric mean =67.8

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Number of cigarettes smoked in the home continued			
Mannino et al.[54]	Cigarettes smoked in home	C	† Mean increase in log cotinine, ng/ml Unknown 0.82 (95% CI 0.64-1.00) 1-9 – ref 10-19 0.86 (95% CI 0.62-1.10) 20-29 1.14 (95% CI 0.86-1.32) 30-39 1.33 (95% CI 0.87-1.79) ≥40 1.55 (95% CI 1.25-1.85)
Attitudes to smoking/SHS exposure			
Mills et al.[55]	Maternal attitudes	C A	† Agreement with statement 'I would ask a smoker to smoke outside my house': Maximum particulate matter was significantly lower in homes of mothers who strongly agreed, compared to no strong opinion (p = .03), disagreed (p = .034) or strongly disagreed (p = 0.013) Salivary cotinine significantly higher in children of mothers who strongly disagreed compared to mothers who agreed (p = .004)or strongly agreed (p = .008) Other attitudinal questions were non-significant
Peltzer[47]	Child attitudes	E	Do you think the smoke from other people's cigarettes is harmful to you? Definitely not - ref Probably not OR 1.38 (95% CI 0.98-1.95) Probably yes OR 1.96 (95% CI 1.39-2.75) Definitely yes OR 2.01 (95% CI 1.57-2.6)
Raute et al.[148]	Child attitudes	E	Awareness about harmfulness of exposure to SHS from other people Yes – ref No adjusted OR = 1.68 (95% CI 1.15-2.45)
Rise & Lund[143]	Attitudes towards SHS (range of questions, lower scores reflecting more negative attitudes towards SHS exposure)	E	1995: $\beta = 0.19$, $p < 0.05$ 2001: $\beta = 0.41$, $p < 0.0001$
Soliman et al.[78]	SHS harmful\not harmful\unsure	E	SHS exposure harmful OR 0.27 (95% CI 0.23-0.32) Don't know if SHS exposure is harmful OR 0.66 (95% CI 0.54-0.81)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Attitudes to smoking/SHS exposure continued			
Liao et al.[82]	Scale measuring parental perceptions, evaluations of the consequences and family reactions to smoking in the presence of children	E	† Disagreed with home smoking bans OR 2.16 (95% CI 1.18-3.94) Parental smokers reaction to family's anti-smoking responses scale (lower score showing more compliance with family's antismoke responses) OR 0.94 (95% CI 0.91-0.96)
Family characteristics, family size			
Jarvis et al.[79]	Number of children in household	A	β = 0.79 (95% CI 0.72 – 0.87) (higher exposure in smaller families)
Bolte & Fromme[74]	Family size	E	1 child – ref 2 children OR 0.68 (95% CI 0.61-0.76) ≥3 children OR 0.66 (95% CI 0.59-0.75)
Longman & Passey[146]	Household size	E	1–2 people, ref 3–4 people, OR 1.20 (95% CI 1.06-1.36) 5+ people, OR 1.36 (95% CI 1.08-1.72)
Hawkins & Berkman[23]	Number of children	F	Smoking mothers: Child with no siblings – ref Child with 1 sibling OR 1.25 (95% CI 1.10-1.41) Child with 2+ siblings OR 1.59 (95% CI 1.40-1.81)
Ulbricht et al.[50]	Number of children	E	1 child – ref ≥3 children OR 1.76 (95% CI 1.09-2.82), p = 0.019
Marital status			
Jarvis et al.[79]	One parent household	A	No β = 2.97 (95% CI 2.32-3.81)
Chen et al.[75]	Single/not single	B	Single OR = 1.67 (95% CI 1.03-2.71) Not single – ref
Preston et al.[150]	Mother living alone	B	Living alone parameter estimates = -0.22 (95% CI -0.41 - -0.02), p = 0.027 Living with partner – ref
Bolte & Fromme[74]	Single parent family/other	E	Single parent OR 1.38 (95% CI 1.20-1.57)
Raisamo et al.[48]	Intact family/other	E	12-14 year olds Non-intact family OR 1.9 (95% CI 1.1-2.2)
Singh et al.[140]	Two parent biological/two parent step family/single mother/other family type	E	Two parent biological – ref Two-parent step family OR 1.35 (95% CI 1.12-1.63) Single mother OR 1.72 (95% CI 1.43-2.07) Other family type OR 2.07 (95% CI 1.60-2.69)
Hawkins & Berkman[23]	Married/not married	F	Smoking mothers: Married – ref Not married – OR 1.13 (95% CI 1.01-1.27)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Home characteristics			
Crowding			
Sims 2010[13]	(>1.5 people per bedroom)	A	4-15 year olds, Adjusted for age and year: People per bedroom <1 ref 1-1.5 β 0.277 (95% CI 0.185-0.369) > 1.5 β 0.555 (95% CI 0.452-0.658)
Jarvis et al.[79]	Persons per room	A	B = 1.29 (95% CI 1.16 – 1.44) (more crowded experience greater exposure)
Dell'Orco et al.[52]	Inhabitant's per room	B	Low (<1) – ref Medium (1-2) 1.08 (95% CI 0.96-1.22) High (>2) 1.38 (95% CI 1.14-1.67) Unknown 1.29 (95% CI 0.93-1.77)
Scherer et al.[56]	Bedroom sharing	B	† % explained by variance (R2) = 0.7, p < 0.01 Bedroom sharing geometric mean = 30.7 No bedroom sharing geometric mean = 26.7
Size of home			
Bakoula et al.[51]	Floor surface area	B	Floor surface area increase of 20 m2 -9% decrease (95% CI -14- -5)
Scherer et al.[56]	Size of flat	B	† % explained by variance (R2) = 10.5, p < 0.001 60m^2 geometric mean = 42.4 60-120m^2 geometric mean = 32.0 >120m^2 geometric mean = 31.1
Mannino et al.[54]	Number of rooms	C	Mean increase in log cotinine, ng/ml ≤5 0.27 (95% CI 0.07 – 0.47) ≥6 – ref
Air conditioning			
Abidin et al.[147]	Air conditioning in living room, child's sleeping area or none	A	None – ref Living room standard β = -0.11, p = 0.002 Child's sleeping area standard β = -0.08, p = 0.017*

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Outside space available			
Bleakley et al.[139]		E	Access to outside space, OR 0.24 (95% CI 0.06-0.98)
Ulbricht et al.[50]		E	No access to outside space, OR 4.38 (95% CI 2.64-7.25), p < 0.001
Child characteristics			
Age			
Mills et al.[55]		A	B = -0.276, p < 0.05
Cook et al.[77]		A	T Test for trend = 3.8, p = 0.003 (younger children have higher geometric mean cotinine)
Delpisheh et al.[44]		A	< 7 years OR = 1.9 (95% CI 1.4-2.6) (children < 7 years of age have higher salivary cotinine)
Sims et al.[13]		A	B = -0.025 (95% CI -0.031-0.018) (younger children have higher salivary cotinine)
Mannino et al.[54]		C	Age years, mean increase in log cotinine, (ng/ml) (younger children have higher serum cotinine) 4-6 – 0.53 (95% CI 0.37-0.69) 7-11 – 0.17 (95% CI 0.03-0.31) 12-16 – ref
Baheiraei et al.[83]		B	Per month increase in age OR 1.19 (95% CI 1.04-1.36) (older infants higher urinary cotinine)
Bakoula et al.[51]		B	Age -9% decrease per year increase in age (95% CI 95% CI -11- -8) (younger children have higher urinary cotinine)
Preston et al.[150]		B	(younger children have higher urinary cotinine) 2-4 years – ref 5-8 years parameter estimates = -0.32 (95% CI -0.5 - -0.13), p < 0.001 9-12 years parameter estimates = -0.42 (95% CI -0.62 - -0.22), p < 0.001
Mantziou et al.[53]		E	Paternal smoking in the house in front of children: B coefficient = -0.12, OR = 0.89 (95% CI 0.8-0.99), p = 0.026 (younger children more likely to be exposed)
Rachiotis et al.[45]		E	Age years: 11-13 - ref 14 OR 1.02 (95% CI 0.87-1.19) 15 OR 1.43 (95% CI 1.2-1.72) 16-17 OR 1.29 (1.13-2.18)
Rudatsikira et al.[49]		E	(older children more likely to be exposed) 11-12 – ref 13 OR 0.97 (95% CI 0.72-1.32) 14 OR 1.27 (95% CI 0.94-1.73) 15 OR 1.41 (95% CI 1.04-1.92) 16-17 OR 1.53 (95% CI 1.03-2.26)
Bleakley et al.[139]		E	Child under 5 years OR 0.38 (95% CI 0.17-0.82) (younger children less likely to be exposed)

Study	Association measurement	Outcome measure	Adjusted effect size († Univariate analysis only)
Gender			
Cook et al.[77]		A	T test for trend = 2.5, p = 0.01 (girls have higher geometric mean cotinine levels)
Jarvis et al.[79]		A	B 1.28 (95% CI 1.11-1.47) (girls have higher cotinine levels)
Sims et al.[13]		A	4-12 years olds Female – 7% increase (regression coefficient = 0.068, 95% CI 0.02-0.1)
Bakoula et al.[51]		B	Male -13% decrease (95% CI -21- -3)
Rachiotis et al.[45]		E	Female – ref Male OR 0.72 (0.62-0.81)
Nursery attendance			
Ulbricht et al.[50]		E	No attendance at nursery OR 1.81 (95% CI 1.21-2.70), p < 0.001

A. Salivary cotinine
B. Urinary cotinine
C. Serum cotinine
D. Airborne particulate matter
E. SHS exposure in the home (parental/respondent/child reported)
F. Smoking in the presence of children
G. SHS exposure all locations (not limited to home

CHAPTER 3 STUDY METHODS: LONGITUDINAL COHORT SURVEY OF WOMEN'S SMOKING BEHAVIOUR AND ATTITUDES IN PREGNANCY

3.1 BACKGROUND

In this chapter, the methods used to assemble the Pregnancy Lifestyle Survey (PLS) cohort, recruitment rates and the sociodemographic characteristics of cohort participants are reported. Comparisons with other previous UK pregnancy cohorts and the generalizability of the PLS cohort are discussed, and the advantages and disadvantages of using the PLS cohort to address relevant thesis objectives are considered.

The PLS is a longitudinal cohort that was recruited as part of the National Institute for Health Research (NIHR) Programme Grant: 'Improving the effectiveness and reach of NHS support for smoking cessation in pregnancy'. The aim of the PLS cohort was to collect detailed information on smoking behaviours across pregnancy and the early postpartum period, and also on the potential determinants of and influences upon smoking during this time.

Prior to starting my PhD, alongside the wider NIHR programme grant team, I was involved in planning and helping to develop data collection tools for the PLS cohort. A colleague and I were responsible for developing and setting up the recruitment process, recruiting participants into the cohort and the coordination of participant follow-ups. During my PhD, my continued responsibilities on the PLS cohort were to monitor follow-up response rates, assist with the development of a database for questionnaire data and carry out data cleaning. Due to the detailed information collected as part of the PLS cohort, and in particular information about smoking behaviours in the early postpartum period, the cohort was considered ideal to address some of the objectives of this thesis.

A paper reporting the PLS cohort methods and baseline characteristics was published in BMJ Open in April 2014, a copy of which can be found in Appendix 7.1.2.

3.2 PREGNANCY LIFESTYLE LONGITUDINAL COHORT METHOD

We recruited a longitudinal cohort of pregnant women using screening questionnaires completed at 8-26 weeks gestation. Data about the cohort were collected via questionnaire at recruitment (8-26 weeks gestation), and at follow-up at 34-36 weeks gestation, and 3 months after childbirth. Data from the baseline and 3 months postpartum questionnaires were utilised in analysis in Chapter 4, which are described in greater detail below. Data from questionnaires distributed at 34-36 weeks gestation were not used in Chapter 4; however, these data were used to determine eligibility and provided a sampling framework for the qualitative work described in Chapter 5, and as such, brief details are outlined below.

3.2.1 Ethics approval

The PLS cohort study received a favourable opinion from the Derbyshire Research Ethics Proportionate Review Sub-Committee (reference number 11/EM/0078).

3.2.2 Participants

Eligible women were those aged 16 years or over and reported being between 8 and 26 weeks pregnant. Women who self-reported being either current smokers (defined as self-reported occasional smokers and daily smokers), or having smoked in the 3 months prior to becoming pregnant were eligible for participation. Women who were unable to understand study procedures sufficiently to provide informed consent (e.g. due to cognitive difficulties), had previously enrolled in the study, or were unable to read or understand the written questionnaires in English were not enrolled.

3.2.3 Recruitment and questionnaire distribution

3.2.3.1 Recruitment and baseline questionnaire

Based on routine hospital data, there were 10,051 infants born in Nottingham hospitals in 2011/2012. It was envisaged that at least 25% of pregnant women in Nottingham would have smoked in the 3 months prior to or during pregnancy based on other national figures,[172] providing 2,500 potential participants from which to recruit to the cohort. Recruitment into the PLS was conducted by myself and a colleague between August 2011 and August 2012. Recruitment took place at two antenatal clinics within Nottingham University Hospitals NHS Trust (City Hospital and Queen's Medical Centre). We attended on average five clinics per week; to try to ensure representative sampling, we attended various clinics and specialist clinics evenly distributed across both sites. All women self-reporting to be between 8 and 26 weeks gestation attending routine antenatal appointments at these clinics were invited to complete an anonymous screening questionnaire to determine study eligibility based upon the criteria described above. Those who met the criteria were directed to read a participant information sheet describing the study, and, if willing, to then complete a baseline questionnaire; women could also seek further information from us whilst in the clinic.

Upon completion of the baseline questionnaire, women were offered a £5 high street shopping voucher as recognition for the time taken to complete the questionnaire. Written informed consent was obtained from those who wished to participate in the rest of the study and to complete the two further follow-up questionnaires. We contacted any women who did not feel able to make a decision about participation whilst they were in clinic after a further 24 hours to ascertain whether they wished to take part.

3.2.3.2 Follow-up at 34-36 weeks gestation

We liaised with hospital administration staff to check antenatal hospital records ensuring that questionnaires were not sent to women who had died or whose foetuses/infants had died. For all other participants at this time point, a second postal questionnaire was sent using the contact details provided at recruitment. Additionally, participants who provided an email address were emailed a link to a web-based version of the questionnaire, and sent one email reminder. Web-based questionnaires were created using the Bristol Online Surveys tool.[173] To complete online, participants needed to log in to the questionnaire using a unique ID number and password, details of which were provided in the email containing the URL link. The web-based questionnaires had a similar layout to the paper versions and, with the exception of current smoking status, all questions were optional. Non-respondents were sent one postal/email reminder letter after 2 weeks, and then contacted by telephone after a further 7 days; if no response was received, a text message reminder was sent to participants' mobile phones. Participants who were successfully contacted via telephone were invited to complete the questionnaire during the call.

All participants who completed follow-up questionnaires were sent a £5 shopping voucher.

3.2.3.3 Follow-up at 3 months after childbirth

We again liaised with hospital administration staff to check antenatal hospital records to determine participants' actual delivery dates, and to ensure that questionnaires were not sent out to participants who had died or whose baby had died. We sent the final questionnaire 3 months after the delivery date by post or email, and if not returned, completion over the telephone was attempted using similar methods to those described above for the follow-up at 34-36 weeks gestation.

3.2.4 Questionnaire contents

Copies of the three questionnaires are in Appendix 7.1.2, and a description of items from each is below. All questions used a range of response formats including: yes/no, multiple choice and 5-point Likert type scales for attitudinal questions. The questionnaire included a combination of original questions and items derived from previous surveys or used in previous studies (shown by citations below).

The questionnaires were reviewed and piloted by a member of the general public who was a current smoker and had smoked during two previous pregnancies. Feedback was given on appropriateness and ease of understanding of written materials (including invitation letters, participant information sheet, consent forms), and the content, style and wording of the questionnaires, and changes were reviewed and made where necessary.

3.2.4.1 Baseline questionnaire

The baseline questionnaire contained 38 items, and was divided into six sections: i) *screening questions*, ii) *your health and your pregnancy*, iii) *your smoking behaviour and beliefs*, iv) *your current smoking behaviour*, v) *your interest in getting help to stop smoking*, and vi) *about you* (sociodemographic information). These questions asked women to describe their current smoking behaviours,[174-177] nicotine dependence based on the 'heaviness of smoking index',[176] general health,[178-182] intentions to quit smoking and self-efficacy in achieving this,[183 184] their beliefs about the harm smoking during pregnancy causes their baby,[183] support from family and friends to stop smoking,[183 185 186] and any stop smoking services accessed.[183] The questionnaire also asked women about their opinions on a range of both health professional provided and self-help stop smoking support, including telephone helplines, group sessions, one-to-one sessions, booklets, a DVD, websites, text messages, email support and a mobile phone/device application.[187] The age that women left education, qualifications, whether they rented or owned their own home, access to a car or van within their household, employment status, occupation and ethnicity were also collected at baseline.

3.2.4.2 Follow-up at 34-36 weeks gestation

The first follow-up questionnaire contained 22 items, divided into four sections. The questions from the baseline questionnaire were repeated, with the exclusion of i) *screening* and sociodemographic information (vi) *about you*) already gathered at baseline. In addition to the questions asked at baseline, this questionnaire also asked women about experiencing nausea or sickness during pregnancy[188] and their concerns about weight gain as a result of stopping smoking.[189]

3.2.4.3 Follow-up at 3 months after childbirth

The second follow-up questionnaire contained 29 items, again divided into four sections. These were similar to the sections used in the baseline and first follow-up questionnaire, but the nature of the questions changed to reflect women's postpartum status. For example, the section i) *your smoking behaviour and beliefs* asked women if they had smoked at all since the birth of their baby and focused on their confidence and determination to stop smoking for good rather than until the birth of their baby. The final section iv) *your health* also asked women about smoking in the home and their beliefs about harm caused to infants through smoking in the home. Further details about these survey questions are in Chapter 4. Additionally, women were asked in this final section about their relationship with their baby,[182] confidence in their parenting ability,[182] money concerns and family routine.[190 191] All questions followed a similar format as the baseline and first follow-up questionnaire.

3.2.5 Sample size

The target sample size for the PLS cohort was 850, anticipating a 20% drop out rate, giving an effective sample size of 683 pregnant smokers.[192] The sample size calculation was estimated based on the primary aim of the cohort, which was to estimate the proportion of smokers who initiate quit attempts in the second or third trimester of pregnancy. This calculation estimated that 850 participants would be sufficient such that, if 20% of women reported quit attempts in the 2nd or 3rd trimester, it would be possible to estimate this percentage with a 95% confidence interval (CI) of +/- 3%.

As the sample size was pre-determined, a post-hoc sample size calculation was conducted based on the primary objective of this thesis, to estimate the proportion of mothers who reported that smoking occurred in their homes at 3 months after birth. With a sample size of 472, and if 20% of mothers reporting smoking in their homes (based on previous estimates from studies conducted in the USA[22 23]), it would be possible to estimate this percentage with a 95% CI of +/- 3.6%.

3.2.6 Data analysis

In this chapter, descriptive analyses were conducted to summarise baseline cohort sociodemographic characteristics and information on current smoking behaviour from all women approached, and from those recruited into the cohort. Chi-square tests were used to examine potential differences in characteristics between those eligible women recruited and not recruited into the cohort, and current and recent ex-smokers within the cohort. Analyses were carried out using SPSS Version 16.[193]

3.3 PREGNANCY LIFESTYLE COHORT CHARACTERISTICS

The sample and PLS cohort characteristics are presented below to allow comparisons to be drawn between the current cohort and existing UK pregnancy cohorts, and to facilitate discussion of the strengths and limitations of using the PLS to address objective 2 of this thesis, the analysis and findings of which are presented in Chapter 4.

3.3.1 Sample characteristics

Screening questionnaires were distributed and completed by 3,265 women attending antenatal clinics in one of two sites at Nottingham University Hospitals NHS Trust. One hundred and forty eight (4.5%) women who were approached declined to complete the screening questionnaire, giving a response rate of 95.5% for screening questionnaires. Routine hospital data indicates that there were 10,051 infants born in Nottingham hospitals in 2011/2012. It is therefore estimated that just under one-third (32.5%) of the pregnant population within Nottingham were screened. A flow diagram illustrating the recruitment and progression of participants through the study is shown in Figure 3-1 and Figure 3-2.

Table 3-1 shows the current smoking status of the 3,265 women approached in antenatal clinics. One third of these women (33.7%, N = 1101, 95% CI = 32.1%–35.4%) who were between 8 and 26 weeks gestation and over 16 years of age, were either current smokers or recent ex-smokers (had stopped smoking either in the 3 months prior to becoming or after finding out they were pregnant). Also, 19.1% (N = 625, 95% CI = 17.8% - 20.5%) of the women who completed the screening questionnaire in clinic were currently smoking whilst pregnant.

3.3.2 Cohort characteristics

Of those eligible to participate from the screening questionnaire, 87.7% (N = 966) went on to complete the baseline survey, and 77.2% (N = 850) gave consent for participation in the longitudinal cohort survey. The cohort comprised of 26% of all women approached in antenatal clinics, and an estimated 8.5% of all pregnant women who gave birth within Nottingham in 2011/12. A CONSORT diagram detailing recruitment can be seen in Figure 3-2.

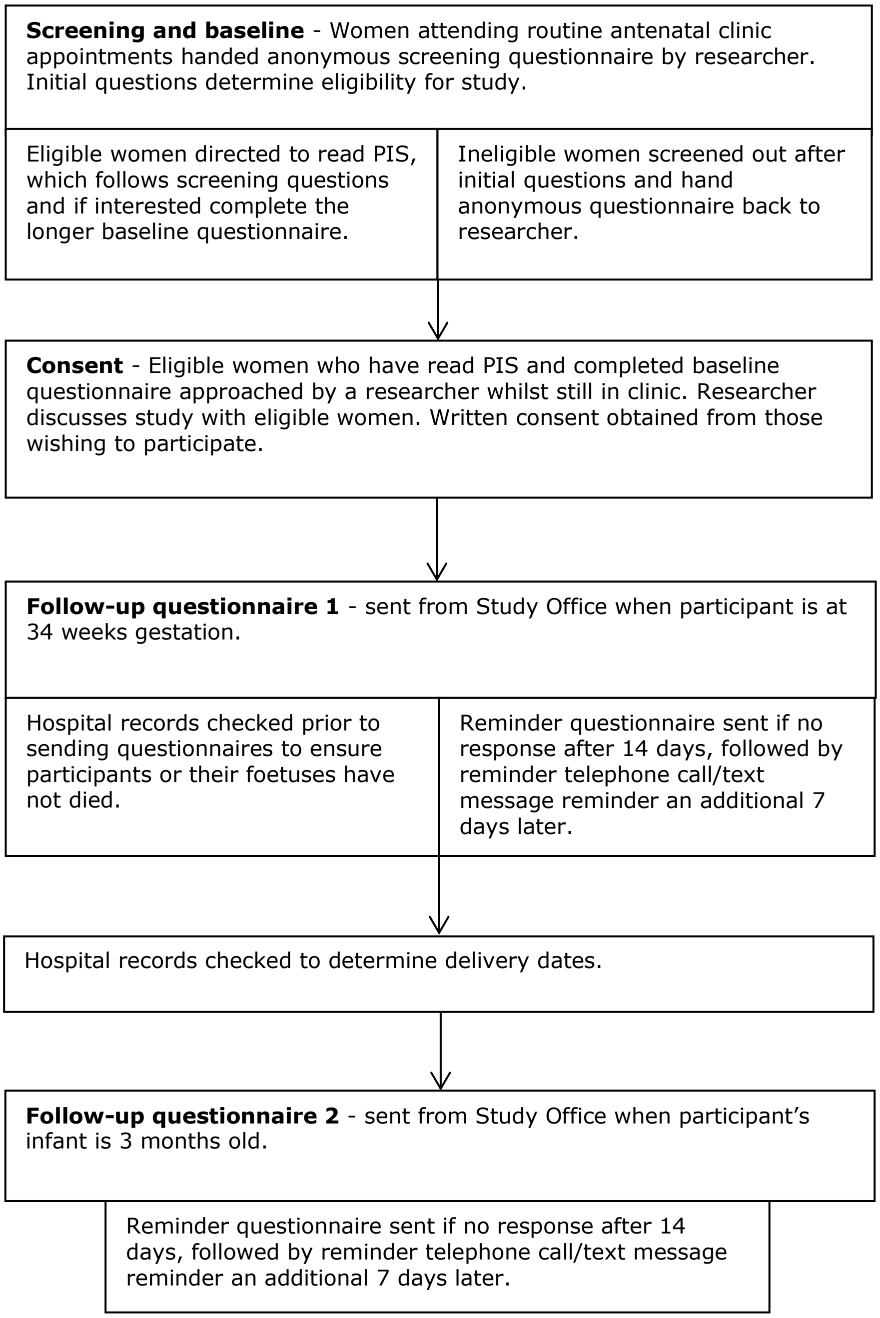

Figure 3-1 Flow diagram illustrating the recruitment and progression of participants through the Pregnancy Lifestyle Survey

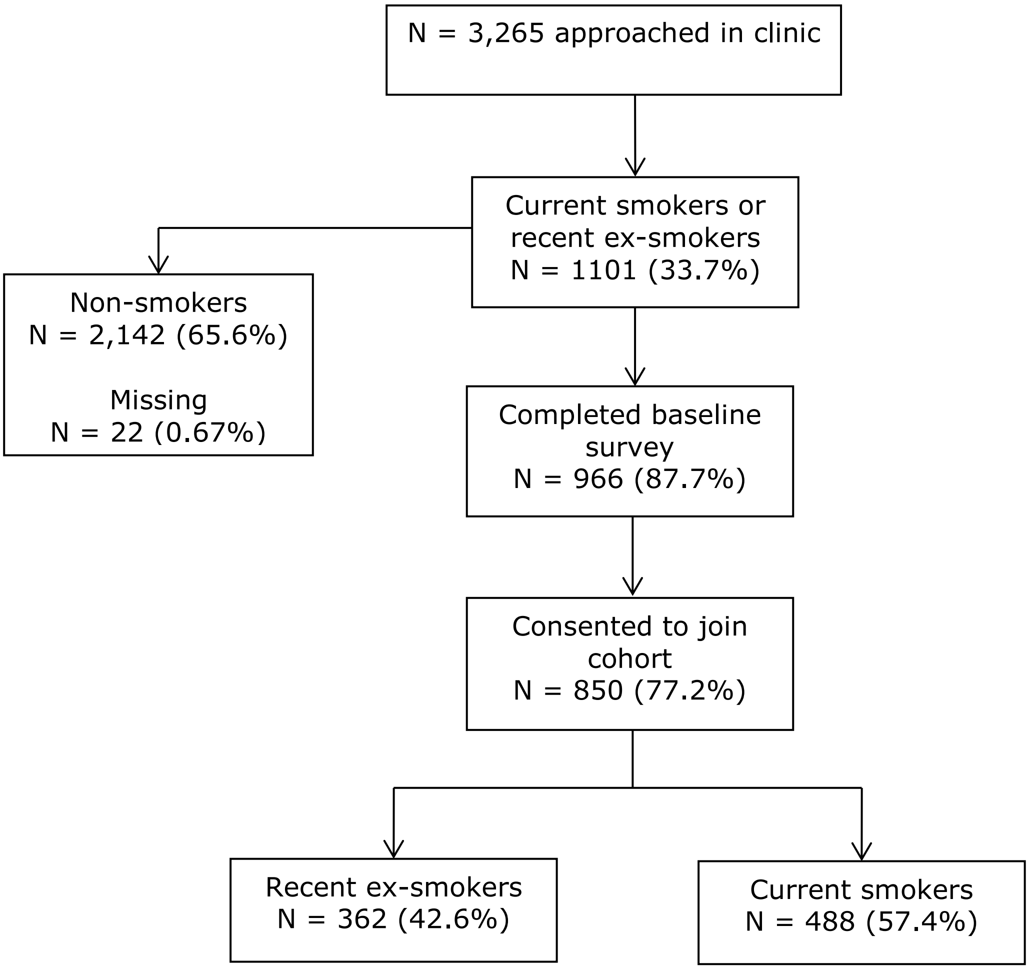

Figure 3-2 CONSORT diagram of recruitment to the Pregnancy Lifestyle Survey

Table 3-1: Smoking status of all women who completed the Pregnancy Lifestyle Survey screening questionnaire

	N = 3,265	%	95% CI
Never smoked	1682	51.5	49.8-53.2
Completely stopped smoking more than 3 months before pregnancy	460	14.1	12.9-15.3
Completely stopped smoking at some time in the 3 months prior to pregnancy	86	2.6	2.1-3.2
Completely stopped smoking after finding out pregnant	390	11.9	10.9-13.1
Smoke occasionally, not every day now pregnant	153	4.7	4.0-5.4
Smoke everyday, cut down during pregnancy	387	11.9	10.8-13.0
Smoke everyday, same as before pregnancy	79	2.4	1.9-3.0
Smoke everyday, more than before pregnancy	6	0.2	0.08-0.4
Missing	22	0.7	

3.3.3 Comparison of eligible women who consented and declined to enter the Pregnancy Lifestyle Survey cohort

Those eligible women who completed the baseline questionnaire but did not consent to enter the longitudinal cohort (N = 116, 12.0%) were similar to the cohort in terms of smoking status, age, ethnicity, current employment and manual/non manual occupations (Table 3-2).

Table 3-2: Comparison of eligible women who consented and declined to enter the Pregnancy Lifestyle Survey cohort

	Consented N = 850 (88.0%)		Declined N = 116 (12.0%)		P value
	N	**%**	**N**	**%**	
Smoking status					
Recent ex-smoker	362	42.6	59	50.9	
Current smoker	488	57.4	57	49.1	0.092
Mean age (standard deviation)	25.8 years	(SD 5.6)	25.9 years	(SD 5.7)	
Ethnicity					
White British	751	89.0	55	82.1	
Other ethnicity	93	11.0	12	17.9	0.089
Home ownership					
Own home	166	19.6	15	23.1	
Do not own home	680	80.4	50	76.9	0.501
Employment					
In current paid work	383	45.2	36	52.2	
Not in current paid work	465	54.8	33	47.8	0.261
Current or most recent occupation manual/non-manual					
Non-manual occupation	216	28.2	22	38.6	
Manual occupation or not applicable	549	71.8	35	61.4	0.096

3.3.4 Smoking status and comparison of the characteristics of smokers and non-smokers in the Pregnancy Lifestyle Survey cohort

At baseline, 42.6% (N = 362, 95% CI = 39.3%-45.9%) reported having stopped smoking either in pregnancy or within the 3 months prior to this ('recent ex-smokers'), and 57.4% (N = 488, 95% CI = 54.1%-60.7%) reported themselves to be current smokers.

As seen in Table 3-3, differences between current and recent ex-smokers were observed across a range of sociodemographic characteristics. Current smokers were significantly younger than ex-smokers ($p < 0.05$), more likely to have no formal qualifications, to have left full-time education at a younger age, to not own their homes, to not be in current paid employment, and to not be in non-manual occupations compared to recent ex-smokers ($P < 0.001$).

Table 3-3: Sociodemographic characteristics of smokers and recent ex-smokers in the Pregnancy Lifestyle Survey cohort

Demographic data	Total N = 850		Current smokers N = 488		Recent ex-smokers N = 362		Unadjusted OR (95% CI)
	N	%	N	%	N	%	
Age							
<20 years	150	17.7	97	20	53	14.6	1.00*
21 – 25	309	36.5	179	36.9	130	35.9	0.75 (0.50–1.10)
26 – 30	215	25.4	123	25.4	92	25.4	0.73 (0.48–1.10)
31 – 35	118	13.9	62	12.8	56	15.5	0.70 (0.37–0.10)
36 – 40	51	6.0	22	4.5	29	8.0	0.42 (0.22–0.79)
Over 40 years	4	0.5	2	0.4	2	0.6	0.55 (0.80–3.99)
Ethnicity							
White British	751	89	447	92	304	84.9	1.00*
White Irish / other white background	32	3.8	14	2.9	18	5.0	0.53 (0.26–1.10)
Asian / Asian British	9	1.1	2	0.4	7	2.0	0.19 (0.04–0.94)
Black / Black British	7	0.8	1	0.2	6	1.7	0.11 (0.01–0.95)
Mixed background	38	4.5	20	4.1	18	5.0	0.76 (0.39–1.45)
Other	7	0.8	2	0.4	5	1.4	0.27 (0.05–1.40)
Qualifications held							
No qualifications	155	18.2	128	26.2	27	7.5	1.00**
GCSEs or equivalent	355	41.7	213	43.7	142	39.2	0.32 (0.20–0.50)
AS/A-levels or equivalent	174	20.5	81	16.6	93	25.7	0.18 (0.11–0.30)
Degree or equivalent	133	15.6	42	8.6	91	25.1	0.10 (0.06–0.17)
Other	33	2.9	24	4.9	9	2.5	0.56 (0.24–1.35)

Demographic data	Total		Current smokers		Recent ex-smokers		Unadjusted OR (95% CI)
	N	**%**	**N**	**%**	**N**	**%**	
Age left full time education							
16 years of age and under	469	56.4	307	64.9	162	45.25	1.00**
17 – 19 years of age	219	26.4	112	23.68	107	29.89	0.55 (0.40–0.77)
20 years of age or older	115	13.8	41	8.67	74	20.67	0.29 (0.19–0.45)
Still in full time education	28	3.4	13	2.75	15	4.2	0.46 (0.21–0.99)
Home ownership							
Own home	166	19.6	57	11.8	109	30.1	1.00**
Do not own home	680	80.0	427	88.2	253	69.9	3.23 (2.26-4.60)
Current employment							
In current paid work	383	45.1	164	33.6	219	60.5	1.00**
Not in current paid work	467	54.9	324	66.4	143	39.5	3.03 (2.28-4.01)
Current or most recent occupation manual/non-manual							
In non-manual occupation	216	28.2	75	17.6	141	41.6	1.00**
In manual occupation/not applicable	549	71.8	351	82.4	198	58.4	3.33 (2.28-4.01)

* Significant in univariate analyses, P <0.05

**Significant in univariate analyses, P <0.001

3.4 FOLLOW-UP RESPONSE RATES

At follow-up one, 776 were eligible to complete questionnaires at 34-36 weeks gestation after withdrawals for miscarriage, termination, withdrawal of consent, early delivery of baby and loss to follow-up (Figure 3-3); a response rate of 60.1% (n=511) was achieved.

At follow-up two, 796 questionnaires were sent out. After allowing for previous withdrawals at follow-up one (with the exception of women who delivered before 34 weeks who were otherwise still eligible to complete the final follow-up questionnaire), and new withdrawals at follow-up two (due to stillbirth, infant death or illness, involvement of safeguarding teams, withdrawal of consent or loss to follow-up), a response rate of 56.1% (n=476) was achieved (Figure 3-3). Follow-up two questionnaire data were therefore available for 476 women. All three questionnaires were completed by 397 participants (46.7%). All follow-ups were completed by August 2013.

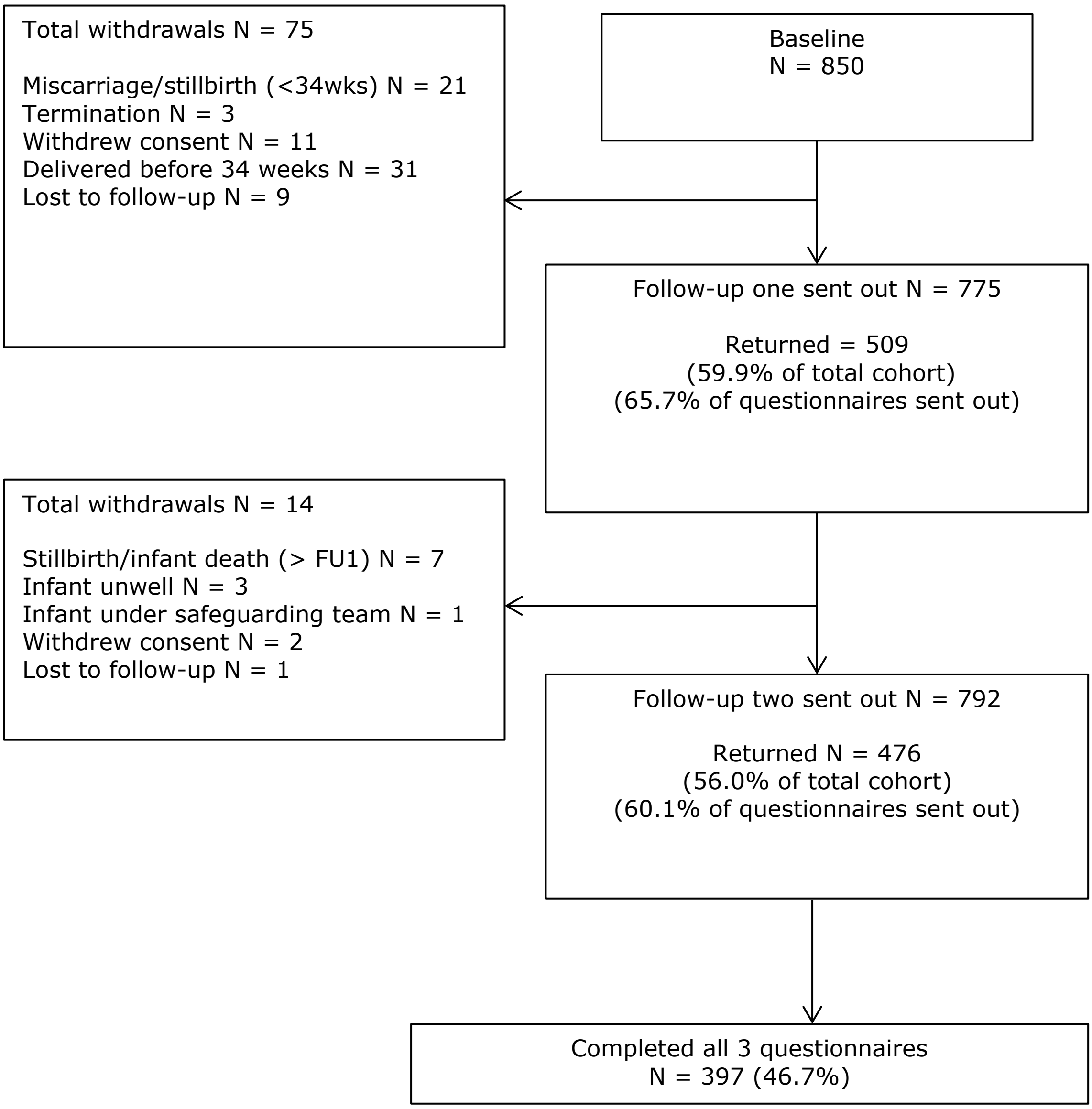

Figure 3-3 Consort diagram of response rates for follow-up questionnaires in the Pregnancy Lifestyle Survey cohort

3.5 DISCUSSION

3.5.1 Characteristics of the Pregnancy Lifestyle Survey cohort

This is the first UK pregnancy cohort for 20 years to investigate smoking behaviour in pregnancy and the postpartum period. It includes detailed longitudinal data on smoking and its determinants, and possibly more so than any previous studies. It found that a third of women between 8 and 26 weeks gestation, and aged over 16 years, screened within Nottingham antenatal clinics were smoking either during pregnancy, or had smoked in the 3 months prior to this. Within this cohort of 850 pregnant women, 57% were current smokers and 43% had stopped either in pregnancy or in 3 months prior to this. Current smokers entering this cohort were significantly younger, less well educated and from lower socioeconomic (SES) backgrounds than recent ex-smokers.

3.5.2 Comparison with other UK pregnancy cohorts and generalizability of the Pregnancy Lifestyle Survey cohort

Between 1984 and 2000, UK cross sectional studies found that 30-35% of women smoked during pregnancy.[194-197] More recently, smoking in pregnancy appears to have decreased,[172] but it remains a significant problem, particularly amongst younger and women from lower SES groups. Pregnant women aged under 20 are four times more likely to smoke than those aged over 35 years[172] and mothers in routine and manual occupations (for example, people working in sales, services, technical, operative or agricultural jobs) are five times more likely to smoke during pregnancy than those in managerial and professional occupations.[172] In 2001, the Millennium Cohort Survey (MCS) data showed that 35.3% of UK women smoked at some point during pregnancy, and 28.4% of women were smoking at 9 months postpartum.[198] By 2010, the UK Infant Feeding Survey (IFS) showed that rates had fallen to 26% of women smoking before or during pregnancy and 12% throughout;[172] however, caution is required as IFS and MCS may not be completely comparable due to some differences in methodology and sampling. Whilst both studies were UK-wide, the MCS collected retrospective maternal self-report of smoking 9 months postpartum, disproportionately sampling families living in high poverty in Northern Ireland, Scotland and Wales, and from populations with a high proportion of ethnic minorities in the UK.[198] In contrast, the IFS collected maternal-reported smoking at 6-10 weeks postpartum from a representative sample of mothers in the UK, weighted for age and low SES.[172]

Twenty-four years ago, the Nottingham Mothers Stop Smoking Project surveyed women within Nottingham Hospitals, using similar definitions of smoking to those used in the PLS cohort.[196] Comparing current smoking rates to those recorded earlier, smoking rates appear to have declined substantially. Within this earlier cohort, 64% of women smoked either before or during pregnancy, and this was nearly double the rate in the current 2012 sample (33.7%).[196] The reduction in smoking prevalence between Nottingham surveys is comparable to the fall in prevalence documented by the IFS,[172] suggesting that reports of smoking behaviours in the PLS cohort are valid.

Prevalence of smoking before or during pregnancy reported by the IFS is lower than found in our cohort. However, whilst smoking rates in the East Midlands are, in general, lower when compared to other regions,[199] rates in Nottingham City are relatively high. Smoking prevalence among Nottingham adults (non-pregnant) was reported to be 27% in 2011,[200] which is higher than the national average for England (20%).[199] Moreover, Nottingham City ranked 20th out of 326 local authorities in England for deprivation in 2010.[201] Together, these factors are likely to contribute towards higher rates of smoking in pregnancy in Nottingham, again suggesting that the PLS cohort findings are valid.

The PLS cohort study found similar associations between smoking behaviour and demographic characteristics as reported in previous studies. For example, it has been widely reported that smoking in pregnancy is more prevalent in younger women.[172 196] Previous cohorts have further shown smoking in pregnancy to be linked with lower SES, whereby those pregnant women in routine or manual occupations are up to five times more likely to smoke.[172 196-198] As with the current cohort, Madeley et al.[196] and the MCS[198] reported lower educational attainment to be strongly related to smoking in pregnancy. These studies observed high smoking rates in those who had left education at 16 years old or younger, had lower than GCSE-level qualifications (General Certificate of Secondary Education) or no qualifications;[196 202] similarly, in the current cohort it was found that 60% of women had no educational qualifications higher than GCSE, with current smokers having left full-time education at a younger age.

Comparisons between women who smoke in pregnancy and 'recent ex-smokers' showed similar findings in the current sample and in the MCS. Smokers enrolled in the MCS were more likely to be in routine and semiroutine occupations,[203] and less likely to be classified as 'non-working class' compared to women who had stopped early in pregnancy.[202] Current smokers were also less likely to have achieved qualifications of GCSEs or above.[202] Current smokers and those who had quit were similar in age.[202 203] Findings from the current cohort were very similar, with the exception that 'recent ex-smokers' were more likely to be older.

A characteristic of the current cohort is that it predominantly consists of a white British population. This is similar to previous cohorts, for example 87.1% of respondents within the MCS were white British[198], and 82% in the IFS.[204] Like the current cohort, the MCS[198] found smoking during pregnancy to be more prevalent amongst women of white British ethnicity. With the exception of those of black Caribbean and Irish ethnicity (smoking prevalence of 24% and 26% respectively), smoking prevalence among women from ethnic minorities is generally less than 8%.[205] However, as the proportion of ethnic minorities within the current cohort is low, the data perhaps can be used most securely to form hypotheses about influences on smoking within a white British population.

3.5.1 Strengths and limitations of using the Pregnancy Lifestyle Survey cohort to address thesis objective 2

There are a number of strengths of the PLS cohort that make it an appropriate data source to address the objectives outlined in this thesis, particularly Objective 2, which examines the prevalence and factors associated with infant secondhand smoke (SHS) exposure in the home. As demonstrated in this chapter, the cohort achieved a very high recruitment rate, with 96% of women attending selected antenatal clinics within Nottingham University Hospital Trust having their smoking status recorded and being screened for eligibility, accounting for around one third of all births within Nottingham in this time. Women who did not attend antenatal screening cannot have been included in the cohort; however, 99% of UK women attend ultrasound anomaly screening scans.[206] The methods used in the PLS cohort are therefore likely to provide a similar sample to that obtained from a thorough population-based approach. Although recruitment was limited to Nottingham, the observed demographic profile of smokers within the cohort is, given the composition of other cohorts, as expected and therefore broadly representative of UK pregnant smokers generally. A further strength of this study was the prospective recording of smoking in the home behaviour in the early postpartum period (≤3 months), which, as far as the author is aware, has not previously been recorded in a contemporary UK pregnancy cohort. Additionally, smoking status during pregnancy was also prospectively recorded both during pregnancy and postpartum; some previous cohorts collected data retrospectively during the postpartum period,[172 198] subjecting their findings to recall error and bias.

A potential limitation in using the PLS cohort to address the objectives of this thesis is the reliance on maternal self-reported smoking in the home. As previously discussed, parental reports have been argued to be subject to bias as parents may be inclined to give socially desirable responses and inaccurate estimates of duration and frequency of their child's exposure to SHS.[9] More accurate estimations of SHS exposure prevalence are likely to have been achieved if infant SHS exposure was validated through salivary or urinary cotinine. However, as described in Chapter 1 (1.1.1.1), there is evidence that parental proxy reports can be a valid measure of child SHS exposure as moderate correlations between biomarkers and reported infant SHS exposure have been observed in previous research. This suggests that using maternal reported SHS exposure in their infants is an appropriate method for estimating prevalence. The cohort similarly relied on self-reported smoking status data. The social stigma of smoking in pregnancy may lead to underreporting, and therefore a response bias, but few studies have investigated this.[207] In a Scottish study, self-reported smoking status measured at 8-12 weeks gestation was noted to be 25% lower than that measured by serum cotinine at 15-16 weeks gestation.[208] This could have been due to underreporting of smoking habits; however, it is also likely that at least a proportion of this was due to return to smoking as gestation progressed. Other research has shown a high correlation between self-reported smoking and biomedical markers within pregnant populations,[209 210] suggesting that self-report measures can be a valid method of assessing smoking status in surveys such as the PLS cohort.

Mothers were recruited into the PLS between 8-26 weeks gestation; this decision was taken to facilitate recruitment as it reflected the gestation of women attending routine appointments within antenatal clinics. This is a wide timeframe encompassing both the first and second trimester. Maternal smoking may fluctuate due to a number of changes that occur across pregnancy, such as changes in morning sickness and women's pregnancy becoming more visible. This is unlikely to impact significantly on the utility of the PLS to address the aims of this thesis as the primary outcome measure (smoking in the home) will be taken from follow-up at 34-36 weeks gestation. Furthermore, the eligibility criteria included both current and recent ex-smokers (within 3 months of pregnancy), ensuring that women were eligible to be included in the cohort regardless of any fluctuations in smoking behaviour across the first and second trimester of pregnancy. The PLS cohort excluded non-smoking mothers from the sample, meaning that it will only be possible to estimate the prevalence of smoking in the home 3 months after childbirth among women who were self-reported current or recent ex-smokers during pregnancy rather than among the general population. Furthermore, participants in the PLS cohort were not asked about their baby's SHS exposure outside of the home, for example in the homes of friends or relatives or in vehicles, limiting the type of information available about SHS exposure in very early infancy. However, as found in the systematic review reported in Chapter 2, research consistently shows parental smoking, and in particular maternal smoking within the home, to be the primary source of children and infant's SHS exposure;[211] therefore, this cohort is likely to give a reliable indication of the scale of the problem of SHS exposure in this age group.

3.6 CONCLUSION

The PLS cohort is appropriate for addressing relevant objectives of this thesis as it provides a contemporary data source with comprehensive information on smoking in pregnancy and the postpartum period, including information on smoking in the home at this time. This cohort is comprised of predominantly white British women, and so will lack generalisability to other ethnic groups. However, the high response rate achieved during recruitment and sample characteristics comparable to other UK pregnancy cohorts increases the representativeness of the PLS cohort, meaning that it is likely to provide a robust indication of the scale of SHS exposure in early infancy. Furthermore, the cohort readily provides a sampling framework through which women could be recruited into a qualitative to allow further exploration of smoking in the home behaviours after childbirth.

CHAPTER 4 SMOKING IN THE HOME AFTER CHILDBIRTH: PREVALENCE AND DETERMINANTS IN AN ENGLISH COHORT

4.1 BACKGROUND

As described in Chapter 1, current UK prevalence estimates for children's secondhand smoke (SHS) exposure in the home focus on children aged ≥4 years,[5 13 80 84-86 138] with most studies including children aged 10-11 years.[84-86 138] There is little research examining SHS exposure in the home among young infants and few prevalence estimates. The author is aware of only one UK study estimating the prevalence of SHS amongst young infants. Amongst children of smokers, 82% of infants (average age 3 months) were exposed to SHS in the home.[20] Elsewhere, the author is aware of just two studies, from the USA, in which 10.8%-21.4% of infants of smoking mothers aged ≤9 months were exposed to SHS in the home,[22] and 24.5% were exposed to SHS for ≥1 hour per day.[23] Although these studies suggest SHS exposure may be a substantial issue, they were conducted prior to,[20 23] or around the time[22] that comprehensive smoke-free legislations were introduced. As far as the author is aware, there are currently no contemporary estimates of prevalence in this age group. Additionally, of the 41 studies investigating factors associated with children's SHS exposure in the home identified by the systematic review reported in Chapter 2, only three[23 83 149] included infants or young children aged <2 years. Due to the small number of studies, little is known about the influences on SHS exposure in the home experienced by young infants; consequently, this chapter reports the prevalence of SHS exposure amongst young infants born to women who took part in the PLS cohort, the methods for which were described in Chapter 3, and identifies factors associated with this exposure. This study was published in BMJ Open in September 2015, a copy of which can be found in appendices 7.1.3.

4.2 METHODS FOR THIS CHAPTER

4.2.1 Outcomes

The primary outcome measure was maternal-reported smoking by either themselves or someone else in their home at 3 months after childbirth, using participants' responses to the questions 'how often do you smoke in your home nowadays?' and 'how often do other people smoke in your home nowadays?'. Responses used Likert items ranging from 1 ('never') to 5 ('very often'). A binary outcome was created, where participants who responded 'almost never' to 'very often' (2-5 on scale) to either of these questions were considered to have smoking in the home 3 months after childbirth, and participants who responded 'never' to have a smoke-free home (SFH).

The maternal sociodemographic characteristics of age, ethnicity, highest qualification, age left full-time education and current employment status were collated from baseline questionnaires. Age left full-time education was categorised as <16 years (UK age of compulsory education at the time of data collection) vs. ≥16 years and still in full-time education. Ethnicity was categorised as a binary variable (white British vs. other ethnicity) due to small numbers of participants in non-white British ethnic groups. A measure of socioeconomic status (SES) was created by mapping participants' postcodes with corresponding 2007 Indices of Multiple Deprivation (IMD) scores, taken from routine UK Data Service data.[212] The 2007 IMD measures a range of domains reflecting economic, social and housing issues, where higher scores reflect greater deprivation.[212] Scores were divided into tertile groups.

Participant's self-reported smoking behaviour was measured at both baseline and follow-up. Women were categorised as being a non-smoker, or smoking 0-5, 6-10, ≥11 cigarettes per day. Heaviness of smoking index (HSI) scores were calculated using the method described by Borland et al.[213] Participant responses to 'how soon after waking do you smoke your first cigarette?' and 'how many cigarettes a day do you smoke?' were given a score from 0-3. The sum of these scores provided an HSI score of 0-6, where 0-2 was categorised as low dependence, 3-4 as moderate dependence, and ≥5 as high dependence. Partner smoking status at 3 months after childbirth was categorised as non-smoker, smoker or not applicable/no partner.

1) If my baby regularly breathes in people's tobacco smoke, it can seriously harm him/her
2) Smoking in the home can seriously harm babies (under 1 year old)
3) Smoking in the home can seriously harm children (over 1 year old)
4) Smoking in the home but not in the same room as a baby can seriously harm him/her

Figure 4-1 Attitudes to child SHS exposure scale items in 3 month Pregnancy Lifestyle Survey follow-up questionnaire

Attitudes to children's SHS exposure were measured by asking participants the extent to which they agreed with four attitudinal statements using 5 point Likert items (Figure 4-1). These questions were developed through qualitative work,[97] patient participant involvement and piloting. The items had high internal consistency (Cronbach's alpha=0.9),[214] and so responses were combined into a single summed score (out of 20), whereby a higher score reflected a more negative attitude towards children's SHS exposure. Attitude scores were highly negatively skewed, with a limited range of observed values, and so were categorised into a binary variable; a score of ≥15 represented 'negative attitudes towards child SHS exposure', and a score of <15 'less negative attitudes towards child SHS exposure'.

4.2.2 Data analysis

Statistical analyses were conducted using Stata 13.[215] The characteristics of responders and non-responders at 3 months after childbirth are presented, and differences examined using chi-squared tests for categorical data and t-tests for continuous data. The prevalence of smoking in the home was estimated using those with complete data; given that there were high levels (50%) of missing data at 3 months after childbirth and observed differences in the characteristics of responders and non-responders (Table 4-1), multiple imputation methods were used to impute values for missing outcome data. Multiple imputation is a recommended method of adjusting for non-response bias within longitudinal studies; in this method, missing values are estimated based on a predictor model multiple times and the results combined.[216] Five imputed datasets were considered sufficient[217] and were constructed using the *mi* command in Stata, based on the following baseline variables: smoking behaviour, HSI, age, ethnicity, qualifications, employment, IMD score and partner smoking status. These variables were selected based on characteristics associated with child SHS exposure in the home in the systematic review reported in Chapter 2 and variables associated with non-response.[218] The imputed outcome variable was only used for estimates of prevalence of smoking in the home; all other analyses were conducted using the original non-imputed outcome variable.

The following variables: smoking behaviour at baseline, smoking behaviour 3 months after childbirth, age, ethnicity, highest qualification, age left full-time education, employment status, IMD, partner smoking status and attitudes towards child SHS exposure score were entered into a univariate logistic regression analysis, and the odds ratios (OR) and 95% Confidence Interval (CI) calculated. For continuous exposure variables, the linearity of the effect was tested using the likelihood-ratio test.

Those variables that were statistically significant in univariate analysis at the $p<0.05$ level, or with strong *a priori* assumptions (e.g. maternal education) based on the findings of the systematic review in Chapter 2, were entered into exploratory multivariable logistic regression models. Correlations were observed between smoking behaviour at baseline, smoking behaviour at 3 months after childbirth and baseline HSI. Smoking behaviour at 3 months after childbirth was most strongly associated with the outcome measure, and was therefore included in the multivariable analyses and the other smoking variables omitted to avoid collinearity. Similarly, highest qualification and age left full-time education were considered in the multivariable analysis independently due to collinearity. Those variables reaching significance ($p<0.05$) were retained in the model, and non-significant variables re-entered into the model sequentially; if a variable was observed to be significant ($p<0.05$) when added to the model, the significance of other variables were explored again. The smoking behaviour variables previously omitted (smoking behaviour at baseline and baseline HSI) were then considered in the multivariable model independently; however, as these did not improve the fit of the model, based on R^2 values, only smoking behaviour at 3 months after childbirth was retained in the final model. Participants with missing data for exposure variables were excluded from multivariable analysis (n=6). Odds ratios, 95% CI, and likelihood ratio test p-values and Wald's p-values for trend for ordered categorical exposure variables are reported.

4.3 RESULTS

4.3.1 Follow-up response rates and characteristics of responders and non-responders

As described in Chapter 3.4, at follow-up two (3 months after childbirth), the response rate was 56.0% (n=476) after non-response and withdrawal. Due to missing data in some of the returned questionnaires, smoking in the home information was available for 471 participants. Table 4-1 shows the characteristics of women who did and did not respond to the follow-up questionnaire 3 months after childbirth. Non-respondents tended to be heavier smokers at baseline, less well educated, leaving full-time education at a younger age, less likely to be in employment and are from a lower SES group as measured by the IMD.

Table 4-1 Pregnancy Lifestyle Survey cohort characteristics and comparison between responders and non-responders at 3 months postpartum

Characteristic	All cohort N (%)	Responders at 3 months postpartum N (%)	Non-responders and withdrawals at 3 months postpartum N (%)	P
	N = 850	**N = 476**	**N = 374**	
Smoking behaviour baseline				
Recent ex-smoker	362 (43.4)	235 (50.1)	127 (34.7)	
≤ 5 cigarettes per day	191 (22.9)	105 (22.4)	86 (23.5)	
6-10 cigarettes per day	151 (18.08)	71 (15.1)	80 (21.9)	
≥11 cigarettes per day	131 (15.4)	58 (12.4)	73 (20.0)	< 0.0001
Age (years) Mean (SD)	25.8 (5.5)	26.5 (5.6)	24.8 (5.3)	< 0.0001
Ethnicity				
White British	751 (89.0)	421 (89.0)	330 (89.0)	
Other ethnicity	93 (11.0)	52 (11.0)	41 (11.1)	0.0007
Highest qualification				
No qualifications	155 (18.2)	62 (13.0)	94 (25.1)	
GCSEs or equivalent	355 (41.8)	184 (38.7)	171 (45.7)	
AS/A-Levels or equivalent	174 (20.5)	118 (24.8)	56 (15.0)	
Degree or equivalent	133 (15.7)	95 (20.0)	38 (10.2)	
Other qualification	33(2.9)	17 (3.6)	16 (4.3)	< 0.0001
Age left education				
≤16 years of age	469 (56.4)	232 (50.0)	237 (64.6)	
≥17 years of age	334 (40.2)	211 (45.4)	123 (33.5)	
Still in full-time education	28 (2.4)	21 (4.5)	7 (1.9)	< 0.0001
Indices Multiple Deprivation score (IMD)†				
1^{st} tertile	284 (33.6)	178 (37.4)	106 (28.8)	
2^{nd} tertile	279 (33.1)	162 (34.0)	117 (31.8)	
3^{rd} tertile	281 (33.3)	136 (28.6)	145 (39.4)	0.002

Characteristic	All cohort N (%)	Responders at 3 months postpartum N (%)	Non-responders and withdrawals at 3 months postpartum N (%)	P
Employment				
Paid work, manual	158 (18.7)	102 (21.5)	56 (15.0)	
Paid work, non-manual	180 (21.3)	131 (27.6)	49 (13.1)	
Paid work, unclear whether manual/non-manual	45 (5.3)	27 (5.7)	18 (4.8)	
Unemployed	201 (23.7)	92 (19.4)	109 (29.2)	
Full-time parent	219 (25.9)	97 (20.5)	122 (32.7)	
Full-time student	23 (2.7)	13 (2.7)	10 (2.7)	
Other	21 (2.5)	12 (2.5)	9 (2.4)	< 0.0001
Baseline heaviness of smoking index (smokers only)				
Low addiction	321 (67.6)	171 (72.8)	150 (62.5)	
Moderate addiction	146 (30.7)	61 (26.0)	85 (35.4)	
High addiction	8 (1.7)	3 (1.3)	5 (2.1)	0.06
Partner smoking baseline				
Partner does not smoke tobacco	499 (59.1)	172 (36.4)	122 (32.9)	
Partner smokes tobacco	294 (34.8)	279 (58.9)	220 (59.3)	
No partner	51 (6.0)	22 (4.7)	29 (7.8)	0.12

†Higher score reflects lower SES group; SD, standard deviation

4.3.2 Smoking in the home 3 months after childbirth: prevalence and determinants

The ‘raw’ prevalence of smoking in the home 3 months after childbirth was 16.3% (95% CI 13.2-19.8%). At this time, 59% of mothers were smokers and of these, 24% reported smoking in the home compared to 4.7% of non-smokers (Table 4-2). After controlling for non-response bias using multiple imputation methods, the prevalence of smoking in the home 3 months after childbirth was 18.2% (95% CI 14.0-22.5%).

Table 4-2 shows the results of univariate analysis for factors associated with smoking in the home 3 months after childbirth, using non-imputed data. The strongest observed associations were for maternal smoking at 3 months after childbirth; those mothers smoking ≥11 cigarettes per day were 10.5 (95% CI 4.73 – 23.32) times more likely to report that smoking occurred in their home compared to non-smoking mothers at this time point. Maternal age, ethnicity, highest qualification, age left full time education, IMD, partner smoking status and attitudes towards child SHS exposure score were also significantly associated with smoking in the home in univariate analysis.

In exploratory multivariable logistic regression modelling, smoking behaviour at 3 months after childbirth, younger maternal age, being of non-white British ethnicity, being from a lower SES group as measured by IMD and holding less negative attitudes towards child SHS exposure were significantly associated with smoking in the home 3 months after childbirth (Table 4-2). The strongest observed association was for mothers who smoked ≥11 cigarettes per day, who were over eight times (95% CI 3.41 – 19.55) more likely to report smoking occurred in their home.

Table 4-2 Prevalence of smoking in the home, and univariate and multivariable analysis of associated factors in the Pregnancy Lifestyle Survey Cohort.

Characteristic	**All sample**	**Smoking occurs in the home**	**Unadjusted OR**	**Adjusted OR**
	(N = 471) **N (column %)**	**(N = 76)** **N (row %)**	**OR (95% CI)**	**(N = 465)** **OR (95% CI)**
Smoking status baseline				
Recent ex-smoker	231 (49.0)	20 (8.7)	Reference***	
Current smoker	240 (51.0)	56 (23.3)	3.21 (1.86, 5.60)	
Smoking behaviour baseline				
Recent ex-smoker	231 (49.8)	20 (8.7)	Reference ***	
≤ 5 cigarettes per day	104 (22.4)	19 (18.3)	2.36 (1.20, 4.64)	
6-10 cigarettes per day	71 (15.3)	14 (19.7)	2.60 (1.23, 5.45)	
≥11 cigarettes per day	58 (12.5)	21 (36.2)	5.99 (2.96, 12.12)	
Smoking status 3 months after childbirth				
Ex-smoker	192 (40.8)	9 (4.7)	Reference ***	
Current smoker	279 (59.2)	67 (24.0)	6.43 (3.12, 13.25)	
Smoking behaviour 3 months after childbirth				
Ex-smoker	192 (40.8)	9 (4.7)	Reference ***	Reference***
≤ 5 cigarettes per day	105 (22.3)	25 (23.8)	6.35 (2.84, 14.23)	6.17 (2.63, 14.46)
6-10 cigarettes per day	83 (17.6)	11 (13.3)	3.11 (1.24, 7.81)	2.09 (0.78, 5.63)
≥11 cigarettes per day	91(19.3)	31 (34.1)	10.51 (4.73, 23.32)	8.17 (3.41, 19.55)

Characteristic	All sample	Smoking occurs in the home	Unadjusted OR	Adjusted OR
Baseline heaviness of smoking index				
Low addiction	171 (36.3)	35 (20.5)	Reference***	
Moderate addiction	60 (12.7)	17 (28.3)	1.54 (0.78, 3.01)	
High addiction	3 (0.6)	2 (66.7)	7.77 (0.68, 88.19)	
Not applicable/non-smoker	237 (50.3)	22 (9.28)	0.40 (0.22, 0.71)	
Maternal age (years)				
Mean (SD)	26.5 (5.6)	24.6 (4.6)	0.93 (0.88, 0.97)***	0.94 (0.89, 1.00)*
Ethnicity				
White British	416 (88.9)	62 (14.9)	Reference*	Reference*
Other ethnicity	52 (11.1)	14 (26.9)	2.10 (1.08, 4.11)	2.69 (1.19, 6.06)
Highest qualification				
No qualifications	61 (13.0)	20 (32.8)	Reference***	
GCSEs or equivalent	183 (38.9)	28 (15.3)	0.37 (0.19, 0.72)	
AS/A-Levels or equivalent	116 (24.6)	10 (8.6)	0.19 (0.08, 0.45)	
Degree or equivalent	94 (20.0)	11 (11.7)	0.27 (0.12, 0.62)	
Other qualification	17 (3.6)	7 (41.2)	1.43 (0.48, 4.33)	
Age left full-time education				
≥17 years of age	208 (45.3)	22 (10.6)	Reference*	
≤16 years of age	230 (50.1)	48 (20.9)	2.23 (1.29, 3.84)	
Still in full-time education	21 (4.6)	3 (14.3)	1.41 (0.38, 5.17)	

Characteristic	All sample	Smoking occurs in the home	Unadjusted OR	Adjusted OR
Employment				
Paid work, manual	102 (21.8)	13 (12.8)	Reference	
Paid work, non-manual	129 (27.5)	13 (10.1)	0.77 (0.34, 1.74)	
Paid work, unclear whether manual/non-manual	27 (5.8)	6 (22.2)	1.96 (0.67, 5.75)	
Unemployed	90 (19.2)	21 (23.3)	2.08 (0.97, 4.45)	
Full-time parent	97 (20.7)	18 (18.6)	1.56 (0.72, 3.39)	
Full-time student	13 (2.8)	2 (15.4)	1.24 (0.25, 6.26)	
Other	11 (2.4)	3 (27.27)	2.57 (0.60, 10.93)	
Indices Multiple Deprivation score (IMD)†				
1^{st} tertile	157 (33.3)	16 (10.2)	Reference***	Reference*
2^{nd} tertile	157 (33.3)	17 (10.8)	1.07 (0.52, 2.20)	1.03 (0.47, 2.25)
3^{rd} tertile	157 (33.3)	43 (27.4)	3.32 (1.78, 6.21)	2.30 (1.13, 4.68)
Partner smoking at 3 months after childbirth				
Partner does not smoke tobacco	201 (42.7)	17 (8.5)	Reference***	
Partner smokes tobacco	220 (46.7)	51 (23.2)	3.27 (1.82, 5.88)	
No partner	50 (10.6)	8 (16.0)	2.06 (0.83, 5.09)	
Attitudes towards SHS				
Negative attitudes towards child SHS exposure (≥15 out of a possible 20)	419 (89.5)	51 (12.2)	Reference***	Reference***
Less negative attitudes towards child SHS exposure (≤ 14 out of a possible 20)	49 (10.5)	25 (51.0)	7.52 (4.00, 14.14)	5.24 (2.57, 10.68)

Odds Ratio (OR)
95% Confidence Interval (95% CI)
Standard Deviation (SD)
*Significant at $p<0.05$
***Significant at $p<0.001$
†Higher score reflects lower SES group

4.4 DISCUSSION

The key novel finding of Chapter 4 was that after multiple imputation to control for non-response, the prevalence of smoking in the home at 3 months following childbirth was 18.2%. Prevalence was higher in homes where mothers who smoked lived compared to those where mothers were non-smokers (24% and 4.7%, respectively). Mothers who were currently smoking ≥11 cigarettes per day, younger, of non-white ethnicity, from a lower SES group and held less negative attitudes towards child SHS exposure were significantly more likely to report that smoking occurred in their home 3 months after childbirth.

4.4.1 Strengths and limitations

The strengths of the PLS for meeting objective two of this thesis, for example, high screening rates for eligibility of women attending antenatal clinics and the representativeness of the cohort, are described in Chapter 3 (3.5.1). A potential limitation of this prevalence study was the lack of power within analysis due to small numbers of participants in some exposure variable groups. Furthermore, there were some differences between those who responded and those who did not respond at follow-up, which are described. These differences may have impacted on the prevalence estimates in the current study; however, appropriate imputation methods were used to allow for this non-response bias. Non-response biases are less likely to have impacted on estimates of association with smoking in the home, because associations within respondents are likely to be similar to associations in non-respondents. These analyses were therefore presented on complete cases. The sample size for the PLS was predetermined based on the primary aim of the research programme for which it was conducted; however, post hoc sample size calculations (section 3.2.5) indicate that the available sample will be appropriate to estimate the proportion of mothers who report smoking occurs in their homes 3 months after childbirth.

A further potential limitation was the reliance on reported smoking measures; parents may be inclined to give socially desirable responses resulting in under-estimates of infants and young children's SHS exposure.[9] However, as described in Chapter 1(1.1.1.1), moderate correlations have been observed between maternal-reported SHS exposure and urinary cotinine, and home environmental nicotine in infants aged <2.5 years.[10] As the cohort included only women who were current or recent ex-smokers during pregnancy, the prevalence estimate obtained does not reflect children's SHS exposure in the home in the general population. However, as parental smoking, and in particular maternal smoking within the home, is the primary source of children and infant's SHS exposure,[211] this study gives a useful indication of the scale of young infant's SHS exposure.

4.4.2 Comparison to previous research

As far as the author is aware, this is the first survey to investigate smoking in the home immediately after childbirth since the introduction of UK smoke-free legislation. The prevalence of SHS in the home in this study was similar to earlier estimates among slightly older infants from the USA, taken from analysis of the Pregnancy Risk Assessment Monitoring System data. The Pregnancy Risk Assessment Monitoring System is a cross-sectional, randomly sampled survey of mothers who are approximately 4 months postpartum.[22 23] Hawkins et al.[23] found that between 2000-

2003, 9.9% of mothers (24.5% of smoking mothers and 6.6% of non-smoking mothers, $p < 0.001$) reported that their infant (aged approximately 9 months) was exposed to SHS for 1 or more hours per day.[23] Gibbs et al.[22] found that between 2004-2008, 4.9-21.4% of infants (again aged approximately 9 months) whose mothers were current smokers or recent ex-smokers (having quit smoking during pregnancy) were exposed to SHS in the home according to maternal reports.

An important novel finding of this study was that the prevalence of smoking in the home 3 months after childbirth in this study was substantially lower than in the only previous UK survey in infants who were a similar age to those in the current sample.[20] In the previous study, 82% of infants aged on average 3 months old whose parents were smokers were exposed to SHS in the home.[20] There are a number of methodological differences between the current study and that conducted by Blackburn et al.[20] that may have influenced the lower estimate of SHS exposure presented in this thesis. For example, in Blackburn et al.'s[20] study participants were recruited by health visitors and data collected through interviews conducted in the home by a trained nurse, rather than by self-completed surveys as in the current study. Furthermore, Blackburn et al.[20] collected urinary cotinine samples from 164 infants as part of their study, and parents may therefore have given more reliable reports of their infant's SHS exposure in the home. However, the characteristics of the samples were similar, in that both had high levels of participants from low SES groups, were less well educated and predominantly white or white British.[20] Blackburn et al.'s[20] study was conducted in 2003; smoke-free legislations have since been implemented across the UK which may have increased awareness of SHS and its implications. It is less likely that this study would have been affected by the socio-political environment surrounding discussed in section 1.1.3.2 in relation to some other UK prevalence studies, as this study was conducted four years prior to the introduction of the smoke-free legislations in 2007. Additionally, smoking prevalence in the UK has reduced since this earlier survey, in particular among those of childbearing age.[219] There has also been an increasing trend in the number of households in the UK reporting to be smoke-free,[29] and corresponding reductions in older children's SHS exposure in the home.[14 18] Taken together, these factors suggest rates of smoking in the home will have declined since Blackburn et al.'s[20] study.

The observed prevalence of young infant's SHS exposure in the home in our study is much lower than estimates of prevalence among older children in England, where 52% of children aged 4-15 whose parents were smokers were exposed to SHS in the home in 2008.[14] More recently, 38.7% of children aged 4-15 years whose parents were smokers were being exposed in the home in 2012.[5] This finding is both important and encouraging; young infants are particularly susceptible to the risks of SHS exposure as they have a higher respiration rate[106] and SHS exposure may have an adverse effect on their developing lungs.[107] This is exacerbated further as young infants experience increased SHS exposure due to the amount of time spent indoors in close proximity to smoking parents and surfaces such as carpets that have been contaminated with smoke, and having more hand to mouth contact compared to older children.[58] However, SHS exposure is dangerous for children of all ages;[29] it is not yet known at what age parents or carers start to consider their children to be less vulnerable to the effects of SHS exposure and relax their home smoking restrictions. The early postpartum period, where the prevalence of SHS exposure in the home appears greatly reduced, may be a significant time-point to prevent future SHS exposure, before smoking in the home becomes an established behaviour.

In the systematic review reported in Chapter 2, it was demonstrated that children whose parents were smokers, of low SES, less educated, or held less negative attitudes towards SHS were at an increased risk of SHS exposure in the home, with the largest risks observed for children living in households with smokers. With the exception of parental education, the factors associated with young infant's SHS exposure in this study are similar to those among older children. The findings also show similarities to the current limited evidence base examining this in infants aged <2 years elsewhere. In the USA for example, having more children in the household, being of white ethnicity, low maternal education, low maternal age, being unmarried, lower income and markers of disadvantage during pregnancy were associated with infant SHS exposure.[22 23] Despite these similarities, it is important to continue to explore SHS exposure among young infants, and the factors associated with exposure, independently from older children. Young infants in this study are less likely to be exposed to SHS in the home than older children; this study was only able to examine a small number of potentially associated factors, and wider exploration of other factors may highlight important differences between the characteristics of parents and families who have smoke free-homes immediately after childbirth, but not later on in childhood. Understanding more about these factors would help to identify families where early intervention may prevent future SHS exposure as their young infant grows older.

4.4.3 Implications

Whilst the demographic characteristics associated with smoking in the home after childbirth are not easily modifiable,[168] they may help to inform which infants, parents or families are best targeted in future interventions. The findings highlight that the best way to prevent or reduce smoking in the home immediately after childbirth is to help smoking mothers to quit and stay quit; more research is needed to identify interventions that support women at this important time. Where women are unable or unwilling to quit smoking, making their home smoke-free is the next most effective way to protect their children.[60] This study, consistent with research in older children,[211] shows that less negative attitudes towards SHS exposure is associated with smoking in the home after childbirth. Interventions targeting attitudes towards SHS by supporting parents to recognise the benefits of protecting children from SHS may therefore be useful to promote SFHs.

4.4.4 Conclusions

The prevalence of smoking in homes where young infants live was lower than has been reported in older children (>3 months), suggesting that the early postpartum period may be an opportune time to intervene to prevent future SHS exposure in the home. The factors associated with smoking in the home immediately following childbirth were similar to those previously reported among older children. Interventions to support smoking mothers and wider household members to quit, or to help them restrict smoking in the home, should target attitudinal change, and address inequality relating to social disadvantage, younger age or non-white ethnic groups.

CHAPTER 5 EXPERIENCES AND BELIEFS OF WOMEN WHO STOPPED SMOKING IN PREGNANCY BUT RETURNED TO SMOKING POSTPARTUM: A QUALITATIVE EXPLORATION

5.1 BACKGROUND

As discussed in Chapter 1, over half (54%) of women manage to quit smoking before or during their pregnancy; however, a reported 70% of these women return to smoking in the first 6 months postpartum.[120 121 220] Return to smoking rates are particularly high in the initial postpartum period, with just under 50% of pregnancy quitters returning to smoking within the first 6 weeks after giving birth.[220] This accounts for 66% of all pregnancy quitters who will return to smoking. As described previously in Chapter 1, maternal smoking is one of the primary sources of child secondhand smoke (SHS) in the home,[13] and consequently postpartum return to smoking has important implications for infant and child SHS exposure. In this chapter, the term 'baby' encompasses newborns, infants and young children (<24 months). This reflects both the terminology most frequently used in mothers' narratives, and the transition between the prenatal and postpartum periods that are explored in this study.

Postpartum return to smoking has been found to be associated with low socioeconomic (SES) groups,[220 221] being single,[221] higher parity,[220 221] not breastfeeding,[220 221] stress,[123] and intending to quit only for pregnancy.[123] The presence of other smokers in the household,[123 220 221] and in particular living in a home where smoking is permitted indoors[123 124] are also important risk factors for postpartum return to smoking. Furthermore, the study described in Chapter 4 found that mothers who were currently smoking were more likely to report that smoking occurred in their home. Consequently, babies of women who return to smoking postpartum may be at a further increased risk of SHS exposure as their homes may not be smoke-free.

Although smoking in the home and postpartum return to smoking are linked, little is currently known about why women who have managed to stop smoking during pregnancy may start again, and what their home smoking behaviours are following their return to smoking. Understanding more about this is important, as women who manage to quit smoking for at least part of their pregnancy are a potentially motivated group who may be more receptive to making behaviour changes to protect their baby from SHS exposure.[117 119 122] Women who abstained from smoking during pregnancy were motivated and able to engage in positive behaviour changes to protect their baby from smoke exposure in utero, with concern for baby's health and not wanting to be a smoking role model for their children being key motivations for stopping during pregnancy.[122] Furthermore, pregnancy and parenthood have been identified as key 'teachable moments', defined as naturally occurring life transitions in which individuals are more likely to be successful in positive health behaviour changes.[101 222] The early postpartum period may therefore be an ideal time to intervene to reduce or prevent SHS exposure in the home by harnessing these mothers' intrinsic motivation. However, the development of effective targeted interventions requires an understanding of why, how and when people behave the way that they do. Not enough is known about the home smoking behaviours, thoughts and beliefs of these women. This study therefore explored why women who stopped smoking in pregnancy re-started again afterwards, with a particular focus on how this affected their home smoking behaviours.

5.2 AIMS

In a group of women whose babies are currently less than 24 months of age, and who quit smoking during pregnancy but have returned to smoking in the 3 months after the birth of their baby:

1. To explore smoking experiences and behaviours in pregnancy and after childbirth
2. To explore attitudes and beliefs of women around their smoking and smoking in the home.

This exploration was undertaken to try to understand reasons for return to smoking and home smoking behaviours after pregnancy.

5.3 METHODS

5.3.1 Qualitative methodology

This research was conducted using the principles of interpretative phenomenological analysis (IPA), as described by Smith et al.[223] Interpretative phenomenological analysis is an inductive approach that aims to explore how participants interpret and make sense of their world, and formulate their own biographical stories.[223-226] Phenomenology is a key theoretical underpinning of IPA, defined as the study of the lived experience, and is concerned not only with the experience itself, but also with how the individual experiences it.[223] The focus of IPA research is therefore the study of the subjective lived experience rather than the objective.[223-225] The second key theoretical underpinning of IPA research is hermeneutics, which is the theory of interpretation.[223] Heidegger's concept of 'fore-conception', in which the individual brings their prior experiences or assumptions to their interpretation of new experiences, is an important aspect of IPA.[223] The researcher engages in a ‘double hermeneutic’, using their own conceptions to make sense of the participants’ personal world,[223 225] with the researcher’s reflection on their role as interpreter and collaborator a key part of the process.[226] Reflexive practice should be ongoing throughout the data collection and analysis, whereby the researcher employs “immediate, dynamic, and continuing self-awareness” (Finlay, p ix).[227]

In this study, it was important to understand smoking behaviour from women’s perspectives; as demonstrated in Chapter 1, SHS exposure in infants and children is a sensitive, complex and changeable issue. Mother’s experiences of smoking are likely to be unique to the individual. Interpretative phenomenological analysis methods were considered appropriate as the focus of the study was to explore the subjective experiences of smoking in the home after childbirth among a homogenous group of women. Whilst each individual’s experience of smoking will be unique, homogeneity in this group of women was observed in their patterns of smoking cessation and return to smoking across pregnancy and the postpartum period. The methods of IPA were considered likely to allow for the exploration and interpretation of women’s subjective experiences beyond standard thematic analysis,[223] providing detailed and individualised accounts to contribute to our understanding of SHS exposure in infancy. Furthermore, the inductive nature of IPA will allow for the emergence of unanticipated themes, enabling a more thorough exploration of individual’s experiences that is not restricted to existing knowledge.[223]

Interpretative phenomenological analysis is an idiographic approach in that it focuses on individual, detailed examinations of particular cases or experiences.[223] Idiographic research is usually carried out on small sample sizes to allow for greater detail in the analysis whilst recognising the limits this imposes on the generalizability of findings.[223] For many women their home smoking behaviour may be at odds with their protective and responsible role as a caregiver,[228] and consequently they may struggle to express or fully disclose their thoughts and beliefs. Due to the potentially sensitive nature of being a smoking mother, it was considered that conducting individual interviews would enable participants to give more accurate and honest accounts of their experiences without fear of judgement or disapproval which can be associated with group data collection methods.[229 230] Brocki and Wearden[224] report in their review of studies using IPA methods that participant numbers varied from one to 30; however, Smith et al.[223] recommend three to six participants as a general guide to enable sufficient depth in each interview.

An interpretative phenomenological approach was chosen over other inductive approaches, such as grounded theory, for its focus on interpretation of participant's experiences rather theory development.[231] Thematic analysis, defined by Braun and Clarke[232] as "a method for identifying, analysing and reporting patterns within data" (p. 79), is distinct from IPA in that it is not tied to any particular theoretical framework.[232] Whilst this offers flexibility in the approach that the researcher takes, this can be considered a disadvantage as the range of factors that the researcher can choose to focus on within their data is broad, meaning that the researcher can lose sight of their original question.[232] Furthermore, thematic analysis has limited interpretative power beyond description if it is not used alongside the broader theoretical assumptions, such as those prescribed for IPA.[232]

5.3.2 Ethical approval

The study received a favourable opinion by Derbyshire Research Ethics Proportionate Review Sub-Committee (reference number 11/EM/0078).

5.3.3 Recruitment

Women were recruited from the Pregnancy Lifestyle (PLS) cohort described in Chapter 3.[192] Prior to invitation, all women had provided consent to be contacted by researchers at the University of Nottingham for future relevant research at the time of consent to participate in the PLS cohort. Recruitment for this study was led and conducted by SO. Mothers were excluded from participation if they reported themselves to be currently pregnant. According to guidelines discussed above, a sample size of up to 10 participants was identified as appropriate; however, this remained flexible to the point where analytical saturation was reached. Due to a low response rate to invitations for interview, four recruitment waves were conducted. A flow diagram of the recruitment procedure and eligibility criteria at each wave can be seen in Figure 5-1; a common feature of all mothers recruited was that they had reported having stopped smoking for at least some of their pregnancy but were smoking again at 3 months post-delivery. The changes in inclusion criteria between each recruitment wave are highlighted in bold (Figure 5-1).

During these recruitment waves, mothers were invited to participate by post (see Appendix 7.3.1), and where necessary contacted by telephone or text message thereafter. Invitation letters provided mothers with details of how they could get in contact if they were interested in participating, including a stamped addressed envelope and response form, a phone number, email address and a phone number they could send a text message to. Mothers were also sent a participant information sheet (see Appendix 7.3.2) to enable them to make an informed decision about participation. Mothers were sent up to two postal invite letters, and contacted up to three times by telephone if there was no response. As can be seen in Figure 5-1, in total, 46 participants were invited to interview across these four recruitment waves, with nine participants consenting to take part in the study.

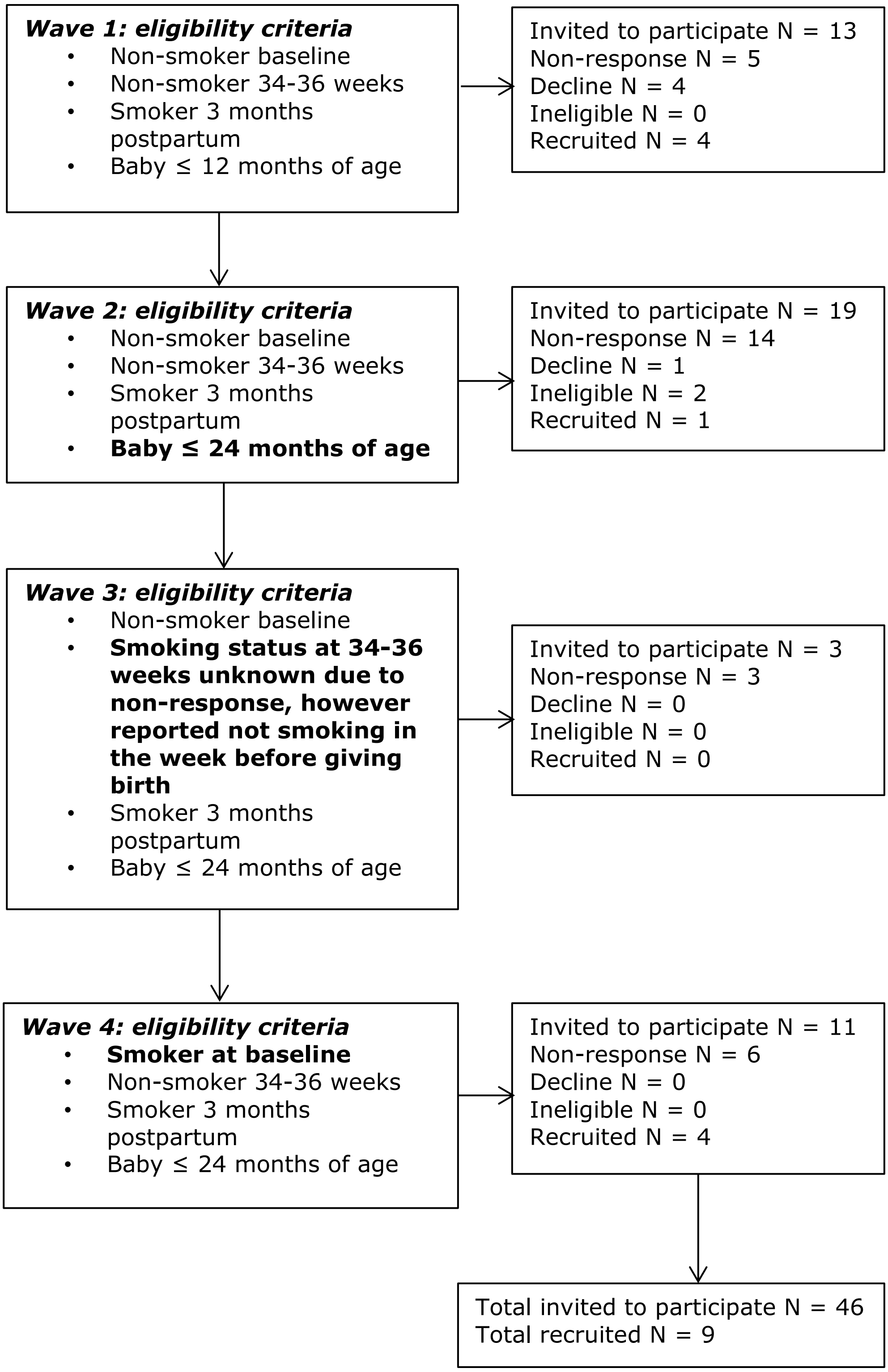

Figure 5-1 Recruitment waves and response rates to the qualitative individual interviews

5.4 DATA COLLECTION METHODS

Written informed consent was obtained before starting the interview (Appendix 7.3.3). Interviews were carried out by SO in participants' homes, allowing the researcher to gain a greater understanding of their home environment, and lasted on average 40 minutes (range 10-60 minutes). All interviews were audio recorded and transcribed clean verbatim by an independent transcription company. At the end of the interview, participants were offered an inconvenience allowance of a £20 high street shopping voucher as compensation for the time taken.

Demographic details (marital status, partner smoking status, employment and occupation of main household income earner if applicable) were collected following the interview via a short survey (Appendix 7.3.5), and from women's baseline PLS survey responses (age at pregnancy and education).

5.4.1 Interview schedule development and piloting

The interview schedule was developed using existing literature, and then refined using the experience of, and discussion within, the university supervision team. A copy of the interview schedule can be found in Appendix 7.3.4. The interview schedule covered mother's experiences of smoking during pregnancy, smoking return, smoking in their home and their attitudes towards child and infant SHS exposure. The involvement of service users and members of the general public is central to health services research.[233] The interview schedule was therefore reviewed and piloted by a member of the general public who was a current smoker and had smoked during two previous pregnancies. Feedback was given on appropriateness and ease of understanding of written materials (including invitation letters, participant information sheet, consent forms), and the content, style and wording of the interview schedule, and changes were reviewed and made where necessary.

The schedule was designed to be semi-structured, as recommended by Smith and Osborne, to give opportunity to explore areas of interest and flexibility in the ordering of topics discussed.[225] 'Funnelling', a technique described by Smith and Osborne[225] whereby general questions are followed by more targeted questions, was used to elicit responses from participants on more specific topics of interest. Using this method, general exploratory questions were asked first, and more specific prompts used later if particular topics had not been spontaneously raised by participants. The schedule remained flexible; preliminary analysis ran in parallel to data collection, enabling the schedule to be developed iteratively as more interviews were conducted and new topics identified and interpreted.

5.5 ANALYSIS

In line with the guidance for IPA research,[225] a three-step approach was taken to analysis. Firstly, each verbatim transcript was read and re-read until the researcher was familiar with the accounts. During these initial readings, comments, associations, observations, interpretations and finally preliminary themes were noted. In the second step, connections between these preliminary themes were examined; these were then clustered and a coherent list of subordinate and superordinate themes was drawn. In the final step, the process was repeated across all transcripts in the study. A consolidated master list of themes was constructed based upon prevalence within the data and the richness of the examples. These were re-examined against the transcripts to ensure that the themes were present and representative of the original data. The analytical process was cyclical, in that themes were continually checked against the data to ensure accurate interpretation of the text, as were new themes that emerged from later transcripts.

The analysis was primarily conducted by SO as the lead researcher, and LLJ (university supervisor). Interpreted themes were also discussed within the wider supervisory team to ensure clarity, plausibility and appropriate interpretation of the data. As advised by Smith et al.[225], analysis continued throughout the write up.

5.6 REFLEXIVITY

In accordance with core principles of IPA described above, whereby the researcher's reflection on their role as interpreter and collaborator is a key part of the research process,[226] reflexivity was undertaken throughout. My characteristics as an individual and as a researcher inevitably shaped the direction that the research process took and my interpretation of the data collected.[234] Gilgun[235] recommends that researchers aiming to be reflexive in their practices need to have an awareness of the following areas:

- "Account for the personal and professional meanings the topics have for them"
- "The perspectives and experiences of the persons with whom they wish to do research"

- “The audiences to whom the research findings will be directed” ([34 p17])

Following Gilgun’s guidelines, reflexive notes were made following each interview and a reflexive journal was kept throughout data collection and analysis. Relevant reflections believed to enhance understanding of the research process, findings or interpretations are discussed below.[235]

I am female, and at the time of conducting the interviews I was 28 years of age. I am white British, well educated, have never been a smoker and do not have any children. Very few people in my social circle, and no-one in my immediate family or close friends, are smokers. In my personal life, I do not know any parents of young children who are smokers. I feel that these personal characteristics and my background were influential in my initial stereotypical opinions towards smoking in pregnancy that were shared by many of my peers; I felt strongly that women should prioritise the health of their baby by quitting smoking, and sometimes passed negative judgements about women who I saw smoking during pregnancy. Probably due to my own level of education, I found it difficult to empathise with women who contested scientific evidence and did not believe their smoking to be harmful to their baby.

Prior to undertaking my PhD, I spent around 12 months working in the smoking in pregnancy research field, which I have continued to be involved in whilst studying. I had considerable contact with pregnant smokers throughout recruitment and data collection of the PLS cohort, an experience which was invaluable in gaining insight into some of the experiences, attitudes or opinions of this group of women. This, coupled with my extensive reading of literature within the smoking in pregnancy area, prompted me to question my previously held opinions towards smoking in pregnancy. I came to understand the complex difficulties that this group of women faced, and in turn became more sympathetic to their position. Since working in this research field, I have often found myself defending the behaviour of women who either choose not to, or who are unable to, quit smoking during pregnancy in conversations with my peers, who often hold stereotypical negative attitudes.

Personal differences between myself and my participants, most notably being a non-smoker and not having children, may have limited my understanding of certain aspects of participant's subjective accounts.[234] Not sharing the characteristics or experiences of my participant group positions me as an 'outsider-researcher'.[236] There are advantages and disadvantages to 'insider' and 'outsider' research; 'insider-researchers' may find participants more willing to share their experiences due to perceived similarity; however, this can also inhibit the research process as participants may fail to explain fully their experiences through assumed understanding.[236] In the context of this study, being an 'outsider-researcher' may have influenced the interviews in both positive and negative ways. The social stigma that may be felt by parents who smoke[105 118 237] may have caused some women in this study to approach the interview defensively, withhold some information, or tell me what they believed I wanted to hear. An assumption may have been made by participants that as a non-smoker (although this information was not disclosed in every interview and only when directly questioned) and a researcher in the field of smoking that I may be disapproving of their smoking, particularly during pregnancy. Conversely, as discussed above, my previous research experience has given me a more sympathetic standpoint towards women who smoke in pregnancy and parents who smoke, although this may not have been perceived by interviewees. My awareness of the complex personal and social reasons why mothers may struggle, or choose not to quit smoking enabled me to approach interviews and analysis from a non-judgemental perspective that may have been more difficult to achieve without my background knowledge.

I found the experience of conducting the interviews a somewhat challenging process; many mothers appeared to perceive a power differential between interviewer and interviewee, which continued despite my striving to address this with a non-judgemental approach. I found it difficult to convey my personal standpoint on the subject in a way that would override any pre-conceived negative attitudes that many mothers may have been expecting. However, this was not always the case; there were other instances during interviews where my position as an outsider researcher appeared to be beneficial. For example, one mother interviewed had managed to quit smoking postpartum using e-cigarettes. At the time of interview, e-cigarettes were an emerging development in the field of tobacco control. This participant was able to take on the role of the 'expert', and willingly explained in detail her experiences of e-cigarettes to myself, a 'novice'. This in turn facilitated a more open dialogue about her experiences of smoking and her children's SHS exposure, which may have been more guarded had we not been able to reverse the power differential of the interview.

My previous experience, that of my supervisory team, and the background literature guided the development of the interview schedule and the prompts I used during interview. For example, the interviews started by asking women about their experiences of smoking during pregnancy, which may have been influenced by my supervisory team's and my own background in the smoking in pregnancy research field and my interest in this area. This may have meant that for some women the structure of the interview and the flow of topics did not reflect those that were of most importance, or more poignant to them within their own experiences. It may have been helpful to allow greater flexibility in the ordering of topics to facilitate a more narrative approach to the interviews.

In order to identify participants who were eligible to be invited to take part in this study and as preparation for each interview, I examined women's previous responses to the PLS questionnaires. I therefore entered into interviews with some prior knowledge of women's prospective reports of their smoking behaviours during pregnancy, and was perhaps more attuned to any discrepancies that may have arisen in their accounts Furthermore, as face-to-face interviews were conducted in women's homes, I was able to form my own interpretations, and potentially subjective judgements, of whether smoking did occur indoors based upon the smell of cigarette smoke or visibility of smoking related paraphernalia in the home. Attempting to explore individual experiences in such situations is challenging. Discrepancies in the women's narratives were not directly questioned to enable women to give their accounts of their experiences in their own words, and to maintain an open interviewer-participant discourse. My interpretations may however have influenced the direction of the interview, for example revisiting certain topics to give participants the opportunity to expand upon or disclose further details about their experiences. This was a difficult line to tread; I sometimes found that revisiting topics previously discussed caused some frustration with mothers who may have felt the reliability of their responses were being questioned. This was uncomfortable for myself as the interviewer, and I would often probe participant's responses less than I would have liked in an attempt to maintain an open dialogue. Instances where I felt participants may not have disclosed their true home-smoking behaviours were rare; there were only two homes in which I was unsure about the true extent of smoking restrictions that were described to me. These circumstances were taken into consideration during my interpretation, with reflection on why these women may have felt unable to reveal their true experiences. These situations also led me to feel less convinced about other aspects of these mother's accounts, for example, questioning their reports of their current smoking behaviour.

My personal characteristics and position as an 'outsider-researcher' were influential throughout the analysis process; the assumptions I made and my subsequent interpretation of interviewee's accounts may be different to those made by either an 'insider-researcher', or someone who does not have background knowledge about smoking in pregnancy or child SHS exposure. For example, there is potential that I may have made certain interpretations of women's accounts of their return to smoking based on my knowledge of research in this area, which may be different to those made by an 'insider-researcher' who may have personal experience of smoking cessation and/or parenting. I do not have personal experience of addiction, and therefore may have simplified or objectified the experience of quitting and returning to smoking.

5.7 RESULTS

Nine semi-structured interviews were conducted between 16th January and 17th March 2014.

5.7.1 Participant characteristics

Participant characteristics can be seen in Table 5-1. The average age of the mothers at the time of entry into the PLS cohort was 28.3 years (range 20-40 years), and the youngest infant or child in the household at the time of the interview was on average 12.2 months (range 6-22 months). Only one interviewee reported currently smoking inside the home; another reported using electronic cigarettes (e-cigarettes) inside the home and the remaining seven reported smoking outside of the home with external doors shut. Eight of the interviewees were current smokers, and one had returned to smoking after giving birth but had since quit again using e-cigarettes. Six of the participants were in relationships with partners who smoked cigarettes at the time of interview.

Table 5-1 Characteristics of participants interviewed

Participant	Smoking during pregnancy	Current smoking status at time of interview	Mother's age at time of interview	Where home smoking took place	Employment	Mother's report of partner's smoking status	Child/family characteristics	Age of youngest child at time of interview
1	Quit for duration of pregnancy	Occasional smoker	26	Outside home	Employed	Smoker, separated	1 child; baby from PLS	6 months
2	Quit for duration of pregnancy	Daily smoker	30	Inside home, kitchen	Unemployed	No partner	4 children; baby from PLS and 3 older siblings	11 months
3	Quit for duration of pregnancy	Occasional smoker	23	Outside	Employed	Smoker	1 child; baby from PLS	11 months
4	Quit for duration of pregnancy	Regular smoker (smoked most days)	20	Outside	Unemployed	Smoker	1 child; baby from PLS	7 months
5	Returned to smoking during pregnancy	Daily smoker	24	Outside	Maternity leave	Smoker	5 children; 2 babies from PLS (twins), 1 older sibling, 2 younger siblings (twins)	7 months
6	Quit for duration of pregnancy	Occasional smoker	36	Outside	Employed	Smoker	1 child; baby from PLS	22 months
7	Returned to smoking during pregnancy	Daily smoker	30	Outside	Employed	Smoker	1 child; baby from PLS	17 months
8	Returned to smoking during pregnancy	Regular smoker (smoked most days)	40	Outside	Employed	Smoker	2 children; baby from PLS and 1 older sibling	15 months
9	Quit in final 2-3 months of pregnancy	Ex-smoker, currently only using e-cigarettes	26	Previously smoked inside in kitchen. Currently using e-cigarettes throughout house	Employed	Ex-smoker, currently only using e-cigarettes	2 children; baby from PLS and 1 older sibling	14 months

5.7.2 Overview of findings

Mothers gave accounts of their smoking behaviour in pregnancy, and described how this changed as they progressed into the postpartum period. All of the mothers described their initial intentions in early pregnancy to quit smoking, and, for many, to stay abstinent permanently after the birth of their baby. Mothers' smoking intentions spanned across pregnancy and the postpartum period; however, it appears that these were adjusted over time reflecting the transient nature of their smoking behaviours. Central to mothers' smoking intentions was the desire to be a 'responsible mother', and mothers sought to reposition the type of smoker they were after having returned to smoking, to fit in with their perception of this ideal (Figure 5-2).

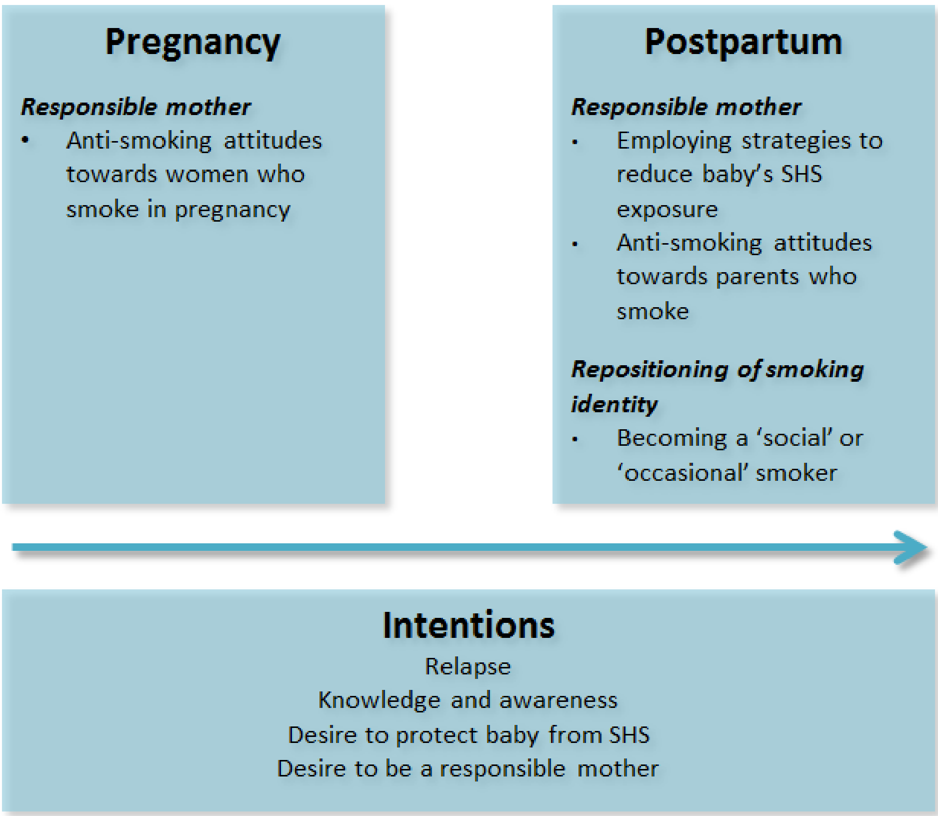

Figure 5-2 Schematic representation of interpreted themes during qualitative analysis

5.7.3 Pregnancy

5.7.3.1 Responsible mother

Being a 'responsible mother' appeared to be important in women's accounts of smoking in pregnancy, with protecting the health of their baby cited as a primary motivation for quitting. Mothers had some awareness that smoking posed a risk to their baby during pregnancy, and used this knowledge to help inform their decision to quit:

> *"I didn't want to cause her [baby] any harm. I know the risk of smoking and I know obviously it can harm your baby. I'd wanted her for a long time, she was planned and I really wanted her so I wanted to make sure that obviously I gave her the best start." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

Mothers who had not been able to maintain abstinence during pregnancy described smoking in a way that managed potential risks to their baby within a level that they personally found acceptable, for example, by only smoking half a cigarette or not smoking every day. These risk reduction strategies were a compromise which enabled them to reconcile their current smoking, or their cravings, with their intentions to be a responsible mother by quitting:

> *"I decided to quit smoking and then I kind of I did cut down, I didn't smoke that much anyway in the first place, but I did really cut down. I think I stopped for a couple of months and then I'd have kind of the odd one." (Participant 5, returned to smoking during pregnancy, daily smoker, smoke-free home)*

The quote below demonstrates that the desire to be perceived by others as a responsible mother was also important. Some mothers wanted to be responsible but did not necessarily want to quit; however, they felt pressured by others to do so:

> *"I used to do it [smoke] behind his [her partner's] back sometimes! Which is wrong really because it's only me that's the bad one because I'm the one that's carrying, you know, throughout the pregnancy sort of thing, so I'm only sort of, like, lying to myself really rather than lying to other people 'oh no I've completely packed up' but I hadn't, you know, I was having the odd one … I did feel bad but, you know, he's [baby] turned out OK." (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)*

5.7.3.1.1 Anti-smoking attitudes towards women who smoke in pregnancy

Mothers held strong negative stereotypes about women who smoked during pregnancy:

> *"I see so many people come in [to her place of work] and they're heavily pregnant and would go out for cigarettes and I just think it is gross. [Laughter] I just think if you can't quit for your own children what can you do for them? If you can't quit for your unborn child – and plus if something was to happen to them you'd blame yourself wouldn't you – you'd feel guilty – yeah, I don't agree with it at all." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

Women reinforced their position of being a 'responsible mother' by drawing on examples of other, less responsible, mothers who smoked whilst pregnant, even though they may have been smoking themselves since their baby had arrived. In doing so, mothers were able to compare and evaluate their own smoking behaviour favourably to others:

> *"The girl [an acquaintance] I mentioned earlier who was smoking when she was pregnant and I found that quite disgusting and she still smokes now that she's had the baby, so she's not that bothered by smoking around her child, which I think is a bit disappointing, I mean, he [her acquaintance's baby] doesn't have a choice." (Participant 6, quit for duration of pregnancy, occasional smoker, smoke-free home)*

> *"My best friend … she smokes around her child – she smoked all the way through her pregnancy and she smokes around her son as well." (Participant 9, quit in final months of pregnancy, returned to smoking postpartum but recently quit smoking using e-cigarettes, previously smoked in the kitchen)*

These types of references to the 'worse' smoking behaviour of others, both in pregnancy and as smoking parents, were used throughout mothers' narratives. Mothers used these to position themselves in a more positive light compared to others to help maintain their desire to be perceived as a responsible parent.

5.7.4 Postpartum smoking

Differences were observed in mothers' smoking trajectories postpartum. Of the five mothers that quit for the duration of pregnancy, two returned to smoking within a couple of days of giving birth and tended to return to pre-pregnancy smoking levels or higher. Three mothers who quit for the duration of pregnancy returned to smoking between 2 and 6 months postpartum, often whilst out with friends or socialising, and tended to describe occasional or social smoking thereafter. Of the four mothers who had not quit for the duration of their pregnancy, two smoked within a couple of days of giving birth, and two mothers returned to smoking within 2 months of giving birth. These mothers tended to return to pre-pregnancy smoking levels. Despite these differing smoking trajectories, similarities were observed in how mothers repositioned their smoking status and identity as a smoker and a new mother.

Stress was a common theme in mother's narratives of returning to smoking, particularly for those who returned in the immediate postpartum period:

> *"I had her on the Wednesday and she became quite poorly and I didn't come out of hospital until the Sunday, and I was that upset in the hospital, I think I had one on the Saturday. I actually went outside the smoking centre entrance, which is disgusting, isn't it? And I felt really, really bad, 'cause my ankles were as big as anything, I still had my jelly belly, and then, like, to me, people probably looked – I was still pregnant. Do you know what I mean? Which I didn't like. But that was, again, because I couldn't cope with the stress of her*

not being very well." (Participant 7, returned to smoking during pregnancy, daily smoker, smoke-free home)

For those mothers who returned to smoking later in the postpartum period, being in a social situation with other smokers, or when drinking alcohol, was commonly discussed as a trigger for returning to smoking:

"I didn't want to start back up [smoking] but then I think he [her baby] was about 3 months old and I was able to go out and then just had the odd one [drink] and then started again." (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)

Some mothers attributed their return to smoking to habit, rather than addiction:

"It [returning to smoking] was habit, habit. Because I'm not addicted to smoking, I was never addicted to it." (Participant 1, quit for duration of pregnancy, occasional smoker, smoke-free home)

Postpartum, mothers described feeling *'differently'* (Participant 5) about smoking, with a subsequent change in risk perceptions. They were less concerned about the health implications for their baby as there was no risk of exposure in-utero:

"After you've given birth then it's, I kind of felt a bit differently about it [smoking] because then it wasn't you know, affecting them [the babies]." (Participant 5, returned

to smoking during pregnancy, daily smoker, smoke-free home)

5.7.4.1 Responsible mother

Similar to the prenatal period, being a 'responsible mother' was a prominent theme dominating mothers' accounts of their baby's SHS exposure in the postpartum period. Some mothers approached this idea when talking about how they had returned to smoking after giving birth:

> *"When you become a mum you feel like you should be a lot more grown up…not just do it because everyone else is doing [it], not just because I was drunk – but I thought 'she's [baby] not even with me, I'm having my first night away' so I was enjoying myself and it's not like I'd come home – she'd come home to me tomorrow and I will [not] still be stinking of them because obviously I would have got a shower and everything by then." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

Knowledge about specific health risks associated with infant SHS exposure was limited. There was some evidence that women were unsure about the level of risk and looked to their social and peer networks to help rationalise or explore knowledge. Similar to smoking in pregnancy, despite being unsure about the risks, a mother's main motivation was to protect their baby. Mothers' concern that SHS exposure could have negative health consequences for their baby was influential in steps that were taken to prevent exposure:

> *"I just go by what people say. A lot of people do say that it's worse. I'm not sure how it is, but a lot of people do say that*

secondhand smoke is worse and I don't like it anyway – I don't like anyone smoking around her. I just think she doesn't need to be breathing that in … it's no good for her." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)

5.7.4.1.1 Strategies to reduce baby's SHS exposure

Mothers described strategies employed to prevent or minimise SHS exposure for their baby in the postpartum period. Eight of the mothers described how their home was now smoke-free, with smoking taking place exclusively outside with the door shut:

> *"Before obviously I was pregnant you just smoke in the front room sort of thing and then when other people used to visit it's outside now, you know, from when I was pregnant because I said to my partner at the time 'you've got to get used to going outside when [baby's] born' sort of thing so, you know, it's a no smoking house now." (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)*

Pregnancy and parenthood were clearly an important life transition which precipitated attempts to make positive changes to mothers' smoking;[101 222] whilst unsuccessful in remaining abstinent postpartum, the majority of mothers described their success in maintaining other positive changes in home smoking behaviours. Just one participant described currently smoking inside her home:

> *"I just smoke in the kitchen with the back door open. That's it – I don't smoke in any bedrooms or I don't smoke in the living room – it's just purely in the kitchen. Not while any of the kids are in there – just me on my own." (Participant 2, quit for duration of pregnancy, daily smoker, smoked in the home)*

For this participant, the birth of her youngest child had caused her to change her home smoking behaviour; having previously smoked in the garden she now described smoking in the home. This participant's description of her smoking in the home highlighted the barriers she experienced to smoking outside. For her, smoking in the kitchen was a compromise that allowed her to balance the safeguarding of her children whilst employing strategies (e.g. opening an external door) that she believed protected them from SHS exposure, or reduced exposure to within an acceptable level. This is linked to the theme 'responsible mother' as this participant describes doing the best she can to protect her children from SHS exposure given her circumstances as a single parent.

A common strategy described by mothers to prevent exposing their baby to SHS was placing a time restriction between smoking and picking up their baby. This appeared to be pertinent for many of the interviewees, and for some enabled them to reduce the amount they smoked when they had childcare responsibilities:

> *"I can remember, like, reading stuff saying that if you've had a cigarette you're not allowed to go near them [baby] for half an hour and you're not allowed to do this; you're not allowed*

to do that, and I'm thinking, 'God, if I have a cigarette, I can't even go and sit with her.' So that stopped me a lot." (Participant 7, returned to smoking during pregnancy, daily smoker, smoke-free home)

A final strategy described by mothers was acting as an advocate by protecting their baby from exposure to SHS from other people's smoking. This was often described in one of two ways: either negotiations with others about their smoking behaviour, such as friends or family members, or through avoidance of situations in which they described a lack of agency to control others' smoking, such as avoiding taking their baby to the homes of friends or family who smoked indoors:

> *"I just said to everyone 'you start washing your hands' I've got a bottle of hand gel on the side of the back door and they have to use that. And I told them straight 'you've got to smoke outside' and I also told them that when we go to their house they need to smoke outside as well.' (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

> *"We've not spoken to this 'friend' [who smoked in her own home] since she's [baby] been born … she [her friend] keeps asking us to go round there, and we've said maybe, 'cause we don't want her [baby] to be in the smoke, whereas she don't want to come round here 'cause she don't want to go outside for a cigarette. So that friendship's died." (Participant 7, returned to smoking during pregnancy, daily smoker, smoke-free home)*

Mothers used these strategies as a way to moderate the gap they experienced between their smoking intentions and their smoking behaviours postpartum. The mothers in this sample had not been able to achieve their intention of being a non-smoker after having their baby; employing these strategies enabled mothers to conform to their perception of a responsible mother through protecting their baby from SHS exposure, or reducing exposure to within a level that they found acceptable.

5.7.4.1.2 Anti-smoking attitudes towards parents who smoke

As with the strong anti-smoking attitudes towards women who smoke during pregnancy identified above, negative opinions towards smokers, in particular smoking parents emerged during mothers' later descriptions of their views about infant and child SHS exposure. Mothers gave unfavourable examples and negative stereotyping of other smoking parents. However, these negative opinions were predominantly directed towards parents who smoked in the presence of their children; it was interpreted that a distinction was drawn between being a parent who smoked, and being a parent who exposed their children to SHS, with the latter being considered irresponsible:

> *"His [the baby's father] sister and husband, they smoke around the children and she's just had a baby and I think it's disgusting… I really don't like it. It makes me feel sick when I think of them smoking around their children and a newborn baby, smoking in the car non-stop, it just makes me feel so bad." (Participant 1, quit for duration of pregnancy, occasional smoker, smoke-free home)*

However, holding strong anti-smoking opinions towards parents who exposed their children to SHS was for some mothers in contradiction to their own smoking behaviour. Participant 2 for example, who smoked in the kitchen in her home, described her shame at smoking, and her disgust at parents who smoked:

> *"It's disgusting. I'm quite ashamed that I do smoke. I look at other people that walk along doing that or walk along with their toddlers and they start smoking and it looks absolutely disgusting and how they can breathe it all over their kids is just beyond me. And regardless of that even if I go out on my own if I've got a baby sitter I still wouldn't smoke on the streets, I just don't like it." (Participant 2, quit for duration of pregnancy, daily smoker, smoked in the home)*

In her account above, she seems aware of the negative stereotype held towards parents who smoke, and describes avoiding smoking in public in an attempt to distance herself from this stereotype. Despite describing her own shame, she fails to acknowledge similarities between the behaviour of other smoking parents and her own home smoking behaviour.

5.7.4.2 Repositioning smoking identity

Since returning to smoking either during pregnancy or following the birth of their baby, many mothers repositioned their smoking behaviour and adopted a new identity of a 'social' or 'occasional' smoker, compared to the 'regular' smoker they perceived themselves to be before pregnancy. Mothers in this study drew comparisons between their smoking prior to pregnancy and postpartum to emphasize the change, illustrating that their own perception of their smoking had fundamentally changed since having their baby:

> *"I was a full time proper smoker – like at work I'd go out for cigarette breaks and yeah – wake up in the morning – but now yes – and to go for none – but then I don't ever fancy one, my boyfriend goes out for one and I don't ever – I smell it on him but I don't think 'oh, I want one'." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

> *"I can go days with not having one and it's only if I go out, you know, to socialise sort of thing that I decide to have one." (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)*

For mothers in this sample, smoking was considered to be on a continuum, whereby occasional smoking was both distinct from, and more acceptable than being a regular *'proper'* smoker. What was important for mothers in this sample was that they employed strategies to protect their baby from SHS exposure, and it was this which differentiated them from other smoking parents, or from the negative social stereotype of parents who smoke.

5.7.5 Intentions

Mother's smoking intentions appeared to be important in both the prenatal and postpartum period. All mothers described their intention to quit at least for the duration of their pregnancy, with those who returned to smoking before giving birth making further quit attempts as their pregnancy progressed:

> *"I was about 5 or 6 months when I would have the odd one [cigarette] and then when I got towards the end I was like oh no, you know, better stop this, but I shouldn't have started it anyway, you know." (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)*

The majority of mothers described their intentions to quit smoking not only for the duration of their pregnancy, but also permanently:

> *"I thought what's the point of going 9 months – or 8 months not having one and then starting again afterwards – that's just pointless." (Participant 3, quit for duration of pregnancy, occasional smoker, smoke-free home)*

This intention was influenced by several perceived factors, including knowledge or awareness of the risks associated with smoking and SHS; their desire to be a responsible mother; their desire to be perceived by others to be a responsible mother, and internalised negative attitudes towards women who smoked during pregnancy or parents who smoked around their children. However, all interviewees in this study had returned to smoking by 3 months after the birth of their baby, with mothers' intentions transitioning as a result of unsuccessfully staying quit. The strategies outlined above, such as placing restrictions on where and when they smoked in the home and repositioning their smoking identity, reflected mothers' new intentions to balance smoking with being a responsible mother. Whilst some mothers were satisfied with using these balancing strategies and had no further intentions to quit, others reiterated their intention to stop smoking permanently:

> *"So that is my plan, is to stop [smoking] again. I can do it, I've got the willpower, just need to stop going out basically!" (Participant 8, returned to smoking during pregnancy, regular smoker, smoke-free home)*

5.8 DISCUSSION

The results from this study suggest that the desire to be, and/or to be perceived to be, a 'responsible mother' were central to mothers' accounts of their smoking behaviours during pregnancy and the postpartum period. This was demonstrated in mothers' descriptions of the strategies they used to protect their baby from SHS exposure, and their strong anti-smoking attitudes towards other smoking parents despite being smokers themselves. A key novel finding from this study was that after returning to smoking, mothers appeared to reposition themselves as 'social' or 'occasional' smokers rather than 'regular' smokers as they described themselves prior to pregnancy to fit in with their ideal of being a responsible mother.

5.8.1 Strengths and limitations

The PLS cohort further provided a sampling framework from which to recruit women into a qualitative study exploring home smoking behaviours after pregnancy; the detailed information collected about participant's smoking behaviours was advantageous as it allowed a group of women with comparatively homogenous smoking patterns and behaviours across pregnancy and the postpartum period to be recruited. Furthermore, participant's prior involvement in the cohort and consent to be contacted about future relevant research aided recruitment in an otherwise potentially hard to reach target population.[238 239] Qualitative research carried out among a subsample of the PLS cohort will enable more effective triangulation of findings between the studies conducted within this thesis than if different samples had been used for quantitative and qualitative investigations. However, the PLS cohort recruitment ended in August 2012, and follow-ups in 2013. Recruitment for the qualitative study took place between August 2013 and March 2014, and consequently some participants had been initially recruited into the PLS over 3 years previously. For these women, at the time of contact being made, their infants were over 2 years of age and therefore no longer in early infancy as defined in Chapter 1. This limited the potential sample size from which to recruit.

A strength of this study was the utilisation of one-to-one interviews, which facilitated in-depth discussion of home smoking experiences, behaviours and beliefs among a target group of mothers. Furthermore, these interviews were conducted in mother's homes, which enabled the researcher to gain insight into the home environment and how this may contribute to their home smoking behaviours. However, a relatively small number of participants were interviewed, and sampling was carried out within a small cohort of mothers, which resulted in a convenience sample. Ideally, sampling would have continued until no new main themes were being interpreted within the data (analytic saturation); however, it was not possible to achieve this given the sampling constraints within the current study. There may also have been some selection bias within the sampling process as mothers who responded to invite letters may have had different characteristics compared to those who did not respond or declined to take part. These mothers had previously taken part in the PLS cohort, and so may be more motivated to participate in this research than the general public. This study however, did not aim for generalizability, rather a more detailed interpretative account from this specific target group. A further potential limitation, as highlighted previously, was my position as an 'outsider-researcher'. However, IPA methods allow for data to be interpreted with contextual and cultural awareness, with the researcher's reflection on their role as collaborator a key part of the process.[226] My role and personal characteristics have been reflected upon throughout the research process, enabling me to approach these from an *a priori* position in that these were identified and acknowledged prior to starting the research process.

5.8.2 Comparisons to previous literature

This is the first study, as far as the author is aware, which explores the experiences and beliefs of mothers who abstained from smoking for at least part of their pregnancy but subsequently returned to smoking in the early postpartum period. Irwin et al.[240] analysed interview data from a mixed sample of mothers who recently returned to smoking following pregnancy, and former smoking mothers whose children were aged 2-4 years.

The intention to be, or perceived by others to be, a 'responsible mother' dominated mothers' narratives in the current study. This may have been used as a response to a wider societal pressure on mothers to protect their infant or child from SHS exposure.[241] Coxhead and Rhodes[242] similarly found smoking mothers of slightly older children (≤3 years) with respiratory illness were keen to portray themselves as 'responsible smokers' and 'good mothers', using emotive narratives and describing self-imposed smoking restrictions to demonstrate their good moral character. A strategy used by mothers in this sample was to draw on examples of other mothers or parents who smoked, demonstrating strong anti-smoking attitudes, often in direct contradiction to their own smoking behaviours. Mothers held negative attitudes towards other smoking parents, viewing the smoking behaviours of these other parents as 'worse'. Previous research has shown that individuals frequently reference either identifiable or generalised 'others' as part of forming moral tales and narrating experiences.[243] Comparisons to 'others' have been observed among smoking parents of older children (aged 0-19 years, with at least one child in the household under five) to demonstrate who they identify themselves with, who they can make judgements of, and also to anticipate judgements of their own behaviour.[118 243] Irwin et al.,[240] whose study included some participants with similar characteristics to those in the current study, also found smoking mothers to hold strong anti-smoking attitudes. These were used to support their image of being a good mother, and, like the mothers in this sample, distance themselves from negative smoking stereotypes.[240] Mothers' anti-smoking attitudes are likely to be influenced by 'shared' or 'normative' morals,[118 244] which have been found to predict both intentions and behaviour.[244] Moral tales of what is acceptable parental smoking behaviour are informed by community endorsements of smoking practices, and through comparisons to the worse smoking of 'others' help defend mothers' own smoking behaviour.[118]

A traditional role for mothers is regarded to be safeguarding their families', and in particular, children's health.[245] Maternal smoking is in direct contradiction to this traditional role and therefore may lead to cognitive dissonance, defined as discomfort experienced when an individual holds contradictory beliefs.[246] Denial of information that contradicts currently held beliefs or behaviours can help reduce cognitive dissonance,[246] and has previously been observed among smoking parents. For example, Robinson and Kirkcaldy[105] found in their sample of smoking mothers from low SES groups of children aged under five, mothers were aware of the publicised short term health risks associated with SHS exposure in children; however, they did not accept this information passively. Instead, women drew on lay information such as observations of their own and other people's children, and reflections of their own health as children of smoking parents, and used these to create an alternative discourse to contest public health messages.[105] Mothers in this study, however, seemed to acknowledge the risks associated with babies' SHS exposure, perhaps because there was greater acceptance of the risks within their social and peer networks. Mothers therefore used other strategies to portray themselves as 'responsible mothers' despite their smoking behaviour.

As found in previous research among older children (0-19 with one child in the household under five;[118] under 3 years and hospitalised with respiratory illness[247]) of smoking parents, mothers in the current sample used harm reduction strategies to reduce or prevent SHS exposure for their baby. The most common of these was to make the home smoke-free, described by all but one in the current sample, suggesting that women who manage to stop smoking in pregnancy are likely to be receptive to smoke-free home (SFH) interventions. This is in contrast to previous research, where mothers who return to smoking postpartum were vigilant in reducing their baby's SHS exposure;[117 119] however, did not necessarily describe making their homes smoke-free.[61 119] Enforcing smoke-free rules often means negotiating with other smokers to implement restrictions, which can be challenging as it may be dependent upon equity in relationships with partners, family members or friends.[92-96 241] Similar to previous research, some mothers in this sample discussed a lack of agency, giving examples of sacrificing relationships where smoking restrictions could not be controlled in the homes of others. Some mothers in the current sample; however, were interpreted as having the agency to implement these restrictions in their own homes and the homes of others, such as family members, which may reflect greater community endorsement of protecting babies and infants from SHS exposure.

Previous research has also identified that some parents struggle to create smoke-free environments, as smoking outside of the home whilst leaving their child alone conflicts with their caregiving responsibilities or their perceptions of being a responsible mother.[94 95 97] Research has found that having infants or children aged under 4 years is significantly associated with not abstaining from smoking in rooms where children are present,[104] reflecting the difficulty that parents have in balancing the perceived risks of smoking outside when their children are younger and require greater supervision. Other environmental constraints, such as lack of outside space, and the desire to smoke in privacy and comfort that have been previously cited by parents as barriers to the creation and maintenance of SFH[94 96-98] were not discussed by mothers in this sample.

The repositioning of smoking identity in the postpartum period from being a 'regular smoker' to an 'occasional smoker' interpreted in this sample has not, to the author's knowledge, previously been observed. Other research has however found that self-identity as a smoker may be important. Recent ex-smokers have been found to perceive two distinct social groups, smokers and non-smokers; with recent ex-smokers quickly transitioning to the identity of non-smoker, perhaps due to their perceived social exclusion as a smoker.[248] A recent survey[249] of adults in California, USA, explored a new emerging category of smokers, labelled as 'non-identifying smokers', who report having smoked at least once in the previous 30 days but do not consider themselves to be a smoker. This group was estimated to comprise around 12.3% of all smokers in California. Non-identifying smokers were associated with having been a prior daily smoker, and having greater perceived control over their smoking behaviour. The authors argued that future tobacco control interventions should target this emerging smoking behaviour pattern, particularly within groups where smoking is stigmatised, and enforce the message that there is no safe level of smoking.[249] Robinson and Holdsworth[250] have previously discussed the limitations of the tendency to label adults as either 'smokers' or 'non-smokers'. These one-dimensional categories are argued to not fully encompass the complexity of smoking and how smoking fits into people's lives.[250] There was further evidence for this in Holdsworth and Robinson's[118] research which found smoking mothers were frustrated that healthcare professionals only made a distinction between smoking and non-smoking mothers, failing to acknowledge that they used strategies to protect their children from SHS exposure. In this sample, transitioning from a 'regular smoker' to an 'occasional smoker' helped mothers to distance themselves from the perceived negative stereotype of being a smoking parent, and identify with the more positive label of 'non-smoker'.

The tendency of mothers in this sample to distance themselves from smoking suggests that these women may be more receptive to messages around cessation or behaviour changes, such as implementing smoking restrictions in their homes, and maintaining these over the longer term. However, this also has implications for future interventions, which need to be designed to take mother's self-perceptions of their smoking into consideration.

5.8.3 Implications

The findings suggest that future interventions to prevent or reduce infant and child SHS exposure in the home should build on mothers' intentions to be a responsible parent. Anti-smoking attitudes and normative morals towards parents who smoke were influential in mothers' accounts of their smoking behaviour, and their perception of being a responsible mother. Interventions that focus on strengthening a community's normative morals to protect infants and young children from SHS exposure, for example, by increasing awareness about the dangers of exposing infants and children to SHS, are therefore also likely to be helpful. However, increased awareness of the risks does not necessarily lead to behaviour change.[251] Strong legislation to protect public spaces and communities from SHS may help to change social norms so that protecting children from SHS becomes embedded and accepted at the household and individual level. Strong normative morals within a community to protect infants and children from SHS may also increase mothers' agency to prevent their baby from other people's smoking. Whilst changing a community's normative beliefs is likely to be challenging, there is evidence that this can be achieved through person-to-person spread of changing smoking behaviour; where a small number of individuals quitting smoking has been found to cascade to others within larger social networks.[252] It may be possible to exploit this effect to spread other positive health behaviour changes,[252] for example, positive home smoking changes made by a small number of households may spread to the wider network. Future interventions should also incorporate mothers' smoking self-identity; as mothers who return to smoking principally view themselves as 'social' or 'occasional' smokers, interventions that are highlighted as relevant for women with these types of smoking patterns are more likely to be responded to, and, ultimately, be effective. This may involve widening the criteria used to identify smokers to be more inclusive of social or occasional smoking behaviour patterns, and raising awareness that there is no safe level of smoking and even occasional smoking is still harmful.[249 253]

5.9 CONCLUSIONS

This is the first study, as far as the author is aware, to explore the experiences and beliefs of mothers who abstained from smoking for at least part of their pregnancy but subsequently returned to smoking in the early postpartum period. Being a 'responsible mother' dominated mothers' accounts of their smoking behaviour; mothers described using strategies to protect their infant from SHS exposure, and held strong negative attitudes towards other smoking parents. After returning to smoking, mothers appeared to reposition themselves as 'social' or 'occasional' smokers rather than 'regular' smokers. These findings suggest that interventions to prevent/reduce infants' home SHS exposure should build on mothers' intentions to be responsible parents, and should be highlighted as relevant for mothers who view themselves as social or occasional smokers.

CHAPTER 6 SUMMARY, IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The overall objectives of this thesis were to explore the prevalence and determinants of smoking in the home after childbirth, and to understand the experience and attitudes of mothers who stop smoking during pregnancy but return to smoking soon after delivery. This concluding chapter summarises the key findings from the research, highlights the implications for the development of future interventions to prevent or reduce infant secondhand smoke (SHS) exposure and suggests directions for future research.

6.1 SUMMARY OF FINDINGS

6.1.1 Objective 1: To identify which factors are associated with children's secondhand smoke exposure in the home

The systematic review in Chapter 2 found that children whose parents were smokers, of low socioeconomic status (SES) or less educated were at an increased risk of SHS exposure in the home. There was also evidence that children whose parents held more negative attitudes towards SHS were less likely to be exposed at home. A novel finding from this review was the association between child age and SHS exposure in the home, with high-quality papers reporting that younger children are more likely to be exposed. The largest observed risks were for children living in households with smokers; it was therefore concluded that the best way to reduce child SHS exposure in the home is for smoking parents to quit, or, if unable or unwilling to stop smoking, to aim to initiate and maintain a completely smoke-free home (SFH). Future research was recommended to examine SHS exposure specifically in infants and young children (<2 years old) as just three studies in this review explored factors associated with SHS exposure in this age group. This should examine the factors associated with infant and young child SHS exposure in the home in a contemporary cohort following the introduction of smoke-free legislations, which may have affected SHS exposure in the home among this age group as observed in previous research among older children.

6.1.2 Objective 2: To determine the prevalence of SHS exposure in the home, and factors associated, in young infants

The prevalence of SHS exposure in the home was measured using maternal reports of whether they themselves, or other people, ever smoked in the home at 3 months postpartum. The prevalence of SHS exposure in the home among young infants was 18.2% (95% CI 14.0-22.5%), with a higher prevalence among smoking compared to non-smoking mothers (24.0% and 4.7%, respectively). This prevalence was substantially lower than in the only previous UK survey undertaken in young infants (82% in infants with an average age of 3 months[20]). This may be due to methodological differences between the studies, for example data collection methods. However, the sample characteristics were broadly similar and there have been corresponding reductions in older children's SHS exposure in the home,[14 18] and therefore the prevalence reported in this study is likely to represent a decline in infant SHS exposure. This prevalence was also lower than has been reported in older children (38.7% in children aged 4-15 years[5]), suggesting that the prevalence of SHS exposure in the home is greatly reduced in the early postpartum period. The factors associated with smoking in the home immediately following childbirth were: mothers smoking ≥11 cigarettes per day, younger in age, of non-white ethnicity, from lower SES groups and holding less negative attitudes towards SHS.

6.1.3 Objective 3: To explore home smoking experiences, behaviours and beliefs among mothers of infants and young children less than 24 months of age who returned to smoking postpartum

The previous chapters have shown that children whose parents are smokers, and in particular whose mothers are smokers, are more likely to be exposed to SHS in the home. Women who stop smoking during pregnancy, but return to smoking soon after giving birth are therefore potentially putting their infants at risk of SHS exposure; however, little was known about why women who have managed to stop smoking during pregnancy may start again, and what their home smoking behaviours are after returning to smoking. This is important because women who managed to quit smoking for at least part of their pregnancy are a potentially motivated group who may be more receptive to making behaviour changes to protect their baby from SHS exposure.[117 119 122] In this study, nine semi-structured interviews with mothers who quit smoking during pregnancy, but returned to smoking ≤3 months postpartum were conducted using the principles of interpretative phenomenological analysis. Central to mothers' accounts of their smoking behaviours during pregnancy and postpartum was their desire to be a 'responsible mother'. Mothers described using strategies to protect their infant from SHS exposure, and held strong negative attitudes towards other smoking parents. After returning to smoking, mothers appeared to reposition their smoking to be 'social' or 'occasional' rather than 'regular', as they perceived themselves to be prior to pregnancy.

6.1.4 Consideration of findings across thesis studies

In Chapter 2 and Chapter 4, those from lower SES groups were more likely to expose their children and young infants to SHS in the home. This is concerning; lower SES is frequently reported to be associated with poorer health outcomes, and increased health morbidity and mortality.[157] Increased SHS exposure in infancy and childhood is likely to exacerbate the cycle of disadvantage. This highlights the importance of targeting those from lower SES groups in future interventions to prevent or reduce infant and child SHS exposure. However, those from lower SES backgrounds are traditionally very difficult to engage with,[254] and may be a challenging group in which to implement interventions.

In Chapter 2 and Chapter 4, maternal smoking status was significantly associated with both young infant and child SHS exposure in the home. However, the current smoking mothers interviewed in Chapter 5 suggest that the relationship between maternal smoking status and infant SHS exposure is more complex. Mothers interviewed in Chapter 5, who had quit smoking for at least part of their pregnancy but returned to smoking by 3 months postpartum, described using strategies to protect their baby from SHS exposure, with the most common of these being implementing SFHs. The individual accounts and experiences of mothers interviewed in Chapter 5 questions the usefulness of future interventions targeting all current smoking new mothers without more specific tailoring.

In Chapter 4, partner smoking was not significantly associated with smoking in the home 3 months after childbirth after controlling for other factors in the multivariable logistic regression model. Similarly, in Chapter

5, whilst partner smoking was touched upon in some mother's accounts, this did not emerge as a prominent theme in their descriptions of their experiences of smoking and smoking in the home. This may reflect common attitudes or intentions shared by both parents to protect infants from SHS exposure. However, the systematic review reported in Chapter 2 suggest that this may not be maintained long-term; paternal smoking was consistently associated with child SHS exposure in the home, which in some studies was found to be independent to maternal smoking. Future interventions need to be mindful of the role that fathers and other immediate caregivers can have in infant and child SHS exposure, and how this may change as infants grow older.

A key novel finding from Chapter 2 was the association between child age and SHS exposure in the home, with evidence from some high quality papers that used validated measures of SHS that younger children experience greater SHS exposure. This was in contrast to studies relying on parental-reported child exposure, which found the opposite trend. As previously discussed, research has found no significant differences in the elimination half-life of urinary cotinine between younger and older children, suggesting that higher cotinine levels observed in younger children are likely to be due to increased exposure.[110] This discrepancy could be due to a reporting bias among parents, or ineffective home smoking restrictions that do not provide sufficient protection from SHS exposure. The prevalence of young infant SHS exposure in the home reported in Chapter 4 should be considered within the context of this important earlier finding in Chapter 2 as it is possible that it under-estimates young infant's exposure.

In Chapter 2 and Chapter 4, attitudes towards infant and child SHS exposure were associated with exposure in the home. Attitudes were also influential in the findings of Chapter 5, where strong anti-smoking attitudes towards mothers who smoked in pregnancy, and parents who smoked around their children, were interpreted in mother's accounts. The strong desire to be 'responsible mothers' described by mothers in Chapter 5 suggests that by increasing knowledge about the risks of infant SHS exposure, attitudes towards exposure are likely to also change. As previously discussed, attitudes are an important construct in many behaviour change theories,[169] however behaviour change theories recognise the complexity of the interrelated components that influence behaviour; addressing just one of these components, such as attitudes, is unlikely to change behaviour.[169]

6.2 METHODOLOGICAL CONSIDERATIONS

This thesis utilised a mixed methods approach, drawing from both quantitative and qualitative methodologies. Mixed methods approaches are expansive, inclusive and can allow for research questions to be more fully answered.[255] Furthermore, mixed methods enables triangulation through exploring corroboration between findings, and can expand the breadth and range of enquiry.[256] Consideration of findings across the methodologies utilised in this thesis, discussed in section 6.1.4, facilitated a more complete understanding of infant and child SHS exposure in the home.

The systematic review reported in Chapter 2 synthesised evidence from quantitative studies only. Qualitative research can enhance understanding of complex areas of research that are not easily addressed using experimental methods alone.[257] Qualitative evidence included in systematic reviews can highlight limitations in methods used in quantitative studies and assist in the interpretation of quantitative findings.[257] As has been demonstrated in the mixed methods employed in this thesis, inclusion of qualitative studies alongside quantitative studies in the systematic review conducted in Chapter 2 may have facilitated greater understanding of the factors associated with child SHS exposure in the home.

The study described in Chapter 4 used an existing data set, the PLS cohort, which was designed for an alternative purpose to those addressed in this thesis. The analysis was therefore limited to the available data within the existing survey. It would have been preferable to use the findings presented in Chapter 2 and Chapter 5 to inform the development and design of a survey to specifically examine smoking in the home 3 months after childbirth. For example, the PLS measured maternal reported smoking in the home by themselves or others in just two survey items, however the background literature and findings from across this thesis suggest that smoking in the home is a complex behaviour. Survey questions on where smoking took place at home, what, if any, smoking restrictions were in place, and whether there were ever exceptions to these smoking restrictions would have facilitated greater understanding on home smoking behaviours immediately after childbirth.

The response rates observed for the follow-up at 3 months postpartum for the PLS described in Chapter 3 and Chapter 4 were low, with data on smoking in the home at this time available for 55.4% of the original sample. Non-response is a common problem in survey research, and can negatively impact the quality of health research.[258] A systematic review[258] of methods used to increase response rates to postal questionnaires found a number of strategies useful, many of which were utilised in the PLS cohort including: the use of monetary incentives, short questionnaires, personalised letters, providing stamped addressed envelopes, follow-up contact. The response rates achieved in the PLS cohort highlights a limitation of survey-based research; future research needs to more carefully consider how response rates can be improved further, particularly at times that are challenging or busy for participants, such as after the birth of a child.

6.3 RECOMMENDATIONS FOR FUTURE WORK

The work in this thesis has highlighted a number of other areas for potential future research. There is a general paucity of research exploring SHS exposure specifically in infants, and whilst this thesis has begun to build a literature base in this area, more research is needed.

A population estimate for young infant SHS exposure in the home would help to assess the scale of associated morbidity and mortality. This would further facilitate making decisions on prioritisation of public health resources to tackle young infant SHS exposure. Future research should therefore examine the prevalence of young infant SHS exposure among the general population rather than, as this thesis has done, only among those mothers who self-report being current or recent ex-smokers during pregnancy. This would capture infant SHS exposure from other household members or visitors, such as partners or family/friends, even when the mother is a non-smoker, thus giving a more accurate estimation of overall prevalence.

Exploring potential relationships between smoking behaviour in the home after childbirth and patterns of smoking during pregnancy was beyond the scope of this thesis; however, the findings of the qualitative work presented in Chapter 5 suggest that this may be an important avenue for future research. Understanding more about this could help to identify the best time to intervene, such as a key time during pregnancy, to prevent future infant SHS exposure in the home after childbirth. This could help parents and families to implement changes before smoking in the home becomes an established behaviour. There is therefore scope to extend the qualitative work carried out in Chapter 5, which provided valuable insight into the experiences and beliefs of a relatively homogeneous group of smoking mothers. Future research should explore whether findings are similar in a more generalizable sample, or among mothers with more heterogeneous smoking patterns.

6.3.1 Future interventions to prevent or reduce infant and child SHS exposure

As discussed in Chapter 1, a recent systematic review[102] did not conclusively demonstrate the effectiveness of any one interventional approach to reduce children's SHS exposure, and thus the authors concluded that there remains a need for novel, evidence-based interventions in this area. Parental smoking and smoking in the home are the primary sources of infant and child SHS exposure;[29] these are both modifiable behaviours, and as such the principal implications of the work in this thesis should be to inform the development of effective, targeted interventions to prevent or reduce infant and child SHS exposure. Interventions should focus on promoting smoking cessation among parents; if parents are unable or unwilling to quit smoking, making the home completely smoke-free is the next most effective way to protect their children from SHS exposure.[20 60-62]

The Behaviour Change Wheel[259] is a comprehensive guide to designing interventions, informed by a behaviour change theory framework. According to this approach, there are three main stages to intervention development: i) understanding the behaviour (defining the problem in behavioural terms, selecting the target behaviour, specifying the target behaviour, identifying what needs to change), ii) identifying intervention options (identifying intervention functions and policy categories) and iii) identifying content and implementation options (identifying behaviour change techniques and mode of delivery).[259] Using the principles of the Behaviour Change Wheel,[259] the findings of this thesis have been used to suggest potential content for future interventions to prevent infant SHS exposure in the home through implementing and maintaining SFHs, which are presented in Table 6-1.

Table 6-1 Smoke-free home intervention design using the principles of the Behaviour Change Wheel[259]

Behaviour change stage	Design process stage	Evidence from thesis
Understanding the behaviour		
	Defining the problem in behavioural terms	Smoking in the home where infants and children live
	Selecting the target behaviour	Parental smoking in the home
	Specifying the target behaviour	Making the home smoke-free Maintaining smoke-free home over the long-term: *What:* Support to help parents quit smoking, or for those who are unable or unwilling to quit smoking to make the home smoke-free *Delivered by who:* Health care professionals/trained behaviour change specialist *Delivered where:* In homes *Delivered when:* Early postpartum
	Identifying what needs to change	**COM-B model components[259]** • **Psychological capability:** knowledge, understanding the dangers of infant and child SHS exposure • **Physical opportunity:** having an outside space in which to smoke; having resources to balance supervision of children and smoking outside of the home • **Social opportunity:** agency to influence the smoking behaviour of others in the home • **Reflective motivation:** intending to make the home smoke-free; believing infants and children should be protected from SHS exposure; smoking self-identity • **Automatic motivation:** managing cravings to smoke with opportunity to smoke outside of the home; managing stress
Identify intervention options		

	Intervention functions	• **Education:** increasing knowledge likely to lead to attitude change, e.g. increasing knowledge about the effects of infant and child SHS exposure; increasing knowledge about the effectiveness of home smoking restrictions
		• **Modelling:** provide an example for people to aspire to, for example, other households within community that have effectively implemented smoke-free home restrictions
		• **Enablement:**
		  • *Reducing barriers to increase capability:* support to manage smoking cravings, support to manage stress, increasing agency to restrict the smoking of others in home
		  • *Opportunity:* support to balance child supervision with smoking outside the home

Behaviour change stage	Design process stage	Evidence from thesis
Identify intervention options continued	**Policy categories**	• **Communication/marketing:** using mass media campaigns • **Service provision:** using local stop smoking service support and health visitors to deliver smoke-free home advice
Identify content and implementation options		
	Behaviour change techniques	**Education:** • Information about health consequences of infant and child SHS exposure • Information about the importance of maintaining smoke-free homes throughout childhood • Feedback on outcomes of behaviour, e.g. effectiveness of home smoking restrictions that have been implemented using validated measures, for example, providing home air particulate matter feedback **Modelling:** • Demonstrating others within community or social networks who have effectively implemented smoke-free home restriction **Enablement:** • *Social support* to increase agency to protect infant or child from SHS exposure in the home • Facilitate *goal setting* • Facilitate *problem solving*, e.g. identifying barriers to making the home smoke-free • Facilitate *action planning*, e.g. solutions to potential barriers to making the home smoke-free, use of e-cigarettes to control cravings to smoke • *Behavioural contract*, to enhance social support for smoke-free home restrictions • Promote valued *self-identity* e.g. responsible parent, non-smoker, occasional/social smoker • Promote *identity associated with changed behaviour*, e.g. responsible parent, parent who protects their infant/child from SHS exposure in the home
	Mode of delivery	**Population level:** broadcast media (television, radio) **Individual level:** in-home intervention

Whilst the demographic characteristics associated with infant and child SHS exposure in the home are not easily modifiable,[168] they can be used to inform which children, parents or families should be targeted in future interventions designed to help parents implement or maintain SFHs. The findings from this thesis highlight two distinct groups that should be targeted in future interventions.

Firstly, mothers who are heavier smokers (e.g. ≥11 cigarettes per day), from lower SES groups, younger, less well educated and who hold less negative attitudes towards child SHS exposure should be a primary target for future interventions as these characteristics were associated with child and young infant SHS exposure. This group may constitute 'hardened-smokers', whose smoking behaviour is resistant to change despite well-established health warnings, smoke-free legislations and general anti-smoking attitudes within society;[260 261] careful consideration, informed by extensive patient participant involvement, would be needed to encourage engagement with interventions among this group, which is likely to be challenging.[254] Interventions among this group should promote the implementation of SFHs, using the behaviour change principles outlined in Table 6-1, which may be more acceptable than complete smoking cessation.

The second target group for future interventions are mothers who principally view themselves as 'social' or 'occasional' smokers. As described by the mothers interviewed in Chapter 5, this group may have already implemented SFHs. However, smoking in the home 3 months after childbirth is substantially lower than the most recent estimates for smoking in homes where older children (aged 4-15) live,[5] suggesting that a proportion of smoking families implement SFHs immediately after childbirth, but relax these restrictions over time. This group may engage well with interventions; they are likely to be motivated to protect their infant or child from SHS exposure in the home having taken steps to do so during early infancy. Intervening to help parents and families maintain home smoking restrictions in the long-term could prevent future SHS exposure. Targeting mothers who identify as being 'social' or 'occasional' smokers, and promoting complete smoking cessation whilst highlighting the importance of maintaining SFHs over the long term is likely to be of use. As can be seen in Table 6-1, promotion of valued self-identity and identifying with changed behaviour are important behaviour change techniques, and should be a key feature of future interventions among this group. Interventions tailored to parents' smoking identity, for example, 'social' or 'occasional' smokers, are more likely to be responded to, and ultimately, be effective.

During intervention development it is important to gather information about the target populations' capability, opportunity and motivation to change the target behaviour, from a range of sources, including interviews, focus groups, questionnaires, observation, expert opinion and review of relevant service protocols.[259] The next steps in designing a comprehensive intervention in this area are to assess the target populations' attitudes towards, and the acceptability of, the behaviour change techniques outlined in Table 6-1 through a combined approach of qualitative interviews and surveys. Further research should determine the best method of intervention delivery by comparing the feasibility, cost and effectiveness of mass media campaigns versus individualised interventions delivered in the home. This future research would help to inform a pilot study to test the feasibility and effectiveness of the SFHs intervention.

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CHAPTER 7 APPENDICES

7.1 PUBLICATIONS

7.1.1 Predictors of Children's Secondhand Smoke Exposure at Home: A Systematic Narrative Review of the Evidence

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Predictors of Children's Secondhand Smoke Exposure at Home: A Systematic Review and Narrative Synthesis of the Evidence

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Abstract

Background: Children's exposure to secondhand smoke (SHS) has been causally linked to a number of childhood morbidities and mortalities. Over 50% of UK children whose parents are smokers are regularly exposed to SHS at home. No previous review has identified the factors associated with children's SHS exposure in the home.

Aim: To identify by systematic review, the factors which are associated with children's SHS exposure in the home, determined by parent or child reports and/or biochemically validated measures including cotinine, carbon monoxide or home air particulate matter.

Methods: Electronic searches of MEDLINE, EMBASE, PsychINFO, CINAHL and Web of Knowledge to July 2014, and hand searches of reference lists from publications included in the review were conducted.

Findings: Forty one studies were included in the review. Parental smoking, low socioeconomic status and being less educated were all frequently and consistently found to be independently associated with children's SHS exposure in the home. Children whose parents held more negative attitudes towards SHS were less likely to be exposed. Associations were strongest for parental cigarette smoking status; compared to children of non-smokers, those whose mothers or both parents smoked were between two and 13 times more likely to be exposed to SHS.

Conclusion: Multiple factors are associated with child SHS exposure in the home; the best way to reduce child SHS exposure in the home is for smoking parents to quit. If parents are unable or unwilling to stop smoking, they should instigate smoke-free homes. Interventions targeted towards the socially disadvantaged parents aiming to change attitudes to smoking in the presence of children and providing practical support to help parents smoke outside the home may be beneficial.

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Background

Exposure to secondhand smoke (SHS), also known as passive smoking or environmental tobacco smoke, is the involuntary inhalation of other people's cigarette smoke. Children's exposure to SHS has been causally linked to increased risks of respiratory tract infections, middle ear infections, sudden unexplained death in infancy, and asthma [1]. A World Health Organisation (WHO) consultation report in 1999 concluded that SHS was a substantial threat to child health, with the 2006 US Surgeon General report later arguing that there is no safe level of SHS exposure [2].

Forty percent of children globally are exposed to SHS [3]. The two main determinants of children's SHS exposure in England have been reported to be smoking by parents or caregivers, and whether smoking occurs in the home [4,5]. Smoke-free legislations banning smoking in enclosed public places have been widely introduced, with a reported 109 countries having implemented legislations by 2012 [6]. However such legislations do not cover smoking in private residences [1]. Children who spend a large proportion of their time indoors [7] and in close proximity to smoking parents [8,9] are particularly at risk of SHS exposure in the home. In the UK, around two million children are estimated to be exposed to SHS in the home [1], with 52% of children who live with one or more smoking parents being regularly exposed [10]. Similar findings were reported in the 2006 Global Youth Tobacco Survey, where internationally 46.8% of never smoking young people aged 13–15 years were exposed to SHS in the home in the last seven days, with the highest level of exposure observed in Europe at 71.5% [11].

To our knowledge, studies which aim to understand the factors or characteristics associated with children's SHS in the home have not been previously reviewed. Consequently, we have carried out such a review of relevant studies conducted in children aged ≤18 years, examining factors associated with home SHS exposure. We aimed to identify factors, such as environmental or socioeconomic characteristics, which have been shown to be independently associated with children's SHS exposure in the home, and to determine potential characteristics that may be important for the development of effective future SHS and smoke-free home interventions.

Methods

This systematic review was conducted and reported in accordance with the PRISMA guidelines [12].

Systematic Review Methods

Electronic databases MEDLINE, EMBASE, PsychINFO, CINAHL and Web of Knowledge were searched to the end of July 2014 without date restrictions, using combinations of the following key words: *secondhand smoke, environmental tobacco smoke, passive smoke/smoking, smoking in the home, smoke-free home, smoking rules, child, children, school child*, infant, baby, babies, parent, mother, father, predictor, association, factors, determinants*.

The reference lists of papers identified as being relevant in the above electronic searches were also hand searched.

Inclusion and exclusion criteria

Titles and abstracts identified from the searches were reviewed, and all studies meeting the following inclusion criteria identified: (a) English language studies examining the factors associated with SHS exposure in children aged ≤18 years, (b) reported a measure of child SHS exposure (e.g. parent reported exposure in the home; child self-reported exposure in the home; objective measures, biochemically validated exposure such as cotinine, carbon monoxide; home air particulate matter), (c) examined potential factors/associations for child SHS exposure (e.g. demographic, social/environmental, pregnancy factors, post-partum factors, health/emotional, tobacco related, smoking in pregnancy behaviours).

The age cut-off of ≤18 years for childhood was chosen to reflect variation in the legal age of adulthood across countries, with the majority of countries considering those aged 19 to be adults, and was considered appropriate as it is also the upper-limit at which adolescents are likely to remain in compulsory full-time education.

Whilst biomarkers are able to provide a quantitative measure of SHS exposure, this may reflect exposure both in the home and elsewhere. However, there is strong evidence to suggest that biomarkers can be used as an appropriate measure for child domestic SHS exposure. Research has shown that children spend the largest proportions of their time either in school attendance or as leisure time inside the home [13], with a reported 75–80% of their time spent in the home [14,15]. This, coupled with the widespread implementation of smoking bans in enclosed public places, makes the home the primary source of SHS exposure [4,5]. Furthermore, previous research has found biomarkers and reported child SHS exposure specifically in the home to have strong and consistent correlations across a range of ages (r range = 0.36–0.66) [16–18]. Similarly, papers that used self-reported measures of indoor SHS exposure, for example, smoking in the same room as children, were included in this review on the assumption that most of this indoor exposure would occur in the home.

Papers that were not original quantitative methodologies were excluded. Papers exploring associations with parental reported 'smoke-free homes' (e.g. their child was NOT exposed to SHS in the home) were also excluded; creating 'smoke-free homes' is a behaviour change, and thus it is likely that there are a number of complex reasons, barriers or facilitators related to implementing home smoking bans. The factors associated with these are therefore likely to be quite different to those associated with children's SHS exposure in the home.

Following the title and abstract review, SO (first author) independently reviewed the full texts. A summary of each of the included studies is presented in Table S1. The significant associations (using the significance level adopted by each individual study) and adjusted sizes of effect of associations in each study were further compiled into a separate table (Table S2). In papers using numerous measures of SHS of exposure, the outcome that related specifically to SHS in the home was used where possible. The purpose of this review was to identify, rather than quantify, the factors and characteristics associated with children's SHS exposure in the home; a meta-analysis was therefore considered inappropriate and data were synthesised in a narrative review.

Assessment of Methodological Quality

Studies that met the inclusion criteria were assessed for quality using a modified version of the Cochrane Collaboration Non-Randomized Studies Working Group recognised Newcastle-Ottawa Quality Assessment Scale [19,20]. Herzog and colleagues [20] modified the original Newcastle-Ottawa Quality Assessment Scale for use when assessing the quality of cross-sectional studies. The studies in this review were all cross sectional in design and so using these criteria, studies were critically appraised and awarded a quality rating score out of a maximum of ten (Table S1). An *a priori* cut off point of seven points out of a possible 10 was used to identify papers considered to be of higher methodological quality, as has been used previously with the comparable original scale [21–23]. All studies of both low and high quality were included in the review, with study quality used to inform the results and conclusions made throughout.

Results

There were 4013 papers identified through the systematic literature searches. After removal of duplicates, a further 2,316 articles were excluded based on title and abstract review. These included intervention studies to reduce child SHS exposure, studies examining the health risks associated with child SHS exposure and editorial papers. Sixty-five papers were considered as potentially eligible based on title and abstract review, and full-texts were obtained. Following the review of full-texts, 41 of these papers were included in the final review (Figure 1).

Included studies

Location. Ten of the 41 studies were conducted in the UK (England [5,24–26], Scotland [27–30], Wales [31], England and Wales [32]), eight in the USA [33–40], three in Germany [41–43], three in Greece [44–46], two in Korea [47,48] and one each in Denmark [49], Sweden [50], Finland [51], Norway [52], Italy [53], Spain [54], Puerto Rica [55], Australia [56], Malaysia [57],

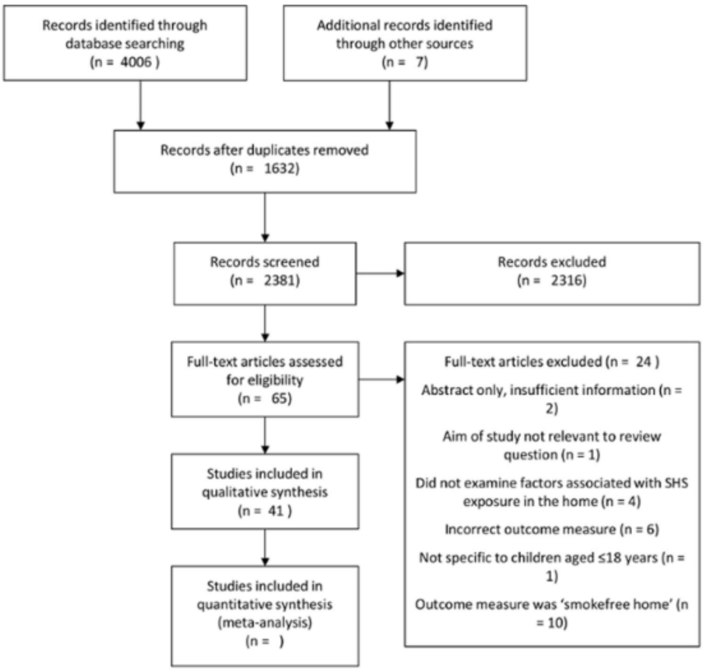

Figure 1. Systematic search results flow diagram of included and excluded studies.
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Mongolia [58], South Africa [59], India [60], Taiwan [61], Thailand [62] and Tehran [63].

Study design. Thirty of the papers reported studies which were of cross sectional design [24,25,30,32,34–39,41,44,45,47-50,52-57,60-62], six were reports of repeated cross sectional designs [5,27,28,31,33,51] and three studies were cross sectional using samples recruited as part of intervention studies [29,43,63].

Assessment of quality. Using the modified Newcastle-Ottawa Quality Assessment Scale [19,20], the median quality score of studies included was seven points (range 2–9). Twenty two papers [5,25–32,39,44–47,50,53,54,56,57,59,62–64] were considered to be of higher quality (Table S1). The remaining studies were of lower quality, primarily due to lower representativeness of study samples, low study power or limited control of potentially confounding factors within analysis.

Ages of children included. The majority of studies focused on school-age children of approximately 5–18 years [5,25–28,30–33,37,39–42,46,47,51,53,57–59,61], or a broader age range to include both preschool and school-aged children (≤18 years) [24,34,36,38,44,45,48,49,56,64]. Eight studies focused on SHS exposure in younger children; five [29,43,50,52,54] of these examined SHS exposure in preschool-children aged less than five years, and only three [35,62,63] focussed on SHS exposure specifically in infants under two years of age.

Measures of SHS exposure. Eighteen studies used the following validated measures of child SHS exposure: salivary cotinine [5,25,27–32,57], urinary cotinine [26,37,42,44,47,50,53,54,63,64], serum cotinine [39] or airborne particulate matter[$PM_{2.5}$] [29]. Some of these studies also included self-report measures, such as parents'/carers' [5,29,42,44,47,50] or children's [27,31] reports of home SHS exposure, or parent [32,37] or child [28] reported SHS exposure outside of the home.

A number of other studies used only self-report measures such as parental [24,33,34,36,38,40,41,43,45,48,49,52,56,61,62] or child (11–17 years of age) [46,59,60] reported exposure in the home. Two studies used parental/respondent [35] or child self-reported [51] smoking in the same room as children, and a further study [58] used child reported SHS exposure in the home and elsewhere. As can be seen in Table S1, different definitions of reported child SHS exposure were used across the studies. These included reported home smoking restrictions or location of smoking at home [24,34,36,38,41,43,49,61], hours per day child exposed [35,51], number of days per week child exposed [33,59,60], number of cigarettes child exposed to [48], exposure to cigarettes in given time periods (i.e. 12 months [40,56]; seven days [58,62]), smoking in the home in front of children [45,46,52], or any smoking in presence of children [47].

Factors associated with child SHS exposure. Of the 41 included studies, the associations between 90 different variables and child SHS exposure were identified; these were grouped into five conceptually similar categories: (1) socioeconomic status (SES) (including composite measures of SES, income, employment and health insurance type), (2) parental characteristics (education, age, race/ethnicity), (3) family and home characteristics (family size, family structure, home environment), (4) child characteristics (age, gender), and (5) parental smoking characteristics (smoking behaviour, attitudes and self-efficacy). The size of effect of statistically significant associations reported between principle variables and SHS exposure in the home (using significance level reported by individual studies) are presented in Table S2.

(1) Socioeconomic status. The relationship between child SHS exposure and proxy measures of SES were examined in 11 studies; measures of SES used were the Registrar General's Social Class system [5,28,30,32,63,65], area level deprivation indicators [47,56], the Family Affluence Scale [27,28,31,66], the Townsend score [25,67] and wealth [62]. In ten out of 11 studies [5,25,27,28,30–32,47,56,63] there were significant associations between low SES and increased exposure. This was observed both in studies using biomarkers as an outcome measure [5,25,27,28,30–32,47,63], and reported exposure [56]. Children of parents in lower SES groups were up to three times more likely to be exposed to SHS, with the odds ratios (OR) from individual studies ranging from 1.1 to 3.3. The majority of studies reporting this were of higher methodological quality [5,25,27,28,30–32,47,63].

Seven studies with mixed findings [36,37,40,41,47,57,61] investigated whether or not there was an independent relationship between income and child SHS exposure. Overall a significant association was reported in three studies [37,41,47]. Two studies [37,57] used biomarkers as outcome measures, with just one [37] reporting a significant association. Five studies [36,40,41,47,61] relying on reported exposure as an outcome measure examined income, with two [41,47] reporting a significant association between low income and child SHS exposure in the home. This finding did not differ according to study quality.

There was similarly inconsistent evidence for a link between employment status or occupation and child SHS exposure. Three studies found a significant association between employment and exposure to SHS in the home; in one study [5] using biomarkers as an outcome measure, children whose parents' employment status was 'other' (including looking after the home) had significantly higher salivary cotinine levels, however, those with unemployed parents did not. A second study [41] that used reported exposure as an outcome measure found a significant association between parental unemployment or part-time employment and increased child exposure. A third study [43], also using reported exposure as an outcome measure found children of households where only one parent was employed were at an increased risk. No significant association was observed in four studies [24,34,62,64]. These findings did not vary dependent upon study quality. There was also little indication of a relationship between type of occupation and child SHS exposure, with just one study [57] reporting that children whose fathers were in the armed forces had higher levels of salivary cotinine compared to children whose fathers were in managerial or professional roles.

(2) Parental characteristics. Twenty-six studies [5,24,33–35,37–45,47–49,51–54,57,61–64] investigated the relationships between parental or highest level of education within the household and child SHS exposure at home, with 18 [5,24,33,35,37–41,43,44,47,49,52-54,57,62] reporting a significant association between low education and increased risk of exposure. In one study [54] there was a significant association between paternal education and child exposure, but no significant association with maternal education. Although there was variation in how parental education was measured and categorised, children whose parents had the lowest levels of education were up to ten times (OR range 1.08 to 10.4) more likely to be exposed to SHS. These findings did not differ according to study outcome measure or quality; of those reporting a significant association between parental education and child SHS exposure in the home, seven [5,37,39,44,53,54,57] used biomarkers as an outcome measure compared to 11 studies [24,33,35,38,40,41,43,47,49,52,62] using reported exposure. Of the high quality studies, three [45,63,64] found no significant association of education on exposure, whilst eight found a significant association [5,39,44,47,53,54,57,62].

Parental race or ethnicity was examined in nine studies [5,26,33,35,36,38,39,42,50], with a significant association found in eight [5,26,33,35,36,38,39,42] of these. In the UK, children of White parents had significantly higher SHS exposure, as measured by biomarkers, than children from other ethnicities [5,26]. The association between race or ethnicity in USA based studies was less clear; there was some evidence that children of White parents were at an increased risk of SHS exposure [33,35,38]; however, other studies found significant associations between SHS exposure and other races/ethnicities [33,36,38,39]. A German based study found children of non-German nationality to have significantly higher urinary cotinine levels [42]. One study [62] further found children of Muslim fathers to be significantly more likely to be exposed to SHS in the home. The outcome measure used across studies did not influence whether a significant association was observed, with four studies [5,26,39,42] that used biomarkers as an outcome, and four [33,35,36,38] that used reported exposure finding a significant association. However, five [33,35,36,38,42] of the studies reporting a significant association between ethnicity and child SHS exposure in the home were of lower quality.

Parental age was not shown to be linked to child SHS exposure; eleven studies [24,29,34–36,45,49,61–64] explored this relationship, however only two [29,35] found significant associations between lower parental age and measures of SHS exposure, and one [62] found a significant association with but with no clear direction of effect. This finding did not differ according to study outcome measure or quality.

(3) Parental smoking behaviour and attitudes. Of the 18 studies [5,25,27,29,30,34,36,42,43,45,46,48,51,53,54,57–59] that investigated parental or household member cigarette smoking status, 15 [5,25,27,30,34,42,43,45,46,48,51,53,57–59] identified a significant association between this and SHS. Children of smoking mothers were up to seven times (OR range 2.1 to 6.9) more likely to be exposed in the home, and children of parents who both smoked were up to 13.5 times (OR range 2.9 to 13.5) more likely to be exposed in the home. This was observed both in studies using biomarkers as an outcome measure [5,25,27,30,42,53,57], and reported exposure [34,43,45,46,48,51,58,59]. These findings did not differ according to study quality.

Eight studies examined an association between the number of cigarettes smoked by parents either per day [44,45,49,50,53,61,63] or per week [34] and child exposure. In four of these [44,45,50,53] a significant association was observed; children whose parents had a higher level of cigarette consumption were more likely to be exposed to SHS. One study [45] observed a significant association with increased number of cigarettes smoked per day by the mother, but not the father. Two further studies [49,61] looked at the effect of respondents being a daily smoker, however no significant association was reported. Significant associations between parental cigarette consumption and child SHS exposure was more frequently observed in studies using objective outcome measures [44,50,53] and in studies of high quality [44,45,50,53].

The number of cigarettes smoked in the home was explored in a further four studies [29,39,42,54], all of which used objective measures of SHS exposure. In three of these [29,39,42] there was a significant relationship between more cigarettes smoked in the home and child exposure; however, this was only investigated in a univariate analysis which means that this finding may not be independent of other confounding factors.

Four studies [29,33,52,61] measured and reported significant associations between parental attitudes towards smoking and SHS exposure. These studies used reported exposure [33,52,61] and home airborne particulate matter [$PM_{2.5}$] [29] as outcome measures. Although the measurement of attitudes varied across the studies, generally more negative attitudes towards SHS exposure were related to lower exposure. In three studies [33,52,61] there was an association between negative opinions towards SHS and reduced risk of exposure. In one study [33], agreement that SHS was harmful to health was associated with reduced risk of child SHS exposure in the home. One study [52] developed a scale of six questions measuring attitudes towards statements about the rights of adults to smoke in their own homes, the rights of children to live in smoke-free homes and the safety of SHS exposure; those with lower scores (reflecting negative attitudes towards child SHS exposure) were less likely to smoke in the home [52]. One study [61] found that those who agreed more with their family's anti-smoking reactions to smoking in the home were less likely to expose their children to SHS. A further study [29] observed lower maximum indoor particulate matter ($PM_{2.5}$) concentrations and child salivary cotinine among those mothers who strongly agreed that they would ask a smoker to smoke outside their house; however, this was only found in univariate analysis and there was no significant effect for other attitudinal questions. Three of the studies [33,52,61] reporting a significant association between parental attitudes and child SHS exposure in the home were of lower quality. Two further studies [59,60] found child attitudes towards the harmfulness of SHS was associated with exposure in the home, however the direction of this association was unclear.

(4) Family and home characteristics. Thirteen studies [30,34–38,40,41,47,48,51,61,64] looked at a link between marital status or family structure and child SHS exposure. In five studies [30,37,38,41,64] being a single parent was associated with children's SHS. Further associations were found for exposure among children whose mothers were unmarried [35], who were separated [51] or part of a step-family [38], with children from these families being up to twice as likely (OR range 1.1 to 2.1) to be exposed to SHS. These findings did not differ between outcome measures used; significant associations between marital status and family structure were observed both in studies using biomarkers as an outcome measure [30,37,64] and reported child SHS exposure in the home [35,38,41,51] However, five of the studies [35,37,38,41,51] reporting an association were of lower quality.

There was no clear relationship between family size and exposure, which was investigated in 11 studies [30,35,39–41,43,45,47,56,62,63]. In studies using biomarkers as an outcome measure, three [39,47,63] found no association whilst one study [30] reported child SHS exposure to decrease with increasing number of children in the family. There were mixed findings in studies using reported exposure; in three studies child SHS exposure in the home [35,43,56] was associated with 20–72% (OR range 1.2 to 1.72) increased odds of SHS with one or more siblings, or a larger family size, whilst in one study exposure decreased with increasing number of children in the family [41]. A further three studies found no significant association [40,45,62]. Those reporting a significant association tended to be of lower quality [35,41,43,56].

There was some evidence for an association with accommodation size or characteristics. Seven studies [5,30,42,43,53,54,63] looked at crowding, defined as number of people per bedroom; four studies [5,30,42,53] all using biomarkers as outcome measures found a significant relationship between more crowded homes and increased SHS exposure. The only study [43] to use reported exposure as an outcome measure found no significant association between child SHS exposure in the home and crowding, however this study was also of lower quality. There was no evidence that this was influenced by study quality. There was similarly some evidence for a relationship between size of home and exposure, which was only measured in studies using biomarkers as outcome measures. Increased home floor surface area was significantly associated with lower SHS exposure in two studies [42,44], and fewer rooms being associated with an increased risk of exposure in a third study [39]. No association with accommodation size was found in a further study [50]. Other significant relationships included the use of air conditioning in the home [57] and the availability of outside space [36,43] both being associated with reduced child exposure. These findings did not differ according to study quality.

(5) Child characteristics. The association between child age and exposure was explored in 19 studies [5,24,25,29,32,36,38,39,44–46,48,53,54,58-60,63,64]. Nine of these [5,25,29,32,36,39,44,45,64] found younger children to be significantly more likely to be exposed to SHS in the home, or to have higher exposure. The studies reporting this association tended to use objective outcome measures [5,25,29,32,39,44,64], and to be of higher quality [5,25,29,32,39,44,45,64] than those finding no significant association. Three studies [46,58,63] found the opposite association; one study [63] found urinary cotinine to increase significantly per one month increase in age among infants aged under one year, and two studies [46,58] found older teenagers to be more likely to report SHS exposure in the home than younger teenagers. These findings did not differ according to study quality.

Nineteen studies [5,29,30,32,38,39,42,44–47,53,54,57–59,62–64] looked at child gender and SHS exposure, with limited support for an association. Significantly higher salivary [5,30,32] and urinary cotinine [44] in females was observed in four studies. A further study [46] found female adolescents to be more likely to report smoking in their homes, however the remaining studies [29,38,39,42,45,47,53,54,57–59,62–64] found no significant association. These findings did not differ according to study quality.

Discussion

Children whose parents are smokers, are of low SES or less educated were at an increased risk of SHS exposure in the home. There was also some evidence that children whose parents held more negative attitudes towards SHS were less likely to be exposed. Associations were strongest for parental cigarette smoking status; compared to children of non-smokers, those whose mothers or both parents smoked were between two and 13 times more likely to be exposed to SHS at home. These findings show that the best way to prevent child SHS exposure in the home is by encouraging smoking parents to quit.

Literature in this review was synthesised narratively, which may introduce some bias if findings of one study are given inappropriate weight compared to others [68]. However, efforts were made to avoid such biases through methodically identifying papers, data extraction, and quality assessments of studies informing the synthesis of findings. It is further acknowledged that only one author reviewed and extracted data from papers. Previous research has reported single-reviewer data extraction to be at greater risk of error compared to multi-reviewer extraction [69]. However, this was found using reviewers who were unfamiliar with the topic area, and errors identified were found to be minimal and to have no significant impact on findings [69].

Papers using biomarkers as an outcome measure were included in this review; biomarkers are not able to identify the location in which exposure occurs, and it is therefore not possible to rule out that some exposure in these studies occurred in locations outside of the index home, such as in other people's homes and private vehicles. However, there is evidence of strong correlations between biomarkers and reported SHS exposure in the home [16–18,70], so it is likely that associations between characteristics identified in this review and biomarkers are principally determined by home exposure.

There were a number of limitations inherent in the studies included in the review. Using a modified Newcastle-Ottawa Quality Assessment Scale [19,20], 19 studies were considered of lower quality, primarily due to low representativeness of study samples and limited control of potentially confounding factors within analysis. Some studies were also at risk of low power and chance findings, whereby the authors used small sample sizes and examined multiple risk factors within their analyses. Furthermore, the studies included in this review were carried out in a broad range of different countries, and so there are likely to be wide cultural differences. These limitations may explain disparities in associations observed across studies, and should be taken into consideration when interpreting the findings of this review.

The finding that parental and other household member cigarette smoking status was associated with child SHS exposure supports previous research, which has shown the primary source of child SHS exposure to be smoking by parents [4,71]. The greatest observed risks in this review were for children whose mothers [5,25,34,51,58] or both parents [5,51,58] were smokers, which strongly suggests that the best way to reduce child SHS exposure in the home is for parents who smoke to quit. This finding has implications for younger children of pre-school age, who spend an increased proportion of their time at home with parents compared to older, school-aged children [8,9]. There was some evidence in this review that younger children may be at an increased risk of SHS exposure in the home, which was found in some high quality papers using biomarkers as outcome measures of SHS exposure. Research has found no significant differences in the elimination half-life of urinary cotinine between younger and older children, suggesting that higher cotinine levels observed in younger children are likely to be due to increased exposure [72].

In line with the findings of this review, sociodemographic characteristics are often linked to health inequalities. Low SES is frequently reported to be associated with poorer health outcomes, health morbidity and mortality [73]. Those with lower education have similarly been found to engage in fewer health promoting behaviours [73,74], and have a higher smoking prevalence than more educated populations [75,76]. There was some evidence in this review that children whose parents were single, separated or divorced were at an increased risk of SHS exposure in the home; children from single parent families [77–79], or whose parents/carers are unmarried [80] have also been shown to have worse health outcomes compared to those from traditional nuclear families. Previous research has shown single mothers to be more likely to relapse to smoking after pregnancy [81], and unmarried or divorced adults to be more likely to be daily smokers [82] or heavier smokers [83].

In a recent review [84], the effectiveness of any one interventional approach to reduce children's SHS exposure was not conclusively demonstrated and as such there remains a need for novel, evidence-based interventions which are sensitive to both the context in which smokers live and smokers' environments. Whilst the demographic characteristics found to be associated with children's SHS exposure in the home are not easily modifiable [85], they may help to inform which children, parents or families are best targeted in future interventions. For example, this review suggests that interventions targeted towards low SES groups aiming to promote smoking cessation would have a positive impact on children's exposure in the home. Where parents are unable or unwilling to quit smoking, making the home smoke-free is the only effective way to protect children from SHS exposure [50,86–88]. The Theory of Reasoned Action argues that interventions designed to change beliefs and attitudes can influence intentions and subsequent behaviour across a range of health behaviours [89]. Interventions targeting attitudes towards SHS by supporting parents to recognise the benefits of protecting their children from SHS may therefore be useful to promote smoke-free homes. However, previous research has shown home smoking behaviours to be complex and fluid among a group of disadvantaged parents [90]; changing attitudes alone may not be sufficient to change behaviour. A combined approach that targets attitudinal change and provides practical context specific advice to parents, for example balancing child safeguarding with smoking outside of the home or negotiation with other household smokers, may be helpful.

Future research is needed to explore SHS exposure specifically in very young infants; just three studies in this review explored factors associated with SHS exposure in this age group. Although other studies included infants of less than two years of age within their samples, this younger age group was not considered or reported independently of older children. Very young infants under two years of age may be particularly susceptible to the risks of SHS exposure as they have a higher respiration rate [91,92], and underdeveloped lungs [93,94]. This increased susceptibility can have serious health implications; infants exposed to SHS postnatally are more vulnerable to infections requiring hospitalization [95], have poorer respiratory health, including episodes of wheeze [96,97], lower respiratory infection [96] and chronic bronchitis [97], and are at an increased risk of sudden unexpected death in early infancy [1]. The findings of this review suggest that younger infants could be at an increased risk of SHS exposure, though it is not possible to generalise other observed associations to very young infants based on the currently available literature.

Conclusions

Children whose parents are smokers, are of low SES, less educated, or hold less negative attitudes towards SHS are at an increased risk of SHS exposure in the home. The largest observed risks were for children living in households with smokers; the best way to reduce child SHS exposure in the home therefore is for smoking parents to quit. If parents are unable or unwilling to stop smoking, they should instigate smoke-free homes. Interventions targeted towards socially disadvantaged parents aiming to change attitudes to smoking in the presence of children, and providing context specific practical support to help parents overcome barriers to smoking outside the home may reduce children's domestic SHS exposure.

Supporting Information

Table S1 Study characteristics.
(DOCX)

Table S2 Associations identified and strength of effect.
(DOCX)

Checklist S1 PRISMA 2009 Checklist.
(DOC)

Author Contributions

Conceived and designed the experiments: SO LJ SC SL TC. Performed the experiments: SO. Analyzed the data: SO. Contributed reagents/materials/analysis tools: SO. Wrote the paper: SO LJ SC SL TC.

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7.1.1.1 Predictors of children's secondhand smoke exposure at home: a systematic review and narrative of the evidence, PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	1-2
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	n/a
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	2
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-6
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	2-3 Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	2

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	2-4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	2
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Table S1
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	2

Section/topic	**#**	**Checklist item**	**Reported on page #**
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	3 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table S1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Table S1
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Table S1, Table S2
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	3
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a

DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	5-6
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	6
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	6
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	1

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Note: Page numbers refer to text in published paper.

Tables S1 and S2 are included in thesis as tables 1-1 and 1-2.

7.1.2 Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy: study methods and baseline data

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Longitudinal cohort survey of women's smoking behaviour and attitudes in pregnancy: study methods and baseline data

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ABSTRACT

Objectives: To report the methods used to assemble a contemporary pregnancy cohort for investigating influences on smoking behaviour before, during and after pregnancy and to report characteristics of women recruited.

Design: Longitudinal cohort survey.

Setting: Two maternity hospitals, Nottingham, England.

Participants: 3265 women who attended antenatal ultrasound scan clinics were offered cohort enrolment; those who were 8–26 weeks pregnant and were currently smoking or had recently stopped smoking were eligible. Cohort enrollment took place between August 2011 and August 2012.

Primary and secondary outcome measures: Prevalence of smoking at cohort entry and at two follow-up time points (34–36 weeks gestation and 3 months postnatally); response rate, participants' sociodemographic characteristics.

Results: 1101 (33.7%, 95% CI 32.1% to 35.4%) women were eligible for inclusion in the cohort, and of these 850 (77.2%, 95% CI 74.6% to 79.6%) were recruited. Within the cohort, 57.4% (N=488, 95% CI 54.1% to 60.7%) reported to be current smokers. Current smokers were significantly younger than ex-smokers (p<0.05), more likely to have no formal qualifications and to not be in current paid employment compared to recent ex-smokers (p<0.001).

Conclusions: This contemporary cohort, which seeks very detailed information on smoking in pregnancy and its determinants, includes women with comparable sociodemographic characteristics to those in other UK cross-sectional studies and cohorts. This suggests that future analyses using this cohort and aimed at understanding smoking behaviour in pregnancy may produce findings that are broadly generalisable.

Strengths and limitations of this study

- This longitudinal cohort has collected the most detailed information on influences and determinants of smoking in pregnancy for almost 20 years.
- Future cohort analyses will investigate determinants of and describe women's smoking behaviour and attitudes and their receptivity to help with stopping smoking during pregnancy and postnatally.
- Although recruitment was in Nottingham, cohort women have a demographic profile which appears broadly representative of other UK women who smoke in pregnancy.

BACKGROUND

Maternal smoking in pregnancy causes substantial harm to the infants and mothers, increasing risks of miscarriage, stillbirth, prematurity, low birth weight, perinatal morbidity and mortality, neonatal or sudden infant death.[1] There is growing evidence of the impact of smoking in pregnancy on children; associations have been found with childhood behavioural problems,[2 3] and being overweight[4] or obese in childhood.[5] In addition, the costs to the National Health Service (NHS) of adverse maternal and infant health outcomes related to smoking are estimated to be between £31.6 million and £87.5 million/year.[6] Reducing smoking in pregnancy is therefore an NHS priority, with the government aiming to reduce rates from 14% in 2009/2010 to less than 11% by 2015.[7]

Between 1984 and 2000, UK studies found that 30–35% of women smoked during pregnancy.[8–11] More recently smoking in pregnancy appears to have decreased,[12] but it remains a significant problem, particularly among younger and more deprived women; pregnant women aged under 20 are four times more likely to smoke than those aged over 35 years.[12] Furthermore, mothers in routine and manual occupations (eg, people working in sales, services, technical, operative or agricultural jobs) are five times more likely to smoke during pregnancy than those in managerial and professional occupations.[12] In 2001, the Millennium Cohort Survey (MCS) data showed that 35.3% of UK women smoked at some point during pregnancy, and 28.4% of women were smoking at 9 months postnatally.[13] By 2010, the UK Infant Feeding Survey (IFS) showed that this had fallen to 26% of women smoking before or during pregnancy and 12% throughout[12]; however, caution is required as IFS and MCS may not be completely comparable due to some differences in methodology and sampling. While both studies were UK-wide, the MCS collected retrospective maternal self-report of smoking 9 months postnatally, disproportionately sampling families living in high poverty in Northern Ireland, Scotland and Wales, and from high ethnic minority populations in the UK.[13] The IFS, however, collected maternal-reported smoking at 6–10 weeks postnatally from a representative sample of mothers weighted for age and deprivation.[12]

There is evidence that smoking behaviour fluctuates during pregnancy. In a US pregnancy cohort, up to 21% of quit attempts were made after the first trimester[14] also, these were often repeated throughout pregnancy[14] and 84% of pre-pregnancy smokers reported daily smoking later in pregnancy.[15] However, little is known about smoking patterns in pregnancies in the UK because there have been very few cohort studies investigating this; in a 1986 cohort, 31% of pregnant mothers smoked and, although 25% of these were successful at quitting at some point during pregnancy, the timing of cessation was unclear and relapse to smoking was not reported.[10] A second UK cohort conducted in the early 1990s[16] found complex smoking trajectories across pregnancy; just over 30% of smoking women stopped smoking temporarily in pregnancy, with quit attempts and relapse occurring at varying times across pregnancy.

Smoking therefore remains prevalent in pregnancy, and although smoking patterns appear to vary across pregnancy there is very little contemporary, normative data available. Similarly, almost nothing is known about when pregnant smokers are most receptive to offers of help with stopping smoking. Currently, pregnant women in the UK are systematically offered referral for NHS smoking cessation support during their first meeting with a midwife, but offers of support are less systematic in later pregnancy. Such later offers of support might be readily accepted but there is almost no research evidence on smokers' propensity for using cessation support during pregnancy. Research documenting women's smoking behaviour across pregnancy and how their attitudes to this and to receiving support with cessation might vary at different times in pregnancy could help determine when offers of cessation support made to pregnant women are most likely to be accepted. We have recruited a longitudinal, pregnancy cohort which has collected detailed information on these issues and also on the many potential determinants of and influences on smoking in pregnancy. The primary aim of this cohort study will be to estimate the proportion of smokers who initiate quit attempts in the second or third trimester of pregnancy. The secondary aims are to describe pregnant women's longitudinal smoking patterns throughout pregnancy, the timing of women's quit attempts and women's use of and attitudes to offers of NHS orientated cessation support and self-help cessation support. The longitudinal cohort will also explore whether individual, family and social context factors predict smoking patterns, use of and attitudes towards cessation support. We believe this cohort has collected some of the most detailed ever longitudinal UK data on smoking in pregnancy. Consequently, future analyses using cohort data will facilitate clearer understanding of the phenomenon of smoking in pregnancy.

We report methods used to assemble the cohort, details of the measures employed to quantify potential determinants of smoking, recruitment rates and the sociodemographic characteristics of cohort participants.

METHODS

Participants

Eligible women were those aged 16 years or above, and reported being between 8 and 26 weeks pregnant. Women who self-reported being either current smokers (defined as self-reported occasional smokers and daily smokers) or having smoked in the 3 months prior to becoming pregnant were eligible for participation. Women who were unable to understand study procedures sufficiently to provide consent (eg, due to cognitive difficulties) had previously enrolled in the study, or were unable to read or understand the written questionnaires in English were not enrolled.

Recruitment and questionnaire distribution

We recruited a longitudinal cohort of pregnant women using questionnaires completed at 8–26 weeks gestation, followed up at 34–36 weeks gestation, and 3 months after childbirth.

Recruitment and baseline questionnaire

On the basis of routine hospital data, there were approximately 10 051 infants born in Nottingham hospitals in 2011/2012. We envisaged that at least 25% of pregnant women in Nottingham would have smoked in the 3 months prior to or during pregnancy, providing 2500 potential participants from which we could recruit to the survey. Recruitment to the Pregnancy Lifestyle Survey took place between August 2011 and August 2012. Recruitment took place at two antenatal clinics within Nottingham University Hospitals NHS Trust (City Hospital and Queen's Medical Centre). Researchers attended on average five clinics per week; to ensure representative sampling researchers attended varied clinics and specialist clinics evenly distributed across both sites. All women self-reporting to be between 8 and 26 weeks gestation attending routine antenatal appointments at these clinics were invited to complete an anonymous screening questionnaire which determined study eligibility based on the criteria described above. Those who met the criteria were directed to read a participant information sheet describing the study, and, if willing, to then complete a baseline questionnaire; women could also seek further information from the researcher in the clinic.

On completion of the baseline questionnaire, women were offered a £5 high street shopping voucher as recognition for the time taken to complete the questionnaire. Written informed consent was obtained from those who wished to participate in the rest of the study and to complete the two further follow-up questionnaires. Researchers contacted any women who did not feel able to make a decision about participation while they were in the clinic after a further 24 h to ascertain whether they wished to take part.

Follow-up at 34–36 weeks gestation

Researchers liaised with hospital administration staff to routinely check antenatal hospital records ensuring that questionnaires were not sent to women who had died or whose fetuses/infants had died; for all other participants at this time point, a second questionnaire was sent by post, using the contact details provided at recruitment. In addition, participants who provided an email address were emailed a link to a web-based version of the questionnaire, and sent one email reminder. Web-based questionnaires were created using the Bristol Online Surveys tool.[17] Participants were required to log in to the questionnaire using a unique ID number, details of which were provided in the email containing the URL link. The web-based questionnaires were designed with a similar layout to the paper versions and, with the exception of current smoking status, all questions were optional. Non-respondents were sent one postal/email reminder letter and then contacted by telephone; if no response was received, a text message reminder was sent to participants' mobile phones. Participants who were successfully contacted via telephone were invited to complete the questionnaire during the call.

All participants who completed follow-up questionnaires were sent a £5 shopping voucher.

Follow-up at 3 months after childbirth

Researchers liaised with hospital administration staff to routinely check antenatal hospital records to determine participants' actual delivery dates. A member of the research team sent the final questionnaire 3 months after the delivery date, using the same method as described above for follow-up in later pregnancy.

Questionnaire contents

Copies of the three questionnaires can be found in attached additional files, and a description of items selected from each is shown below. All questions used a range of response formats including yes/no responses, multiple choices and five-point Likert-type scales for attitudinal questions.

Baseline questionnaire

The baseline questionnaire contained 38 items including a combination of original questions and items derived from previous surveys or used in previous studies (shown by citations). The baseline questionnaire was divided into six sections: (1) *screening questions,* (2) *your health and your pregnancy,* (3) *your smoking behaviour and beliefs,* (4) *your current smoking behaviour,* (5) *your interest in getting help to stop smoking* and (6) *about you* (sociodemographic information). These questions asked women to describe their current smoking behaviour,[18–21] nicotine dependence based on the 'heaviness of smoking index'[20] general health,[22–26] intentions to quit smoking and self-efficacy in achieving this,[27 28] their beliefs about the harm smoking during pregnancy causes their baby,[27] support from family and friends to stop smoking,[27 29 30] any stop smoking services accessed.[27] The questionnaire also asked women about their opinions on a range of health professional provided and self-help stop smoking support, including telephone helplines, group sessions, one-to-one sessions, booklets, a DVD, websites, text messages, email support and a mobile phone/device application.[31] The age that women left education, qualifications, whether they rented or owned their own home, access to a car or van within their household, employment status, occupation and ethnicity were also collected at baseline.

Follow-up at 34–36 weeks gestation

The first follow-up questionnaire contained 22 items, divided into four sections. Many of the questions from the baseline questionnaire were repeated, with the exclusion of screening and sociodemographic information already gathered at baseline. The four sections covered by follow-up questionnaire were (1) *your smoking behaviour and beliefs,* (2) *your current smoking behaviour,* (3) *your interest in getting help to stop smoking* and (4) *your health and your pregnancy.* In addition to the questions asked at baseline, this questionnaire also asked women about experiencing nausea or sickness during pregnancy[32] and their concerns about weight gain as a result of stopping smoking.[33]

Follow-up at 3 months after childbirth

The second follow-up questionnaire contained 29 items, again divided into four sections. These were similar to the sections used in the baseline and first follow-up questionnaire, but the nature of the questions changed to reflect women's postnatal status. For example, the section (1) *your smoking behaviour and beliefs* asked women if they had smoked at all since the birth of their baby and focused on their confidence and

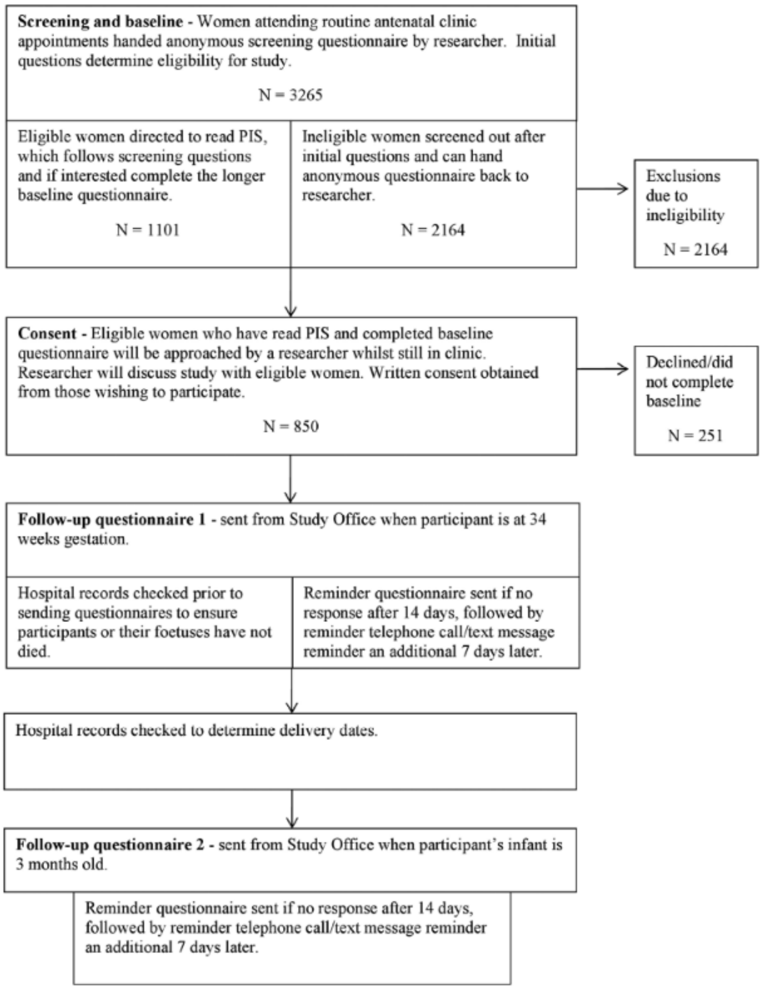

Figure 1 Flow diagram of recruitment and progress through study.

determination to stop smoking for good rather than until the birth of their baby. The final section (4) *your health* also asked women about smoking in the home and their beliefs about harm caused to infants through smoking in the home. In addition women were asked in this section about their relationship with their baby,[26] confidence in their parenting ability,[26] money concerns and family routine.[34 35] All questions followed a similar format as the baseline and first follow-up questionnaire.

Sample size

The target sample size was 850, anticipating a 20% drop out rate, giving an effective sample size of 683 pregnant smokers. The sample size calculation was conducted based on the primary aim of the cohort, to estimate the proportion of smokers who initiate quit attempts in the second or third trimester of pregnancy. This calculation estimated that 850 participants would be sufficient such that, if 20% of women reported quit attempts in the second or third trimester, we would be able to estimate this percentage with a 95% CI of ±3%.

Data analysis

Descriptive analyses were conducted summarising baseline cohort sociodemographic characteristics and information on current smoking behaviour from all women

Table 1 Smoking status of all women who completed screening questionnaire

	N=3265	Per cent	95% CI
Never smoked	1682	51.5	49.8 to 53.2
Completely stopped smoking more than 3 months before pregnancy	460	14.1	12.9 to 15.3
Completely stopped smoking at some time in the 3 months prior to pregnancy	86	2.6	2.1 to 3.2
Completely stopped smoking after finding out pregnant	390	11.9	10.9 to 13.1
Smoke occasionally, not every day now pregnant	153	4.7	4.0 to 5.4
Smoke everyday, cut down during pregnancy	387	11.9	10.8 to 13.0
Smoke everyday, same as before pregnancy	79	2.4	1.9 to 3.0
Smoke everyday, more than before pregnancy	6	0.2	0.08 to 0.4
Missing	22	0.7	

approached, and those recruited into the cohort. χ^2 Tests were used to examine potential differences in characteristics between those eligible women recruited and not recruited into the cohort, and current and recent ex-smokers within the cohort. Analyses were carried out in SPSS V.16.

Future analysis of the longitudinal cohort data will include descriptive statistics to delineate women's smoking patterns across pregnancy and receptivity to cessation support. Multivariable regression models will investigate whether patterns of smoking behaviour are predicted by individual, family or contextual factors and will be modelled for the potential impact of offering NHS Stop Smoking Services in Pregnancy (SSSP) and self-help to women at different points in pregnancy, based on the prevalence of women making unsupported quit attempts at those times.

RESULTS

Sample characteristics

Screening questionnaires were distributed and completed by 3265 women attending antenatal clinics in one of two sites at Nottingham University Hospitals NHS Trust. In total 148 (4.5%) women approached declined to complete the screening questionnaire, giving us a response rate of 95.5% for screening questionnaires. Routine hospital data indicate that there were 10 051 infants born in Nottingham hospitals in 2011/2012. We therefore estimate that just under one-third (32.5%) of the pregnant population within Nottingham were screened. A flow diagram illustrating the recruitment and progression of participants through the study can be seen in figure 1.

Table 1 shows the current smoking status of the 3265 women approached in antenatal clinics. In total 33.7% (N=1101, 95% CI 32.1% to 35.4%) of women between 8 and 26 weeks gestation, and over 16 years of age, were either current smokers or recent ex-smokers (had stopped smoking either in the 3 months prior to becoming or after finding out they were pregnant). Overall 19.1% (N=625, 95% CI 17.8% to 20.5%) of women who completed the screening questionnaire in clinic were currently smoking while pregnant.

Cohort characteristics

Of those eligible to participate, 87.7% (N=966) completed the baseline survey, and 77.2% (N=850) gave consent for participation in the longitudinal cohort survey. The cohort comprised of 26% of all women approached in antenatal clinics, and an estimated 8.5% of all pregnant women who gave birth within Nottingham in 2011/2012. A consort diagram detailing recruitment can be seen in figure 2.

Those eligible women who completed the baseline questionnaire but did not consent to enter the longitudinal cohort (N=116, 12.0%) were similar to the cohort in terms of smoking status, age, ethnicity, current employment and manual/non-manual occupations (table 2).

Table 3 shows the baseline smoking status of the 850 women enrolled into the cohort. In total 42.6% (N=362, 95% CI 39.3% to 45.9%) of participants reported having stopped smoking either in pregnancy or within the 3 months prior to this ('recent ex-smokers'), and 57.4% (N=488, 95% CI 54.1% to 60.7%) reported to be current smokers.

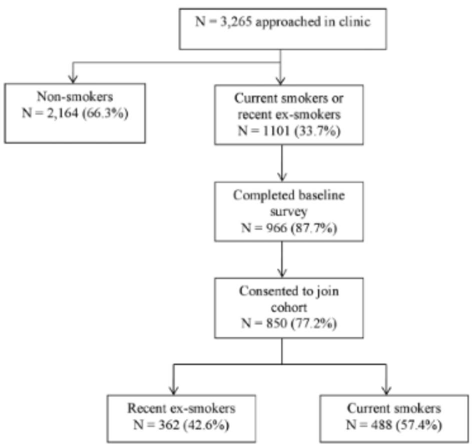

Figure 2 Consort diagram of recruitment.

Table 2 Comparison of eligible women who consented and declined to enter cohort

	Consented N=850 (88%)		Declined N=116 (12%)		
	N	Per cent	N	Per cent	p Value
Smoking status					
Recent ex-smoker	362	42.6	59	50.9	
Current smoker	488	57.4	57	49.1	0.092
Mean age (SD)	25.8 years	(SD 5.6)	25.9 years	(SD 5.7)	
Ethnicity					
White British	751	89.0	55	82.1	
Other ethnicity	93	11.0	12	17.9	0.089
Home ownership					
Own home	166	19.6	15	23.1	
Do not own home	680	80.4	50	76.9	0.501
Employment					
In current paid work	383	45.2	36	52.2	
Not in current paid work	465	54.8	33	47.8	0.261
Current or most recent occupation manual/non-manual					
Non-manual occupation	216	28.2	22	38.6	
Manual occupation or not applicable	549	71.8	35	61.4	0.096

As seen in table 4, differences between current and recent ex-smokers were observed across a range of socio-demographic characteristics. Current smokers were significantly younger than ex-smokers ($p<0.05$), more likely to have no formal qualifications, to have left full-time education at a younger age, to not own their homes, to not be in current paid employment and to not be in non-manual occupations compared with recent ex-smokers ($p<0.001$).

DISCUSSION

This is the first UK pregnancy cohort for 20 years to investigate smoking behaviour in pregnancy and, we believe, it may include more detailed longitudinal data on smoking and its determinants than any predecessor studies. We found that a third of women between 8 and 26 weeks gestation, and aged over 16 years, screened within Nottingham antenatal clinics were smoking either during pregnancy, or had smoked in the 3 months prior to this. Within our cohort of 850 pregnant women, we observed that 57% were current smokers and 43% had stopped either in pregnancy or 3 months prior to this. Current smokers entering our cohort were significantly younger, less educated and from lower socioeconomic backgrounds than recent ex-smokers. These findings are similar to those from previous UK cohorts, which reported that women who smoke before or during pregnancy are more likely to be less than 25 years of age,[10 12] more likely to have left education at a younger age and gained fewer formal qualifications,[10 13 36 37] and to be from lower socio-economic groups than non-smokers.[10–13 36 37]

Twenty-four years ago, The Nottingham Mothers Stop Smoking Project surveyed women within Nottingham Hospitals, using similar definitions of smoking to those we used.[10] Comparing current smoking rates to those recorded earlier, smoking rates appear to have declined substantially. Within this earlier cohort 64% of women smoked either before or during pregnancy and this was nearly the double rate in our 2012 sample (31%).[10] The reduction in smoking prevalence between Nottingham surveys is comparable to the fall in prevalence documented by the authoritative Infant Feeding Survey, suggesting that cohort findings are valid.[12]

Prevalence of smoking before or during pregnancy reported by the Infant Feeding Survey is lower than found in our cohort. However, while smoking rates in the East Midlands are, in general, low compared with other regions,[38] rates in Nottingham city are relatively

Table 3 Cohort baseline smoking status

Smoking status at baseline	N=850	Per cent	95% CI
Completely stopped smoking at some time in the 3 months prior to pregnancy	61	7.2	5.6 to 9.1
Completely stopped smoking after finding out pregnant	301	35.4	32.2 to 38.6
Smoke occasionally, not every day now pregnant	117	13.8	11.6 to 16.2
Smoke everyday, cut down during pregnancy	304	35.8	32.6 to 39.0
Smoke everyday, same as before pregnancy	64	7.5	5.9 to 9.5
Smoke everyday, more than before pregnancy	3	0.4	0.01 to 1

Table 4 Sociodemographic characteristics of smokers and recent ex-smokers in cohort

Demographic data	Total N=850 N	Total Per cent	Current smokers N=488 N	Current smokers Per cent	Recent ex-smokers N=362 N	Recent ex-smokers Per cent	Unadjusted OR (95% CI)
Age, years							
<20	150	17.7	97	20	53	14.6	1.00*
21–25	309	36.5	179	36.9	130	35.9	0.75 (0.5 to 1.1)
26–30	215	25.4	123	25.4	92	25.4	0.73 (0.48 to 1.1)
31–35	118	13.9	62	12.8	56	15.5	0.7 (0.37 to 0.1)
36–40	51	6.0	22	4.5	29	8.0	0.42 (0.22 to 0.79)
Over 40	4	0.5	2	0.4	2	0.6	0.55 (0.8 to 3.99)
Ethnicity							
White British	751	89	447	92	304	84.9	1.00*
White Irish/other white background	32	3.8	14	2.9	18	5.0	0.53 (0.26 to 1.1)
Asian/Asian British	9	1.1	2	0.4	7	2.0	0.19 (0.04 to 0.94)
Black/Black British	7	0.8	1	0.2	6	1.7	0.11 (0.01 to 0.95)
Mixed background	38	4.5	20	4.1	18	5.0	0.76 (0.39 to 1.45)
Other	7	0.8	2	0.4	5	1.4	0.27 (0.05 to 1.4)
Qualifications held							
No qualifications	155	18.2	128	26.2	27	7.5	1.00**
General Certificate of Secondary Educations or equivalent	355	41.7	213	43.7	142	39.2	0.32 (0.2 to 0.50)
AS/A-levels or equivalent	174	20.5	81	16.6	93	25.7	0.18 (0.11 to 0.30)
Degree or equivalent	133	15.6	42	8.6	91	25.1	0.1 (0.06 to 0.17)
Other	33	2.9	24	4.9	9	2.5	0.56 (0.24 to 1.35)
Age left full time education, years							
16 and under	469	56.4	307	64.9	162	45.25	1.00**
17–19	219	26.4	112	23.68	107	29.89	0.55 (0.40 to 0.77)
20 or older	115	13.8	41	8.67	74	20.67	0.29 (0.19 to 0.45)
Still in full time education	28	3.4	13	2.75	15	4.19	0.46 (0.21 to 0.99)
Home ownership							
Own home	166	19.6	57	11.8	109	30.1	1.00**
Do not own home	680	80.0	427	88.2	253	69.9	3.23 (2.26 to 4.6)
Current employment							
In current paid work	383	45.1	164	33.6	219	60.5	1.00**
Not in current paid work	467	54.9	324	66.4	143	39.5	3.03 (2.28 to 4.01)
Current or most recent occupation manual/non-manual							
In non-manual occupation	216	28.2	75	17.6	141	41.6	1.00**
In manual occupation/not applicable	549	71.8	351	82.4	198	58.4	3.33 (2.28 to 4.01)

*Significant in univariate analyses, p<0.05.
**Significant in univariate analyses, p<0.001.

high. Smoking prevalence among Nottingham adults (non-pregnant) was reported as 27% in 2011[39] and this is higher than the national average for England (20%).[38] Moreover, Nottingham City ranked 20 of 326 local authorities in England for deprivation in 2010.[40] Together, these factors are likely to contribute towards higher rates of smoking in pregnancy in Nottingham, again suggesting that cohort findings are valid.

Our cohort study found similar associations between smoking behaviour and demographic characteristics as reported in previous studies. For example, it has been widely reported that smoking in pregnancy is more prevalent in younger women.[10 12] Previous cohorts have further shown smoking in pregnancy to be linked with lower socioeconomic status, whereby those pregnant women in routine or manual occupations are up to five times more likely to smoke.[10–13] As with our cohort, Madeley *et al*[10] and the MCS[13] reported lower educational attainment to be strongly related to smoking in pregnancy. These studies observed high smoking rates in those who had left education at 16 years or younger, had lower than General Certificate of Secondary Education (GCSE)-level qualifications or no qualifications [10 37]; similarly, we found that 60% of cohort women had no educational qualifications higher than GCSE, with current smokers having left full-time education at a younger age.

Comparisons between women who smoke in pregnancy and 'recent ex-smokers' gave similar findings in our sample and in the MCS. Smokers enrolled in the MCS were more likely to be in routine and semiroutine occupations,[36] and less likely to be classified as 'non-working class' compared with women who had stopped smoking early in pregnancy.[37] Current smokers were also less likely to have achieved GCSE qualifications or above.[37] Current smokers and those who had quit were similar in age.[36 37] Findings from our cohort were very similar, with the exception that 'recent ex-smokers' were more likely to be older.

A characteristic of our cohort is that it predominantly consists of white British population. This is similar to previous cohorts, for example 87.1% of respondents within the MCS [13] and 82% in the 2010 IFS were white British.[41] Like our own cohort, the MCS[13] found smoking during pregnancy to be more prevalent among women of white British ethnicity. With the exception of those of black Caribbean and Irish ethnicity (smoking prevalence of 24% and 26%, respectively), smoking prevalence among women from ethnic minorities is generally low at less than 8%.[42] However, as the proportion of ethnic minorities within our cohort is low, the data, perhaps can be used most securely to form hypotheses about influences on smoking within a white British population.

A strength of our study was the very high response rate achieved, with 96% of women attending selected antenatal clinics within the Nottingham University Hospital Trust having their smoking status recorded and being screened for eligibility, accounting for around one-third of all births within Nottingham. Women who did not attend antenatal screening could not have been included in the cohort; however, 99% of UK women attend ultrasound anomaly screening scans[43]; so our methods are likely to provide a similar sample to that obtained from a thorough population-based approach. A further strength of our study was the prospective recording of smoking status during pregnancy; some previous cohorts collected data retrospectively during the postnatal period,[12 13] subjecting their findings to recall error and bias.

A potential limitation of this research and of our cohort was the reliance on self-reported smoking status data. The social stigma of smoking in pregnancy may lead to under-reporting and therefore a response bias but few studies have investigated this.[44] In a Scottish study, self-reported smoking status measured at 8–12 weeks gestation was noted to be 25% lower than that measured by serum cotinine at 15–16 weeks gestation.[45] This could have been due to under-reporting of smoking habits; however, it is also likely that at least a proportion of this was due to relapse to smoking as gestation progresses. However, other research has shown a high correlation between self-reported smoking and biomedical markers within pregnant populations,[15 46] suggesting that self-report measures can be a valid method of assessing smoking status in surveys such as ours. Furthermore, although recruitment was limited to Nottingham the observed demographic profile of smokers within the cohort is, given the composition of other cohorts, as expected and broadly representative of pregnant smokers generally.

This cohort provides contemporary data source for investigating the phenomenon of smoking in pregnancy. We achieved a high response rate which has resulted in comprehensive population coverage. Future analyses using cohort data will attempt to gain greater understanding of smoking in pregnancy and, as the characteristics of cohort participants are similar to those of other white British smokers, findings from future studies will be most generalisable pregnant smokers from this social group.

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7.1.3 Smoking in the home after childbirth: prevalence and determinants in an English cohort

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Smoking in the home after childbirth: prevalence and determinants in an English cohort

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ABSTRACT

Objectives: Children's exposure to secondhand smoke (SHS) is causally linked to childhood morbidity and mortality. Over 38% of English children (aged 4–15) whose parents are smokers are exposed to SHS in the home. Little is known about the prevalence of SHS exposure in the homes of young infants (≤3 months). This study aimed to estimate maternal self-reported prevalence of SHS exposure among infants of women who smoked just before or during pregnancy, and identify factors associated with exposure.

Setting: Primary Care, Nottingham, England.

Participants: Current and recent ex-smoking pregnant women (n=850) were recruited in Nottingham, England. Women completed questionnaires at 8–26 weeks gestation and 3 months after childbirth. Data on smoking in the home 3 months after childbirth was available for 471 households.

Primary and secondary outcome measures: Maternal-reported smoking in the home 3 months after childbirth.

Results: The prevalence of smoking in the home 3 months after childbirth was 16.3% (95% CI 13.2% to 19.8%) and after multiple imputation controlling for non-response 18.2% (95% CI 14.0% to 22.5%). 59% of mothers were current smokers; of these, 24% reported that smoking occurred in their home compared to 4.7% of non-smokers. In multivariable logistic regression, mothers smoking ≥11 cigarettes per day were 8.2 times (95% CI 3.4 to 19.6) more likely to report smoking in the home. Younger age, being of non-white ethnicity, increased deprivation and less negative attitudes towards SHS were also associated with smoking in the home.

Conclusions: This survey of smoking in the home 3 months after childbirth found a lower prevalence than has been reported in older children. Interventions to support smoking mothers to quit, or to help them restrict smoking in the home, should target attitudinal change and address inequality relating to social disadvantage, younger age and non-white ethnic groups.

Strengths and limitations of this study

- This is the first survey since the introduction of smoke-free legislation, as far as we are aware, of smoking in the home immediately after childbirth.
- During recruitment, 96% of women attending selected antenatal clinics within Nottingham University Hospital Trust were screened for eligibility, accounting for around one-third of all births within Nottingham, England, during this time.
- The demographic profile of smokers within this cohort is similar to other UK pregnancy cohorts, meaning the sample is likely to be broadly representative.
- A potential limitation was the reliance on reported smoking measures.
- There were some differences between those who responded and those who did not respond at follow-up, however appropriate imputation methods were used to allow for this non-response bias.

BACKGROUND

Exposure to secondhand smoke (SHS) is the involuntary inhalation of other people's cigarette smoke and globally, 40% of children are exposed.[1] Children's SHS exposure has been causally linked to respiratory tract infections, middle ear disease, sudden unexplained death in infancy and asthma.[2] The WHO believes that SHS is a substantial threat to child health,[3] and the US Surgeon General argues there is no safe exposure level.[4]

In 2008, a study conducted in England reported 52% of children aged 4–15 whose parents were smokers were exposed to SHS in the home.[5] This has reduced in recent years, with a reported 38.7% of children of smoking parents aged 4–15 years being exposed to SHS in the home in England in 2012,[6] however it clearly remains a significant problem. Similar trends have been observed elsewhere, both in the UK,[7–10] and internationally (eg, USA;[11 12] Ireland, France, Germany and the Netherlands [13]). However, current UK prevalence estimates for children's SHS exposure in the home focus on children aged >4 years,[6–10 14–16] and most studies include children aged 10–11 years.[7–10 16] There is therefore little research examining SHS exposure in the home among young infants (≤3 months) and few prevalence estimates. We are aware of only one UK study estimating the prevalence of SHS among young infants. Among children of smokers, 82% of infants (average age 3 months) experienced SHS exposure in the home.[17] Elsewhere, we are aware of just two studies, from the USA, in which 10.8–21.4% of infants of smoking mothers aged ≤9 months were exposed to SHS in the home[18] and 24.5% were exposed to SHS for ≥1 h per day.[19] Although these studies suggest SHS exposure may be a substantial issue, they were conducted prior to,[17 19] or around the time[18] that comprehensive smoke-free legislations were introduced. There are no contemporary estimates of prevalence in this age group.

Additionally, of 41 studies investigating factors associated with children's SHS exposure in the home identified by systematic review,[20] only three[19 21 22] included infants or children aged <2 years. This review found parental smoking, low socioeconomic status (SES) and being less educated were all consistently independently associated with children's SHS exposure in the home.[20] However, due to the small number of studies focusing on younger age groups, little is known about the influences on SHS exposure in the home experienced by young infants; consequently, this paper reports the prevalence of SHS exposure among young infants born to women from an English pregnancy cohort, and identifies factors associated with this exposure.

METHODS

This study presents secondary analysis on data collected as part of the longitudinal cohort, the Pregnancy Lifestyle Survey (PLS); methods and cohort characteristics have been described in detail previously.[23] The study received a favourable opinion from Derbyshire Research Ethics Proportionate Review Sub-Committee (reference 11/EM/0078).

Participants

The baseline sample size for the PLS was 850, based on the cohort's primary aim to estimate the proportion of smokers who initiate quit attempts in the second or third trimester of pregnancy.[23] Women who were aged ≥16 years, between 8 and 26 weeks pregnant, and self-reported being current smokers or having smoked in the 3 months prior to pregnancy were eligible for participation.

Recruitment and data collection

Participants were recruited between August 2011 and August 2012 at two antenatal clinics within Nottingham University Hospitals NHS Trust, England. Participants completed a baseline questionnaire in the antenatal clinic when they were between 8 and 26 weeks gestation, and a follow-up questionnaire when their baby was 3 months old. At Follow-up, hospital administration staff obtained participants' delivery dates from their antenatal records. Participants were sent a questionnaire 3 months after their delivery date by post or email; if not returned, completion by telephone was attempted.

The questionnaires have been described elsewhere.[23] In summary, both the baseline and the follow-up questionnaires were similar in format and content, using yes/no, multiple choice and five-point Likert items. The baseline questionnaire was divided into six sections: screening questions, health and pregnancy, smoking beliefs, current smoking behaviour, interest in getting help to stop smoking and sociodemographic information. At the 3-month follow-up, the same topics were covered but edited to reflect women's postnatal status. Additional questions about smoking in the home, and beliefs about harm caused to infants and children through SHS exposure were included.

Outcomes

The primary outcome measure was maternal-reported smoking by either themselves or someone else in their home 3 months after childbirth, using participants' responses to the questions 'how often do you smoke in your home nowadays?' and 'how often do other people smoke in your home nowadays?'. Responses used Likert items ranging from 1 ('never') to 5 ('very often'). A binary outcome was created, where participants who responded 'almost never' to 'very often' (2–5 on scale) to either of these questions were considered to have smoking in the home 3 months after childbirth, and participants who responded 'never' to have a smoke-free home.

The maternal sociodemographic characteristics of age, ethnicity, highest qualification, age left full-time education and current employment status were taken from baseline questionnaires. Age left full-time education was categorised as ≤16 years (UK age of compulsory education), ≥16 years and still in full-time education. Ethnicity was categorised as a binary variable (white British vs other ethnicity) due to small numbers of participants in non-white British ethnic groups. A measure of socioeconomic status (SES) was created by mapping participants' postcodes with corresponding 2007 Indices of Multiple Deprivation (IMD) scores, taken from routine UK Data Service data.[24] The 2007 IMD measures a range of domains reflecting economic, social and housing issues, where higher scores reflect greater deprivation. Scores were divided into tertile groups.

Participant's self-reported smoking behaviour was measured at both time points. Women were categorised as being a non-smoker, or smoking 0–5, 6–10, ≥11 cigarettes per day. Heaviness of smoking index (HSI) scores were calculated using the method described by

Borland *et al*[25] Partner smoking status at 3 months after childbirth was categorised as non-smoker, smoker or not applicable/no partner.

Attitudes to children's SHS exposure were measured by asking participants the extent to which they agreed with four attitudinal statements using Likert items (figure 1). The items had high-internal consistency (Cronbach's α=0.9),[26] and so responses were combined into a single summed score (out of 20), whereby a higher score reflected a more negative attitude towards children's SHS exposure. Attitude scores were highly negatively skewed, and so were categorised into a binary variable; a score of ≥15 represented 'negative attitudes towards child SHS exposure' and a score of <15 'less negative attitudes towards child SHS exposure'.

Data analysis

Statistical analyses were conducted using Stata V.13.[27] Cohort characteristics and the characteristics of responders and non-responders at 3 months after childbirth are presented, and differences examined using χ^2 tests for categorical data and t tests for continuous data. The prevalence of smoking in the home was estimated using those with complete data; given that there was a high level (50%) of missing data at 3 months after childbirth and observed differences in the characteristics of responders and non-responders, multiple imputation methods[28] were used to impute values for missing outcome data. Five imputed data sets were considered sufficient[29] and were constructed using the mi command in Stata, based on the following baseline variables: smoking behaviour, HSI, age, ethnicity, qualifications, employment, IMD score and partner smoking status. These variables were selected based on characteristics associated with child SHS exposure in the home in a previous systematic review[20] and variables associated with non-response.[30] The imputed outcome variable was only used for estimates of prevalence of smoking in the home; all other analyses were conducted using the original non-imputed outcome variable.

The variables smoking behaviour at baseline, smoking behaviour 3 months after childbirth, age, ethnicity, highest qualification, age left full-time education, employment status, IMD, partner smoking status and attitude towards child SHS exposure score were entered into a univariate logistic regression analysis and the ORs and 95% CI calculated. For continuous exposure variables, the linearity of the effect was tested using the likelihood-ratio test.

Those variables that were statistically significant in univariate analysis at the p<0.05 level, or with strong a priori assumptions (eg, maternal education) based on the findings of a systematic review,[20] were entered into exploratory multivariable logistic regression models. Correlations were observed between smoking behaviour at baseline, smoking behaviour at 3 months after childbirth and baseline HSI. Smoking behaviour at 3 months after childbirth was most strongly associated with the outcome measure, and was therefore included in the multivariable analyses and the other smoking variables omitted to avoid collinearity. Similarly, highest qualification and age left full-time education were considered in the multivariable analysis independently due to collinearity. Those variables reaching significance (p<0.05) were retained in the model, and non-significant variables re-entered into the model sequentially. Participants with missing data for exposure variables were excluded from multivariable analysis (n=6). ORs, 95% CI, and likelihood ratio test p values and Wald's p values for trend for ordered categorical exposure variables are reported.

RESULTS

Cohort characteristics

The cohort consisted of 850 pregnant women, of which 56.6% were current smokers at baseline (table 1). The demographic profile of smokers within the cohort was similar to other UK pregnancy cohorts.[23]

Follow-up response rates

At follow-up, the response rate was 56% (n=476) after non-response and withdrawal (figure 2). Owing to missing data in some of the returned questionnaires, smoking in the home information was available for 471 participants. Table 1 shows the characteristics of women who did and did not respond to the follow-up questionnaire 3 months after childbirth.

Figure 1 Attitudes to child secondhand smoke exposure scale items.

1) If my baby regularly breathes in people's tobacco smoke, it can seriously harm him/her
2) Smoking in the home can seriously harm babies (under 1 year old)
3) Smoking in the home can seriously harm children (over 1 year old)
4) Smoking in the home but not in the same room as a baby can seriously harm him/her

Rated using a 5-point Likert scale, 1 being 'not at all' and 5 being 'extremely'

Table 1 Cohort characteristics and comparison between responders and non-responders at 3 months postnatal

Characteristic	All cohort N (%) N=850	Responders at 3 months postnatal N (%) N=476	Non-responders and withdrawals at 3 months postnatal N (%) N=374	p Value
Smoking behaviour baseline				
Recent ex-smoker	362 (43.4)	235 (50.1)	127 (34.7)	
≤5 cigarettes per day	191 (22.9)	105 (22.4)	86 (23.5)	
6–10 cigarettes per day	151 (18.08)	71 (15.1)	80 (21.9)	
≥11 cigarettes per day	131 (15.4)	58 (12.4)	73 (20.0)	<0.0001
Age (years) Mean (SD)	25.8 (5.5)	26.5 (5.6)	24.8 (5.3)	<0.0001
Ethnicity				
White British	751 (89.0)	421 (89.0)	330 (89.0)	
Other ethnicity	93 (11.0)	52 (11.0)	41 (11.1)	0.0007
Highest qualification				
No qualifications	155 (18.2)	62 (13.0)	94 (25.1)	
GCSEs or equivalent	355 (41.8)	184 (38.7)	171 (45.7)	
AS/A-Levels or equivalent	174 (20.5)	118 (24.8)	56 (15.0)	
Degree or equivalent	133 (15.7)	95 (20.0)	38 (10.2)	
Other qualification	33 (2.9)	17 (3.6)	16 (4.3)	<0.0001
Age left education				
≤16 years of age	469 (56.4)	232 (50.0)	237 (64.6)	
≥17 years of age	334 (40.2)	211 (45.4)	123 (33.5)	
Still in full-time education	28 (2.4)	21 (4.5)	7 (1.9)	<0.0001
Employment				
Paid work, manual	158 (18.7)	102 (21.5)	56 (15.0)	
Paid work, non-manual	180 (21.3)	131 (27.6)	49 (13.1)	
Paid work, unclear whether manual/ non-manual	45 (5.3)	27 (5.7)	18 (4.8)	
Unemployed	201 (23.7)	92 (19.4)	109 (29.2)	
Full-time parent	219 (25.9)	97 (20.5)	122 (32.7)	
Full-time student	23 (2.7)	13 (2.7)	10 (2.7)	
Other	21 (2.5)	12 (2.5)	9 (2.4)	<0.0001
Indices Multiple Deprivation score (IMD)*				
1st tertile	284 (33.6)	178 (37.4)	106 (28.8)	
2nd tertile	279 (33.1)	162 (34.0)	117 (31.8)	
3rd tertile	281 (33.3)	136 (28.6)	145 (39.4)	0.002
Baseline heaviness of smoking index (smokers only)				
Low addiction	321 (67.6)	171 (72.8)	150 (62.5)	
Moderate addiction	146 (30.7)	61 (26.0)	85 (35.4)	
High addiction	8 (1.7)	3 (1.3)	5 (2.1)	0.06
Partner smoking baseline				
Partner does not smoke tobacco	499 (59.1)	172 (36.4)	122 (32.9)	
Partner smokes tobacco	294 (34.8)	279 (58.9)	220 (59.3)	
No partner	51 (6.0)	22 (4.7)	29 (7.8)	0.12

*Higher score reflects greater deprivation.
GCSE, General Certificate of Secondary Education.

Smoking in the home 3 months after childbirth: prevalence and determinants

The 'raw' prevalence of smoking in the home 3 months after childbirth was 16.3% (95% CI 13.2% to 19.8%). At this time, 59% of mothers were current smokers; of these, 24% reported smoking in the home compared to 4.7% of non-smokers (table 2). After controlling for non-response bias using multiple imputation methods, prevalence of smoking in the home 3 months after childbirth was 18.2% (95% CI 14.0% to 22.5%).

Table 2 shows the results of univariate analysis for factors associated with smoking in the home 3 months after childbirth, using non-imputed data. The strongest observed associations were for maternal smoking at 3 months after childbirth; those mothers smoking ≥11 cigarettes per day were 10.5 times more likely to report that smoking occurred in their home compared to non-smoking mothers at this time point. Maternal age, ethnicity, highest qualification, age left full-time education, IMD, partner smoking status and attitudes towards child

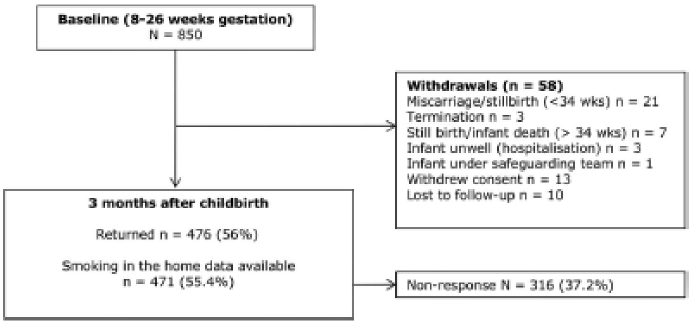

Figure 2 Consort diagram of response rates and reasons for withdrawal.

SHS exposure score were also significantly associated with smoking in the home in univariate analysis.

In exploratory multivariable logistic regression modelling, smoking behaviour at 3 months after childbirth, younger maternal age, being of non-white British ethnicity, being more deprived as measured by IMD and holding less negative attitudes towards child SHS exposure were significantly associated with smoking in the home 3 months after childbirth (table 2). The strongest observed association was for mothers who smoked ≥11 cigarettes per day, who were over eight times more likely to report smoking occurred in their home.

DISCUSSION

After multiple imputation to control for non-response, the prevalence of smoking in the home at 3 months following childbirth was 18.2%. Prevalence was higher in homes where mothers who smoked lived compared to those where mothers were non-smokers (24% and 4.7%, respectively). Mothers who were currently smoking ≥11 cigarettes per day, younger, of non-white ethnicity, more deprived and held less negative attitudes towards child SHS exposure were significantly more likely to report that smoking occurred in their home 3 months after childbirth.

As far as we are aware, this is the first survey to investigate smoking in the home immediately after childbirth since the introduction of UK smoke-free legislation. Our estimate of the prevalence of SHS in the home was similar to estimates among slightly older infants from the USA, where 10.8–24.5% of infants of smoking mothers were exposed.[18 19] However, this was substantially lower than in the only previous UK survey in infants who were a similar age as those in our sample.[17] In that study, 82% of infants aged on average 3 months old whose parents were smokers were exposed to SHS in the home. A number of factors are likely to have influenced our lower estimate of SHS exposure. Blackburn *et al*'s[17] study was conducted in 2003; smoke-free legislations have since been implemented across the UK and this may have increased awareness of SHS and its implications. Additionally, UK smoking prevalence has reduced since the earlier survey, in particular among those of childbearing age[31]; increasing numbers of UK households are reported as smoke-free[2] and older children's SHS exposure in the home has reduced.[5 10] Together these factors suggest that rates of smoking in the home will have declined since Blackburn's study.[17]

The observed prevalence of young infant's SHS exposure in the home is much lower than the most recent estimates of prevalence among older children in England, where 38.7% of children aged 4–15 years whose parents were smokers were exposed in the home in 2012.[6] This finding is positive; young infants are particularly susceptible to the risks of SHS exposure as they have a higher respiration rate[32] and underdeveloped lungs.[33] This is exacerbated further as young infants experience increased SHS exposure due to the amount of time spent indoors in close proximity to smoking parents and surfaces such as carpets that have been contaminated with smoke, and having more hand to mouth contact compared to older children.[34] However, SHS exposure is dangerous for children of all ages[2]; it is not yet known at what age parents or carers start to consider their children to be less vulnerable to the effects of SHS exposure and relax their home smoking restrictions. The early postnatal period, where the prevalence of SHS exposure in the home appears greatly reduced, may be a significant time-point to prevent future SHS exposure, before smoking in the home becomes an established behaviour.

In a recent systematic review,[20] children whose parents were smokers, of low SES, less educated or held less negative attitudes towards SHS were at an increased risk of SHS exposure in the home, with the largest risks observed for children living in households with smokers. With the exception of parental education, the factors associated with young infant's SHS exposure in this study are similar to those among older children. The findings also show similarities to the current limited evidence base examining this in infants aged <2 years elsewhere; in the USA, having more children in the household, being of white ethnicity, low maternal education, low maternal age, being unmarried, lower income and markers of disadvantage during pregnancy were associated with infant SHS exposure.[18 19]

Table 2 Prevalence of smoking in the home, and univariate and multivariable analysis of associated factors

Characteristic	All sample (N=471) N (column %)	Smoking occurs in the home (N=76) N (row %)	Unadjusted OR OR (95% CI)	Adjusted OR (N=465) OR (95% CI)
Smoking status baseline				
Recent ex-smoker	231 (49.0)	20 (8.7)	Reference*	
Current smoker	240 (51.0)	56 (23.3)	3.21 (1.86 to 5.60)	
Smoking behaviour baseline				
Recent ex-smoker	231 (49.8)	20 (8.7)	Reference*	
≤5 cigarettes per day	104 (22.4)	19 (18.3)	2.36 (1.20 to 4.64)	
6–10 cigarettes per day	71 (15.3)	14 (19.7)	2.60 (1.23 to 5.45)	
≥11 cigarettes per day	58 (12.5)	21 (36.2)	5.99 (2.96 to 12.12)	
Smoking status 3 months after childbirth				
Ex-smoker	192 (40.8)	9 (4.7)	Reference*	
Current smoker	279 (59.2)	67 (24.0)	6.43 (3.12 to 13.25)	
Smoking behaviour 3 months after childbirth				
Ex-smoker	192 (40.8)	9 (4.7)	Reference*	Reference*
≤5 cigarettes per day	105 (22.3)	25 (23.8)	6.35 (2.84 to 14.23)	6.17 (2.63 to 14.46)
6–10 cigarettes per day	83 (17.6)	11 (13.3)	3.11 (1.24 to 7.81)	2.09 (0.78 to 5.63)
≥11 cigarettes per day	91 (19.3)	31 (34.1)	10.51 (4.73 to 23.32)	8.17 (3.41 to 19.55)
Baseline heaviness of smoking index				
Low addiction	171 (36.3)	35 (20.5)	Reference*	
Moderate addiction	60 (12.7)	17 (28.3)	1.54 (0.78 **to** 3.01)	
High addiction	3 (0.6)	2 (66.7)	7.77 (0.68 **to** 88.19)	
Not applicable/non-smoker	237 (50.3)	22 (9.28)	0.40 (0.22 **to** 0.71)	
Maternal age (years)				
Mean (SD)	26.5 (5.6)	24.6 (4.6)	0.93 (0.88 to 0.97)*	0.94 (0.89 to 1.00)†
Ethnicity				
White British	416 (88.9)	62 (14.9)	Reference†	Reference†
Other ethnicity	52 (11.1)	14 (26.9)	2.10 (1.08 to 4.11)	2.69 (1.19 to 6.06)
Highest qualification				
No qualifications	61 (13.0)	20 (32.8)	Reference*	
GCSEs or equivalent	183 (38.9)	28 (15.3)	0.37 (0.19 to 0.72)	
AS/A-Levels or equivalent	116 (24.6)	10 (8.6)	0.19 (0.08 to 0.45)	
Degree or equivalent	94 (20.0)	11 (11.7)	0.27 (0.12 to 0.62)	
Other qualification	17 (3.6)	7 (41.2)	1.43 (0.48 to 4.33)	
Age left full-time education				
≥17 years of age	208 (45.3)	22 (10.6)	Reference†	
≤16 years of age	230 (50.1)	48 (20.9)	2.23 (1.29 to 3.84)	
Still in full-time education	21 (4.6)	3 (14.3)	1.41 (0.38 to 5.17)	
Employment				
Paid work, manual	102 (21.8)	13 (12.8)	Reference	
Paid work, non-manual	129 (27.5)	13 (10.1)	0.77 (0.34 to 1.74)	
Paid work, unclear whether manual/ non-manual	27 (5.8)	6 (22.2)	1.96 (0.67 to 5.75)	
Unemployed	90 (19.2)	21 (23.3)	2.08 (0.97 to 4.45)	
Full-time parent	97 (20.7)	18 (18.6)	1.56 (0.72 to 3.39)	
Full-time student	13 (2.8)	2 (15.4)	1.24 (0.25 to 6.26)	
Other	11 (2.4)	3 (27.27)	2.57 (0.60 to 10.93)	
Indices Multiple Deprivation score (IMD)‡				
1st tertile	157 (33.3)	16 (10.2)	Reference*	Reference†
2nd tertile	157 (33.3)	17 (10.8)	1.07 (0.52 to 2.20)	1.03 (0.47 to 2.25)
3rd tertile	157 (33.3)	43 (27.4)	3.32 (1.78 to 6.21)	2.30 (1.13 to 4.68)
Partner smoking at 3 months after childbirth				
Partner does not smoke tobacco	201 (42.7)	17 (8.5)	Reference*	
Partner smokes tobacco	220 (46.7)	51 (23.2)	3.27 (1.82 to 5.88)	
No partner	50 (10.6)	8 (16.0)	2.06 (0.83 to 5.09)	

Continued

Table 2 Continued

Characteristic	All sample (N=471) N (column %)	Smoking occurs in the home (N=76) N (row %)	Unadjusted OR OR (95% CI)	Adjusted OR (N=465) OR (95% CI)
Attitudes towards SHS				
Negative attitudes towards child SHS exposure (≥15 out of a possible 20)	419 (89.5)	51 (12.2)	Reference*	Reference*
Less negative attitudes towards child SHS exposure (≤14 out of a possible 20)	49 (10.5)	25 (51.0)	7.52 (4.00 to 14.14)	5.24 (2.57 to 10.68)

*Significant at p<0.001.
†Significant at p<0.05.
‡Higher score reflects greater deprivation.
GCSE, General Certificate of Secondary Education; SHS, secondhand smoke.

A strength of this study was that during recruitment, 96% of women attending selected antenatal clinics within Nottingham University Hospital Trust were screened for eligibility, accounting for around one-third of all births within Nottingham, England, during this time.[23] The demographic profile of smokers within this cohort is similar to the composition of other UK pregnancy cohorts,[23] meaning that the sample is likely to be broadly representative. A potential limitation of this research was the lack of power within analysis due to small numbers of participants in some exposure variable groups. Furthermore, there were some differences between those who responded and those who did not respond at follow-up, which are described. These differences may have impacted on our prevalence estimates, however appropriate imputation methods were used to allow for this non-response bias. Non-response biases are less likely to have impacted on estimates of association with smoking in the home. A further potential limitation was reliance on reported smoking measures; parents may be inclined to give socially desirable responses resulting in under-estimates of children's SHS exposure.[35] However, maternal-reported SHS exposure has been found to correlate with urinary cotinine and home environmental nicotine (r range 0.3–0.6) in infants aged <2.5 years.[36] As the cohort included only women who were current or recent ex-smokers during pregnancy, the prevalence estimate obtained does not reflect children's SHS exposure in the home in the general population. However, as parental smoking, and in particular maternal smoking within the home, is the primary source of children and infant's SHS exposure,[20] this study gives a useful indication of the scale of young infant's SHS exposure.

While the demographic characteristics associated with smoking in the home after childbirth are not easily modifiable, they may help to inform which infants, parents or families are best targeted in future interventions. The findings highlight that the best way to prevent or reduce smoking in the home immediately after childbirth is to help smoking mothers to quit and stay abstinent after childbirth. However, a recent systematic review did not find a significant effect of any behavioural intervention approach to prevent postpartum smoking relapse,[37] and as such more research is needed to identify interventions which can support women at this important time. Where women are unable or unwilling to quit smoking, making their home smoke-free is the next most effective way to protect children.[38] This study, consistent with research in older children,[20] shows that less negative attitudes towards SHS exposure is associated with smoking in the home after childbirth. Interventions targeting attitudes towards SHS by supporting parents to recognise the benefits of protecting children from SHS may therefore be useful to promote smoke-free homes.

CONCLUSIONS

The prevalence of smoking in homes where young infants live is lower than has been reported in older children (>3 months), suggesting that the early postnatal period may be an ideal time to intervene to prevent future SHS exposure in the home. The factors associated with smoking in the home immediately following childbirth were similar to those previously reported among older children. Interventions to support smoking mothers to quit, or to help them restrict smoking in the home, should target attitudinal change and address inequality relating to social disadvantage, younger age and non-white ethnic groups.

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7.2 PREGNANCY LIFESTYLE SURVEY STUDY MATERIALS

7.2.1 Pregnancy Lifestyle Survey baseline

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospitals NHS
NHS Trust

Researcher's use only

Participant ID number / Initials	☐☐☐☐ / ☐☐☐
Date returned	☐☐ / ☐☐ / ☐☐
Researcher's initials	☐☐

Pregnancy lifestyle survey

BASELINE QUESTIONNAIRE
Final Version number: 2.4
Version date: 19th October 2011

Dear Madam,

We are looking at ways to improve the health and lifestyle of pregnant women and their babies. We are therefore inviting ALL women who come to the antenatal clinic to answer a few questions.

Your answers will be used in our research but are totally confidential and will only be seen by researchers from the University of Nottingham

Thank you for reading this and for your help.

Best wishes

Dr Tim Coleman
Division of Primary Care, University of Nottingham
QMC Medical School, Nottingham NG7 2RD

SCREENING QUESTIONS

Your answers to the questions on this page will determine whether you should complete the rest of the questionnaire. Please read the instructions carefully. Thank you.

S1 Have you completed this questionnaire before? (e.g. on a previous visit to the antenatal clinic or for a scan)

❑ Yes ❑ No ❑ Don't know

If you ticked **Yes**, please **hand back the questionnaire** - you are finished – thank you. Otherwise please continue

S2 Approximately, how many weeks pregnant are you?

[|] weeks ❑ Don't know

S3 How old are you?

[|] Years of age

S4 Please tick the box below next to the statement that best describes your smoking right now

1 ❑ I have never smoked (if you have ticked this box please hand back the questionnaire – you are finished)
2 ❑ I completely stopped smoking **more than** 3 months before finding out I was pregnant (if you have ticked this box please hand back the questionnaire – you are finished)
3 ❑ I completely stopped smoking at some time **in** the 3 months before finding out I was pregnant
4 ❑ I completely stopped smoking after I found out I was pregnant
5 ❑ I smoke occasionally, but not every day now I am pregnant
6 ❑ I smoke every day, but have cut down during my pregnancy
7 ❑ I smoke every day, about the same as before my pregnancy
8 ❑ I smoke every day, and I tend to smoke more than before my pregnancy

If you ticked one of the boxes 3-8, **and** you are between 8 and 26 weeks pregnant (or don't know), **and** are 16 years old or over, then please read the **NEXT PAGE**. Otherwise please **hand back the questionnaire** - you are finished – thank you.

(If you are not sure whether you should be filling in the rest of the questionnaire please ask the researcher)

Your answers mean that we are interested in finding out more about your views on smoking and pregnancy. We would be very grateful if you could read the following information that gives full details of the study.

If you want to ask any questions either before or after you read this then please ask to speak to our researcher who is in the clinic waiting area.

Once you have read this, if you are happy to continue, you can complete the longer questionnaire and once you have finished this we will give you a £5 gift voucher to thank you for your effort.

The University of Nottingham
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Nottingham University Hospitals NHS
NHS Trust

INFORMATION ABOUT THE RESEARCH

Study title: *Pregnancy Lifestyle Survey*

Name of Researchers: Tim Coleman, Sue Cooper, Jo Leonardi-Bee, Jim Thornton, John Britton, Stephen Sutton, Felix Naughton, Michael Ussher and Kate Pickett

We are inviting you to take part in a questionnaire research study by the University of Nottingham. The information below is to help you understand why we are doing the research and what it involves. We will also answer any questions you have so that you can decide if you want to join the study.

What is the purpose of the study?
We want to find out about the times in their pregnancy that women smoke, when they might try to stop, plus your opinion on different types of support that could help with this. We also want to know how accurately GPs record when women smoke during their pregnancy.

Why have I been chosen?
We are asking you to take part because you have told us that either you smoke now, or you have smoked at some point since becoming pregnant or in the three months before this.

Do I have to take part?
No, this is entirely up to you. If you decide to take part then we will ask you to sign a consent form. Even if you sign this, you are free to leave the study at any time without giving a reason, and it would not affect the care you receive.

What will happen to me if I take part? What will I have to do?
There are three questionnaires altogether. There is one for you to complete today and then we will then send you two further questionnaires. We will send you the first of these when you are around 34 weeks pregnant and the second 3 months after

your baby is born. If we don't get them back then we will call you to ask if you would answer the questions over the phone. If you prefer, we can send them to you by email or you can fill them in on a special webpage. As we know that filling in the questionnaires takes some of your time, we will give you a £5 voucher for each one that you complete and return to us. If you take part in the study, a researcher will check your hospital antenatal records to ensure all is well with you and your baby before we send the questionnaires, but we will not use this information for any other reason.

As well as giving us your own contact details, we will also ask you for contact details of another family member. You don't have to give us these, but if you do we will also keep them strictly confidential and we will only use them to help us get in touch with you if you move or change your contact details.

Later, we want to see how accurately GPs record smoking in pregnancy. To do this we need your permission to look in your GP medical records to compare the information on smoking held there with what you tell us in the survey. We would keep your personal information for no longer than 7 years to allow us to do this (at the moment we don't have any funding to do this part of the study). You can indicate on the consent form if you are happy for us to do this.

Will my taking part in this study be kept confidential?
Yes. We will keep all information that is collected about you during the research strictly confidential. The questionnaires will not have your name and address on them, only a code. Only the researchers and people allowed to check that the research is carried out correctly could have access to your personal information.

After this study has started, researchers may think up important research questions that you could help them to answer. Therefore, we would like you to agree to allow other researchers based at the University of Nottingham to contact you to ask for your help with other studies. They would not do this unless a research ethics committee agreed to let them. You could ignore any contact letter about other research projects if you are not interested in taking part. You can indicate on the consent form if you are happy with this.

What are the possible disadvantages and risks of taking part?
Filling in the questionnaires will take a little of your time. Each one should take about 10 or 20 minutes to fill in.

What are the possible benefits of taking part?
We cannot promise the study will help you but the information we get from this study may help us to improve the help offered to women who want to try to stop smoking when they are pregnant. If, during the study, you decide that you want help to stop smoking, please tell us and we will let you know how you can receive NHS support with this.

What will happen if I don't want to carry on with the study?
Although we would like you to return the questionnaires, whether or not you do so is up to you. If you change your mind and don't want us to send you any more questionnaires, you can let us know by phone, text or email, or you can return the Freepost card we will give you. However, we wouldn't be able to erase the

information you had already given us and we may still use this in the study. This does not affect your legal rights.

What will happen to the results of the research study?
We will publish the study results but you will not be identified in any report. Findings will help the NHS decide how and when to offer smoking cessation support in pregnancy. You will be able to see a summary of study findings on the UK Centre for Tobacco Control Studies website at: http://www.nottingham.ac.uk/ukctcs/index.aspx

Who is organising and funding the research?
NHS National Institute for Health Research is funding the research. It is organised by the University of Nottingham.

Who has reviewed the research?
To protect your interests, an independent group of people, called a Research Ethics Committee, looks at all research in the NHS. Derbyshire Research Ethics Proportionate Review Sub-Committee have reviewed and approved this study.

What if there is a problem or you need further information
If you have any concerns about the study then please speak to the researchers or contact the project manager (contact details below). If you remain unhappy and wish to complain formally, you can do this by contacting NHS Complaints. Details can be obtained from your hospital.

You can also contact the researchers below if you need more information or would like to give feedback.

Dr Sue Cooper
Smoking in Pregnancy Project Manager
Tel 0115 823 1898
Email sue.cooper@nottingham.ac.uk

Dr Tim Coleman (*Chief Investigator*)
Tel 0115 823 0204
Email tim.coleman@nottingham.ac.uk

Katharine Bowker *(Research Fellow)*
Tel 0115 7484040
Email katharine.bowker@nottingham.ac.uk

Sophie Orton (*Research Fellow*)
Tel 0115 7484043
Email sophie.orton@nottingham.ac.uk

Smoking and Pregnancy Research Office
Division of Primary Care,
Room 1406, Tower Building
University of Nottingham
NG7 2RD

This information sheet is for you to keep.

Thank you very much for your time and help – we are very grateful for this.

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospitals NHS
NHS Trust

Researcher's use only

Participant ID number / Initials	☐☐☐☐ / ☐☐☐
Date returned	☐☐ / ☐☐ / ☐☐
Researcher's initials	☐☐

Pregnancy lifestyle survey

YOUR HEALTH AND YOUR PREGNANCY

A1 How would you describe your health generally?

1 ❑ Excellent
2 ❑ Good
3 ❑ Fair
4 ❑ Poor

A2 Do you have a long standing physical or mental illness or disability? By longstanding I mean anything that has troubled you over a period of time or that is likely to affect you for some time into the future?

❑ Yes ❑ No

If Yes, does this illness or disability limit your activities in any ways?

❑ Yes ❑ No

A3 During the past month, have you often been bothered by feeling down, depressed or hopeless?

❑ Yes ❑ No

A4 During the past month, have you often been bothered by having little interest or pleasure in doing things?

❑ Yes ❑ No

A5 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Never	Almost never	Sometimes	Fairly often	Very often
In the last month, how often have you felt…					
…that you were unable to control the important things in your life?	1	2	3	4	5
…confident about your ability to handle your personal problems?	1	2	3	4	5
…that things were going your way?	1	2	3	4	5
…difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

A6 Have you been pregnant before?

❑ Yes ❑ No

If Yes, did you smoke at all after finding out you were pregnant during your last pregnancy?

❑ Yes ❑ No ❑ I don't remember

A7 This time, were you planning to get pregnant or was it a surprise?

❑ Planning ❑ Was a surprise

YOUR SMOKING BEHAVIOUR AND BELIEFS

B1 When did you last smoke any cigarettes or tobacco (even a puff)?

- ❑ In the last 24 hours
- ❑ 1-6 days ago
- ❑ 7-30 days ago
- ❑ 1-2 months ago
- ❑ 2-3 months ago
- ❑ More than 3 months ago

B2 If you have a partner, do they smoke tobacco?

❑ Yes ❑ No ❑ I don't have a partner

B3 Does anyone who lives with you smoke tobacco in the home?

❑ Yes ❑ No

B4 How much of the time have you felt the urge to smoke in the past 24 hours?

- ❑ Not at all
- ❑ A little of the time
- ❑ Some of the time
- ❑ A lot of the time
- ❑ Almost all of the time
- ❑ All the time
- ❑ Don't know

B5 How strong have the urges been in the past 24 hours?

- ❑ No urges
- ❑ Slight
- ❑ Moderate
- ❑ Strong
- ❑ Very strong
- ❑ Extremely strong
- ❑ Don't know

B6 If you are planning on stopping smoking, or have already stopped, how long do you intend to stop for?

- ☐ Permanently/for good
- ☐ Until the birth of your baby/babies
- ☐ Unsure
- ☐ I am not planning on stopping smoking

B7 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
How **determined** are you to stop smoking until your baby is born?	1	2	3	4	5
How **confident** are you that you can stop smoking until your baby is born?	1	2	3	4	5
How **determined** are you to stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped on your own (i.e. without help from a health professional)?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped with help from a health professional?	1	2	3	4	5

B8 Please indicate how much you agree with each statement below. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
Smoking during pregnancy can cause serious harm to my baby	1	2	3	4	5
Smoking in pregnancy makes me feel uncomfortable or embarrassed	1	2	3	4	5
People I know continued to smoke when they were pregnant	1	2	3	4	5
I have support from my family or friends to help me stop smoking	1	2	3	4	5
People who are important to me think I should avoid smoking	1	2	3	4	5
Asking for professional support to help me stop smoking in pregnancy would make me feel uncomfortable or embarrassed	1	2	3	4	5

If you **SMOKE EVERY NOW & AGAIN or MORE OFTEN** continue to question C1 on the next page.

If you **DO NOT SMOKE AT THE MOMENT** go to question D1 on page 9

YOUR CURRENT SMOKING BEHAVIOUR

Please complete this section if you **SMOKE EVERY NOW & AGAIN or MORE OFTEN THAN THIS**

C1 Approximately how many cigarettes do you smoke each day?

- ❑ 0-5
- ❑ 6-10
- ❑ 11-15
- ❑ 16-20
- ❑ 21-30
- ❑ 31 or more

C2 How soon after waking do you smoke your first cigarette of the day?

- ❑ Within 5 minutes
- ❑ 6-30 minutes
- ❑ 31-60 minutes
- ❑ After 60 minutes

C3 Since finding out you were pregnant, have you tried to stop smoking?

- ❑ Yes
- ❑ No

If yes, please write in how many times you managed to stop smoking ***completely*** for at least 24 hours

☐ times

C4 Since you found out you were pregnant, what was the longest you managed to remain stopped?

- ❑ I have not tried to stop smoking
- ❑ Less than 24 hours
- ❑ 1-6 days
- ❑ 7-30 days
- ❑ 1-2 months
- ❑ 2-3 months
- ❑ More than 3 months

C5 Are you seriously planning to quit?:

- ❑ Within the next 2 weeks
- ❑ Within the next 30 days
- ❑ Within the next 3 months
- ❑ No I am not seriously planning to quit

YOUR INTEREST IN GETTING HELP TO STOP SMOKING

All respondents should complete this section

D1 Since you found out you were pregnant, have you tried any of the following to help you stop smoking? (**Please tick all that apply**)

- ❑ Talked to your GP or a nurse about giving up smoking
- ❑ Talked to your midwife about giving up smoking
- ❑ Attended a NHS stop smoking service group session
- ❑ Attended a solo/individual NHS stop smoking service session (i.e. not with other people)
- ❑ Called a stop smoking telephone helpline
- ❑ Used Nicotine Replacement Therapy (e.g. nicotine patches or gum)
- ❑ Set a quit date
- ❑ Other. Please state: ____________________
- ❑ None of the above

D2 Currently, how interested are you in receiving help with stopping smoking?

- ❑ Not at all
- ❑ A little
- ❑ Moderately
- ❑ Very much
- ❑ Extremely

D3 How **interested** would you be in the following types of help to stop smoking/stay stopped? Please answer by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
How interested would you be in stop-smoking help ***from a health professional*** *who offered you…*					
…a telephone helpline	1	2	3	4	5
…group sessions	1	2	3	4	5
…one-to-one sessions	1	2	3	4	5
How interested would you be in stop-smoking help ***that you can work through on your own (self-help)*** *if we gave you…*					
…a booklet	1	2	3	4	5
…a DVD	1	2	3	4	5
…a website	1	2	3	4	5
… text messages	1	2	3	4	5
…email	1	2	3	4	5
…an application on your mobile phone/device	1	2	3	4	5

D4 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
*How **useful** do you think the following ways would be to help you to stop smoking/stay stopped?*					
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application on your mobile phone/device	1	2	3	4	5
*If it were available, how **difficult** do you think it would be for you to **use** the following types of stop-smoking help?*					
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application on your mobile phone/device	1	2	3	4	5

D5 Do any of the following describe your feelings about stop-smoking help that you work through on your own (ie, self-help)? **Please tick all that apply**

- ❑ I would miss having personal contact with a health professional
- ❑ It is too much effort to work through this type of support on my own
- ❑ It would be too difficult for me to understand this type of support
- ❑ I don't have the time to work through this type of support on my own
- ❑ I don't think this type of support would be much help with quitting smoking
- ❑ I think this type of support would be boring
- ❑ I would not read/work through this type of support if I received it
- ❑ I prefer to receive support from a health professional
- ❑ None of the above

D6 Which of the following applies to you? (**Please select one option per line**)

I own a mobile phone	❑ Yes	❑ No	❑ Don't know
I get free text messages as part of my tariff/package	❑ Yes	❑ No	❑ Don't know
I can install applications on my mobile phone	❑ Yes	❑ No	❑ Don't know
I have regular access to the internet/emails via my mobile phone	❑ Yes	❑ No	❑ Don't know
I have regular access to the internet/emails via a computer	❑ Yes	❑ No	❑ Don't know
I have an email account	❑ Yes	❑ No	❑ Don't know
I have a DVD player	❑ Yes	❑ No	❑ Don't know

ABOUT YOU

E1 At what age did you leave/finish full time education?

| | | Years of age ❑ I am still in education

E2 Which of the following qualifications do you have?

❑ None
❑ GCSEs or similar (e.g. level 1 diploma or NVQ level 1/2)
❑ A-levels/AS-levels or similar (e.g. level 2 diploma or NVQ level 3)
❑ Degree or similar (e.g. diploma in higher education or NVQ level 4)
❑ Other

E3 Do you own or rent your home?

❑ Own ❑ Rent ❑ Other

E4 Are there any cars or vans available for use in your household?

❑ Yes ❑ No

E5 Which of the following applies to you? **(Please tick all that apply)**

❑ I am in paid work at the moment
❑ I'm unemployed
❑ I'm a full-time student
❑ I'm a homemaker/full time parent
❑ Other

E6 Please describe your current or most recent paid job. Please leave blank if you have not previously been in paid work.

____

E7 Is your usual occupation manual or non-manual?

- ❑ Manual ❑ Non-manual ❑ Don't know ❑ Not applicable

E8 How would you describe your ethnic group?

- ❑ White - British
- ❑ White - Irish
- ❑ Other white background
- ❑ Mixed - white and black Caribbean
- ❑ Mixed - white and Asian
- ❑ Other mixed background
- ❑ Asian or Asian British - Indian
- ❑ Asian or Asian British - Pakistani
- ❑ Asian or Asian British - Bangladeshi
- ❑ Other Asian background
- ❑ Black or black British - Caribbean
- ❑ Black or black British - African
- ❑ Other black background
- ❑ Chinese
- ❑ Other. Please specify: ____________________

Thank you for completing the questionnaire.

Please hand this to our researcher in clinic who will give you a £5 voucher and may talk with you about the rest of the study.

If you can't find the researcher, then please speak to one of the reception staff in clinic who will, if necessary, take your contact details so that the researcher can get in touch with you later.

If you haven't had time to complete the entire questionnaire today, or if you want some more time to think about it, then please ask the researcher or reception staff for a return envelope. Once you have decided, you can return the questionnaire along with your completed details on the attached sheet, and the researcher will contact you.

Thank you for your time today. We are very grateful for your help.

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospitals NHS
NHS Trust

Pregnancy lifestyle survey

CONTACT DETAILS

If you would like to take part in the study or you would to discuss this further, then please complete your personal details below.
The researcher will contact you as soon as possible

Name		
Address		
Telephone	Day:	Evening:
	Mobile:	
Best time to contact		
Email address		

Pregnancy Lifestyle Survey Baseline Questionnaire Final Version 2.4 19th Oct 2011

7.2.2 Pregnancy Lifestyle Survey Follow-up one

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Researcher's use only

Participant ID number / Initials					/			
Date returned		/		/		
Researcher's initials			

Pregnancy lifestyle survey

FOLLOW UP QUESTIONNAIRE 1
Final Version number: 2.3
Version date: 19th October 2011

Please complete this questionnaire **within the next two weeks** and then return it in the envelope provided (no stamp required).

The information you give us will be confidential and only used by the Pregnancy Lifestyle Survey researchers.

If you have any questions or concerns about this questionnaire, please call the Smoking and Pregnancy Research Office on 0115 823 1899.

Thank you for your help

Today's date: ....

1

Pregnancy Lifestyle Survey Follow up Questionnaire 1 Final Version 2.3 19th October 2011

YOUR SMOKING BEHAVIOUR AND BELIEFS

A1 Please tick the box below next to the statement that best describes your smoking right now

- ❑ I don't smoke at all
- ❑ I smoke occasionally, but not every day
- ❑ I smoke every day, but have cut down during my pregnancy
- ❑ I smoke every day, about the same as before my pregnancy
- ❑ I smoke every day, and I tend to smoke more than before my pregnancy

A2 If you have a partner, do they smoke tobacco?

❑ Yes ❑ No ❑ I don't have a partner

A3 Does anyone who lives with you smoke tobacco in the home?

❑ Yes ❑ No

A4 How much of the time have you felt the urge to smoke in the past 24 hours?

- ❑ Not at all
- ❑ A little of the time
- ❑ Some of the time
- ❑ A lot of the time
- ❑ Almost all of the time
- ❑ All the time
- ❑ Don't know

A5 How strong have the urges been in the past 24 hours?

- ❑ No urges
- ❑ Slight
- ❑ Moderate
- ❑ Strong
- ❑ Very strong
- ❑ Extremely strong
- ❑ Don't know

A6 If you are planning on stopping smoking, or have already stopped, how long do you intend to stop for?

- ❑ Permanently/for good
- ❑ Until the birth of your baby/babies
- ❑ Unsure
- ❑ I am not planning on stopping smoking

A7 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
How **determined** are you to stop smoking until your baby is born?	1	2	3	4	5
How **confident** are you that you can stop smoking until your baby is born?	1	2	3	4	5
How **determined** are you to stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped on your own (i.e. without help from a health professional)?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped with help from a health professional?	1	2	3	4	5

A8 Please indicate how much you agree with each statement below. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
Smoking during pregnancy can cause serious harm to my baby	1	2	3	4	5
Smoking in pregnancy makes me feel uncomfortable or embarrassed	1	2	3	4	5
If I breathe in other people's smoke regularly it can seriously harm my unborn baby	1	2	3	4	5
People I know continued to smoke when they were pregnant	1	2	3	4	5
I have support from my family or friends to help me stop smoking	1	2	3	4	5
People who are important to me think I should avoid smoking	1	2	3	4	5
Asking for professional support to help me stop smoking in pregnancy would make me feel uncomfortable or embarrassed	1	2	3	4	5

A9 How concerned are you about putting on weight as a result of stopping smoking?

- ❑ Not at all
- ❑ A little
- ❑ Moderately
- ❑ Very much
- ❑ Extremely

If you **SMOKE EVERY NOW & AGAIN or MORE OFTEN** continue to question B1 on the next page. If you **DO NOT SMOKE AT THE MOMENT** go to C1 on page 6

YOUR CURRENT SMOKING BEHAVIOUR

Please complete this section if you **SMOKE EVERY NOW & AGAIN or MORE OFTEN THAN THIS**

B1 Approximately how many cigarettes do you smoke each day?

- ❑ 0-5
- ❑ 6-10
- ❑ 11-15
- ❑ 16-20
- ❑ 21-30
- ❑ 31 or more

B2 How soon after waking do you smoke your first cigarette of the day?

- ❑ Within 5 minutes
- ❑ 6-30 minutes
- ❑ 31-60 minutes
- ❑ After 60 minutes

B3 Since completing the first study questionnaire, have you tried to stop smoking?

- ❑ Yes
- ❑ No

If yes, please write in how many times during this period you managed to stop smoking ***completely*** for at least 24 hours

☐ times

B4 Are you seriously planning to quit?:

- ❑ Within the next 2 weeks
- ❑ Within the next 30 days
- ❑ Within the next 3 months
- ❑ No I am not seriously planning to quit

YOUR INTEREST IN GETTING HELP TO STOP SMOKING

All respondents should complete this section

C1 Since you completed the first study questionnaire, have you tried any of the following to help you stop smoking? (**Please tick all that apply**)

- ☐ Talked to your GP or a nurse about giving up smoking
- ☐ Talked to your midwife about giving up smoking
- ☐ Attended a NHS stop smoking service group session
- ☐ Attended a solo/individual NHS stop smoking service session (i.e. not with other people)
- ☐ Called a stop smoking telephone helpline
- ☐ Used Nicotine Replacement Therapy (e.g. nicotine patches or gum)
- ☐ Set a quit date
- ☐ Other. Please state: ______________________
- ☐ None of the above

C2 Currently, how interested are you in receiving help with stopping smoking?

- ☐ Not at all
- ☐ A little
- ☐ Moderately
- ☐ Very much
- ☐ Extremely

C3 How **interested** would you be in the following types of help to stop smoking/stay stopped? Please answer by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
How interested would you be in stop-smoking help ***from a health professional*** *who offered you…*					
…a telephone helpline	1	2	3	4	5
…group sessions	1	2	3	4	5
…one-to-one sessions	1	2	3	4	5
How interested would you be in stop-smoking help ***that you can work through on your own (self-help)*** *if we gave you…*					
…a booklet	1	2	3	4	5
…a DVD	1	2	3	4	5
…a website	1	2	3	4	5
… text messages	1	2	3	4	5
…email	1	2	3	4	5
…an application on your mobile phone/device	1	2	3	4	5

C4 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
*How **useful** do you think the ways would be to help you to stop smoking/stay stopped?*					
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application on your mobile phone/device	1	2	3	4	5
*If it were available, how **difficult** do you think it would be for you to **use** the following types of stop-smoking help?*					
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application on your mobile phone/device	1	2	3	4	5

C5 Do any of the following describe your feelings about stop-smoking help that you work through on your own (self-help)? **Please tick all that apply**

- ☐ I would miss having personal contact with a health professional
- ☐ It is too much effort to work through this type of support on my own
- ☐ It would be too difficult for me to understand this type of support
- ☐ I don't have the time to work through this type of support on my own
- ☐ I don't think this type of support would be much help with quitting smoking
- ☐ I think this type of support would be boring
- ☐ I would not read/work through this type of support if I received it
- ☐ I prefer to receive support from a health professional
- ☐ None of the above

Please turn over the page for the final section of questions →

YOUR HEALTH AND YOUR PREGNANCY

All respondents should complete this section

D1 During the past month, have you often been bothered by feeling down, depressed or hopeless?

❑ Yes ❑ No

D2 During the past month, have you often been bothered by having little interest or pleasure in doing things?

❑ Yes ❑ No

D3 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Never	**Almost never**	**Sometimes**	**Fairly often**	**Very often**
In the last month, how often have you felt…					
...that you were unable to control the important things in your life?	1	2	3	4	5
...confident about your ability to handle your personal problems?	1	2	3	4	5
...that things were going your way?	1	2	3	4	5
...difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

D4 How much have you had any of the following **during your pregnancy**? **Please circle one number per question.**

	Not at all	**A little**	**Moderately**	**Very much**	**Extremely**
I have felt nauseous or sick	1	2	3	4	5
I have vomited	1	2	3	4	5

Thank you for completing the questionnaire
Please return **within the next 2 weeks** in the envelope provided (no stamp required)

7.2.3 Pregnancy Lifestyle Survey Follow-up two

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Researcher's use only

Participant ID number / Initials	/
Date returned	
Researcher's initials	

Pregnancy lifestyle survey

FOLLOW UP QUESTIONNAIRE 2
Final Version number: 2.0
Version date: 2nd December 2011

Please complete this questionnaire **within the next two weeks** and then return it in the envelope provided (no stamp required).

The information you give us will be confidential and only used by the Pregnancy Lifestyle Survey researchers.

If you have any questions or concerns about this questionnaire, please call the Smoking and Pregnancy Research Office on 0115 823 1899.

Thank you for your help

Today's date: ....

1

Pregnancy Lifestyle Survey Follow Up Questionnaire 2 Final Version 2.0 2nd December 2011

YOUR SMOKING BEHAVIOUR AND BELIEFS

A1 Please tick the box below next to the statement that best describes your smoking right now

- ❑ I don't smoke at all
- ❑ I smoke occasionally, but not every day
- ❑ I smoke every day, but less than when I was pregnant
- ❑ I smoke every day, and about the same as when I was pregnant
- ❑ I smoke every day, and I tend to smoke more now than when I was pregnant

A2 Did you smoke at all in the week before the birth of your baby ?

❑ Yes ❑ No ❑ I can't remember

A3 Have you smoked at all since the birth of your baby?

❑ Yes ❑ No (If No – go to question A4)

If Yes, how soon after the birth of your baby did you first smoke?

- ❑ Within 24 hours
- ❑ 1-6 days
- ❑ 7-30 days
- ❑ 1-2 months
- ❑ More than 2 months

A4 If you have a partner, do they smoke tobacco?

❑ Yes ❑ No ❑ I don't have a partner

A5 How much of the time have you felt the urge to smoke in the past 24 hours?

- ❑ Not at all
- ❑ A little of the time
- ❑ Some of the time
- ❑ A lot of the time
- ❑ Almost all of the time
- ❑ All the time
- ❑ Don't know

A6 How strong have the urges been in the past 24 hours?

- ❑ No urges
- ❑ Slight
- ❑ Moderate
- ❑ Strong
- ❑ Very strong
- ❑ Extremely strong
- ❑ Don't know

A7 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
How **determined** are you to stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking for good?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped on your own (i.e. **without** help from a health professional)?	1	2	3	4	5
How **confident** are you that you can stop smoking/remain stopped **with** help from a health professional?	1	2	3	4	5
Do you have support from family or friends to help you stop smoking?	1	2	3	4	5
Do people who are important to you think you should avoid smoking?	1	2	3	4	5

A8 How concerned are you about putting on weight as a result of stopping smoking?

- ❑ Not at all
- ❑ A little
- ❑ Moderately
- ❑ Very much
- ❑ Extremely

If you **SMOKE EVERY NOW & AGAIN or MORE OFTEN** continue to question B1 on the next page. If you **DO NOT SMOKE AT THE MOMENT** go to C1 on page 5

YOUR CURRENT SMOKING BEHAVIOUR

Please complete this section if you **SMOKE EVERY NOW AND AGAIN or MORE OFTEN THAN THIS**

B1 Approximately how many cigarettes do you smoke each day?

- ❑ 0-5
- ❑ 6-10
- ❑ 11-15
- ❑ 16-20
- ❑ 21-30
- ❑ 31 or more

B2 How soon after waking do you smoke your first cigarette of the day?

- ❑ Within 5 minutes
- ❑ 6-30 minutes
- ❑ 31-60 minutes
- ❑ After 60 minutes

B3 Since the birth of your baby have you tried to stop smoking?

- ❑ Yes
- ❑ No

If yes, please write in how many times during this period you managed to stop smoking ***completely*** for at least 24 hours

[ ] times

B4 Are you seriously planning to quit?

- ❑ Within the next 2 weeks
- ❑ Within the next 30 days
- ❑ Within the next 3 months
- ❑ No I am not seriously planning to quit

YOUR INTEREST IN GETTING HELP TO STOP SMOKING

All respondents should complete this section

C1 Since the birth of your baby, have you tried any of the following to help you stop smoking / remain stopped? (**Please tick all that apply**)

- ❑ Talked to your GP or a nurse about giving up smoking
- ❑ Talked to your midwife about giving up smoking
- ❑ Attended a NHS stop smoking service group session
- ❑ Attended a solo/individual NHS stop smoking service session (i.e. one-to-one - not with other people)
- ❑ Called a stop smoking telephone helpline
- ❑ Used Nicotine Replacement Therapy (e.g. nicotine patches or gum)
- ❑ Set a quit date
- ❑ Other. Please state: ______________________
- ❑ None of the above

C2 Currently, how interested are you in receiving help with stopping smoking?

- ❑ Not at all
- ❑ A little
- ❑ Moderately
- ❑ Very much
- ❑ Extremely

C3 How **interested** would you be in the following types of help to stop smoking/stay stopped? Please answer by circling the appropriate number.
Please circle one number per question.

	Not at all	A little	Moderately	Very much	Extremely
*How interested would you be in stop-smoking help **from a health professional** who offered you…*					
…a telephone helpline	1	2	3	4	5
…group sessions	1	2	3	4	5
…one-to-one sessions	1	2	3	4	5
*How interested would you be in stop-smoking help **that you can work through on your own (self-help)** if we gave you…*					
…a booklet	1	2	3	4	5
…a DVD	1	2	3	4	5
…a website	1	2	3	4	5
… text messages	1	2	3	4	5
…email	1	2	3	4	5
…an application (app) on your mobile phone / device	1	2	3	4	5

C4 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

*How **USEFUL** do you think the following ways would be to help you to stop smoking/stay stopped?*					
	Not at all	**A little**	**Moderately**	**Very much**	**Extremely**
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application (app) on your mobile phone / device	1	2	3	4	5

C5 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

*If it were available, how **DIFFICULT** do you think it would be for you to **use** the following types of stop-smoking help?*					
	Not at all	**A little**	**Moderately**	**Very much**	**Extremely**
A telephone helpline	1	2	3	4	5
Group sessions with a health professional	1	2	3	4	5
One-to-one sessions with a health professional	1	2	3	4	5
A self-help booklet	1	2	3	4	5
A DVD	1	2	3	4	5
A self-help website	1	2	3	4	5
Self-help mobile phone text messages	1	2	3	4	5
Self-help emails	1	2	3	4	5
A self-help application (app) on your mobile phone/device	1	2	3	4	5

C6 Do any of the following describe your feelings about stop-smoking help that you work through on your own (self-help)? **Please tick all that apply**

- ❑ I would miss having personal contact with a health professional
- ❑ It is too much effort to work through this type of support on my own
- ❑ It would be too difficult for me to understand this type of support
- ❑ I don't have the time to work through this type of support on my own
- ❑ I don't think this type of support would be much help with quitting smoking
- ❑ I think this type of support would be boring
- ❑ I would not read/work through this type of support if I received it
- ❑ I prefer to receive support from a health professional
- ❑ None of the above

YOUR HEALTH

All respondents should complete this section

D1 During the past month, have you often been bothered by feeling down, depressed or hopeless?

❑ Yes ❑ No

D2 During the past month, have you often been bothered by having little interest or pleasure in doing things?

❑ Yes ❑ No

D3 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Never	Almost never	Sometimes	Fairly often	Very often
In the last month, how often have you felt…					
…that you were unable to control the important things in your life?	1	2	3	4	5
…confident about your ability to handle your personal problems?	1	2	3	4	5
…that things were going your way?	1	2	3	4	5
…difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

D4 Please answer each of the following questions by circling the appropriate number. **Please circle one number per question.**

	Never	Almost never	Sometimes	Fairly often	Very often
How often do you smoke in your home nowadays?	1	2	3	4	5
How often do other people smoke in your home nowadays?	1	2	3	4	5

D5 Please indicate how much you **agree** with each statement below. **Please circle one number per question.**

	Not at all	A little	Moderately	Very much	Extremely
If my baby regularly breathes in people's tobacco smoke, it can seriously harm him/her	1	2	3	4	5
Smoking in the home can seriously harm babies (under 1 year old)	1	2	3	4	5
Smoking in the home can seriously harm children (over 1 year old)	1	2	3	4	5
Smoking in the home but not in the same room as a baby can seriously harm him/her	1	2	3	4	5
Smoking in the home makes my house smell unpleasant	1	2	3	4	5

D6 How old was your baby when he/she last had breast milk?

- ❑ Never took breast milk
- ❑ Less than one week
- ❑ Less than one month
- ❑ Over one month but stopped breastfeeding
- ❑ Still breastfeeding

The next questions are about the different sorts of feelings parents might have when caring for young children. This includes their relationship with the baby, confidence in their parenting ability and their family routine. For each one please say which is closest to how **you** feel.

D7 When you are caring for your baby, how often do you feel annoyed or irritated?

- ❑ Almost all the time
- ❑ Very frequently
- ❑ Frequently
- ❑ Occasionally
- ❑ Rarely
- ❑ Never

D8 When you are caring for your baby, do you feel that you are…

- ❑ Very unskilled and lacking in confidence?
- ❑ Fairly unskilled and lacking in confidence?
- ❑ Fairly skilled and confident?
- ❑ Very skilled and confident?

D9 When you think about the things that you have had to give up because of your baby do you find that you…

- ❑ resent / dislike this a lot?
- ❑ resent / dislike this a fair amount?
- ❑ resent / dislike this a bit?
- ❑ don't resent / dislike this at all?

D10 How often do you have enough of the following things in your family? **Please circle one number per question.**

	Never enough	Rarely enough	Sometimes enough	Usually enough	Almost always enough
Money to pay monthly bills	1	2	3	4	5
Use of a car (either your own or someone else's)	1	2	3	4	5
Money to buy things for yourself	1	2	3	4	5
Money to save	1	2	3	4	5

D11 The following questions are about your day-to-day life and routines

Do you usually eat at least one meal a day at home with family or friends?	❑ Yes	❑ No
Do you have a diary or a calendar for keeping track of appointments?	❑ Yes	❑ No
Do you plan your spending money or make a budget for yourself?	❑ Yes	❑ No
Do you regularly care for anybody who has either a long-term illness or a problem with alcohol or drugs?	❑ Yes	❑ No
Do you have people living with you that you often wish weren't there?	❑ Yes	❑ No

Thank you for completing the questionnaire.
Please return **within the next 2 weeks** in the envelope provided (no stamp required)

7.3 CHAPTER 5 STUDY MATERIALS

7.3.1 Participant invite letter

Pregnancy lifestyle survey

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Invite Letter

Study title: Pregnancy Lifestyle Survey, mother's views on smoking in the home

Name of Researchers: Sophie Orton, Tim Coleman, Laura Jones, Sue Cooper, Sarah Lewis

Date

Dear

We hope that you remember joining a study when you were pregnant (The Pregnancy Lifestyle Survey). For this study, you completed questionnaires that asked about your views on stopping smoking and on the different types of support there are to help with this. We are extremely grateful to have had your help with this so far.

We would now like to invite you to have an informal discussion with us about your views on smoking in the home. We would also like to hear your experiences and opinions about smoking in pregnancy and after the birth of your baby. Everyone has different experiences and opinions, and so your participation would be extremely valuable for the research.

We will be able to carry out the discussion at a time that is convenient for you, and a researcher will be able to meet you at your home. The discussion will last for around 1 hour, but you can stop it at any time if you change your mind. No one else but the researcher will be present, unless you would like someone else to be there such as a friend or relative.

For taking part in this discussion, we will give you a £20 shopping voucher for your time and as a thank you for your support once the discussion has been completed. We have enclosed some more detailed information to help you understand why we are doing the research and what it involves.

If you are interested in taking part or would like to ask any questions, there are a number of ways you can get in touch to arrange an appointment.

- You can fill in the **enclosed reply slip and return it to us in the stamped addressed envelope**
- You can send us a **text message** to the number …..
- You can **call us** on ……
- You can send an **email** to …….

You can also use these to let us know if you would not like to take part.

Thank you for considering this and for your participation to date in this research study.

Pregnancy Lifestyle Survey, mother's views on smoking in the home – INVITE LETTER, Final Version 1.0, 7the May 2013

Pregnancy lifestyle survey

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

With best wishes,

Yours sincerely

Sophie Orton,

Research student, working with Chief Investigator Dr Tim Coleman

7.3.2 Participant information sheet

Pregnancy lifestyle survey

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

PARTICIPANT INFORMATION SHEET – Interview
Final Version 1.1, 23rd May 2013

Study title: Pregnancy Lifestyle Survey, mother's views on smoking in the home

Name of Researchers: Sophie Orton, Tim Coleman, Laura Jones, Sue Cooper, Sarah Lewis

We are inviting you to take part in a research study run by the University of Nottingham. The information below is to help you understand why we are doing the research and what it involves. Talk to others about the study if you wish. Ask us if there is anything that is not clear.

What is the purpose of the study?
We want to find out about mother's views on smoking in the home. We would also like to hear about mother's experiences and opinions about smoking in pregnancy and after the birth of their baby.

Why have I been chosen?
You are a mother who has personal experience, knowledge and in-sight about smoking, pregnancy and having a new born baby at home, and we would be interested to hear more about this. In addition, you have been chosen because you previously took part in the Pregnancy Lifestyle Survey, and you agreed then that researchers at the University of Nottingham could contact you about any future research we are carrying out that you may be interested in. During the Pregnancy Lifestyle Survey you told us that you smoked when you were pregnant or in the three months before this.

Do I have to take part?
No, this is entirely up to you. If you decide to take part then we will ask you to sign a consent form. Even if you sign this, you are free to leave the study at any time without giving a reason, for example by asking for the discussion to end, and it will not affect the care you receive.

What will happen to me if I take part? What will I have to do?
You will take part in an informal discussion with a female researcher. We will be able to carry out the discussion at your home. No one else but the researcher will be present, unless you would like someone else to be there, such as a friend or relative. With your permission, the entire discussion will be audio recorded. If you do not wish to answer any of the questions during the discussion, you may say so and the researcher will move on to the next question.

What are the possible disadvantages and risks of taking part?
Taking part in a discussion with a researcher will take a little of your time. You will only have to take part in one discussion. While the length of time the discussion will take varies depending on how much you have to say, they normally last between 30-60 minutes.

What are the possible benefits of taking part?
We cannot promise the study will help you, but the information we get from this study may help us to better understand why women choose to smoke or not smoke in their homes when young babies are present. If, during the study, you decide that you want help to stop smoking, please tell us and we will let you know how you can receive NHS support with this.

Pregnancy lifestyle survey

The University of Nottingham
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What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. The researchers contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you can do this by contacting PALS. Details are given at the end.

Will my taking part in this study be kept confidential?
We will follow ethical and legal practice and all information about you will be handled in confidence.
If you join the study, some parts of the data collected for the study will be looked at by authorised persons from the University of Nottingham who are organising the research. They may also be looked at by authorised people to check that the study is being carried out correctly. All will have a duty of confidentiality to you as a research participant and we will do our best to meet this duty.
All information which is collected about you during the course of the research will be kept **strictly confidential**, stored in a secure and locked office, and on a password protected database. Any information about you which leaves the hospital will have your name and address removed (anonymised) and a unique code will be used so that you cannot be recognised from it. If during your participation in this research you disclose something that suggests that you or others may be at harm, the researcher is required to disclose this information to the relevant persons or body.

Your personal data (address, telephone number) will be kept for 12 months after the end of the study so that we are able to contact you about the findings of the study *and possible follow-up studies* (unless you advise us that you do not wish to be contacted). All other data (research data) will be kept securely for 7 years. After this time your data will be disposed of securely. During this time all precautions will be taken by all those involved to maintain your confidentiality, only members of the research team will have access to your personal data.

Your name or any identifiable information will not appear on any written reports linked to this research. However quotes, from which it will not be possible to identify you, may be used in the study reports.

What will happen if I don't want to carry on with the study?
Although we would like you to take part in the discussion, whether or not you do so is up to you. If you change your mind and don't want to take part in the discussion beforehand, you can let us know by phone or email. You can also stop the discussion at any point without giving a reason, without your care or legal rights being affected. If you do decide to withdraw however, the information you have given us up until that point may still be used.

What will happen to the results of the research study?
The results of this study will be written up as part of a research degree by Sophie Orton. We also intend to publish the study results so that other interested people may learn from the research, but you will not be identified in any report. We will send a summary of the results to all participants who would like them (please initial the box on the consent form if you would like to receive a summary of the results).

Who is organising and funding the research?
The research is being organised by the University of Nottingham and funded by the NIHR National School for Primary Care Research.

Who has reviewed the research?
To protect your interests, an independent group of people, called a Research Ethics Committee, looks at all research in the NHS. Derbyshire Research Ethics Proportional Review Sub-Committee have reviewed this study.

Further information and contact details

PALS: NUH NHS Trust, c/o PALS, Freepost, NEA 14614, Nottingham, NG7 1BR.
City Hospital : 0115 9691169 ext 59671, QMC: 0115 924 9924 ext 65412 or 62301

Sophie Orton (Researcher)
Tel: 0115 7484043
Email: sophie.orton@nottingham.ac.uk or pls@nottingham.ac.uk

Professor Tim Coleman (Principle Investigator)
Tel: 0115 8230204
Email: tim.coleman@nottingham.ac.uk

7.3.3 Participant consent form

Pregnancy lifestyle survey

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

(Form to be printed on local headed paper)

CONSENT FORM - Interview
(Final version 1.0: 7th May 2013)

Title of Study: Pregnancy Lifestyle Survey, mother's views on smoking in the home

REC ref: 11/EM/0078

Name of Researcher: Sophie Orton, Tim Coleman, Laura Jones, Sue Cooper, Sarah Lewis

Name of Participant: **Please initial box**

1. I confirm that I have read and understand the information sheet version number 1.1 dated 23rd May for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without my medical care or legal rights being affected. I understand that should I withdraw then the information collected so far cannot be erased and that this information may still be used in the project analysis. ☐

3. I understand that relevant sections of data collected in the study may be looked at by authorised individuals from the University of Nottingham, the research group and regulatory authorities where it is relevant to my taking part in this study. I give permission for these individuals to have access to these records and to collect, store, analyse and publish information obtained from my participation in this study. I understand that my personal details will be kept confidential. ☐

4. I understand that the discussion will be recorded and that anonymous direct quotes from the discussion may be used in the study reports. ☐

5. I understand that I will receive a £20 High street shopping voucher as an inconvenience allowance and compensation for my time at the end of the discussion. ☐

6. I would like to receive a summary of the results of this study when it has been completed. (Optional) ☐

5\. I agree to take part in the above study. ☐

______________________	____________	______________________
Name of Participant	Date	Signature
Name of Person taking consent	Date	Signature

2 copies: 1 for participant, 1 for the project notes

7.3.4 Semi-structured interview schedule

Pregnancy lifestyle survey

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

SEMI-STRUCTURED INTERVIEW SCHEDULE

Final Version 1.0, 7th May 2013
Study title: Pregnancy Lifestyle Survey, mother's views on smoking in the home

Name of Researchers: Sophie Orton, Tim Coleman, Laura Jones, Sue Cooper, Sarah Lewis

1. Can you describe your experiences of smoking during your pregnancy?
    a. How did you find stopping smoking (or trying to stop smoking)?
    b. What were your reasons for stopping (or trying to stop)?
    c. How did you feel about smoking?
    d. What were your intentions about smoking when pregnant (e.g. did you intend to stop for good, intend to stop temporarily for pregnancy)?

2. How long after your baby was born did you start smoking again?
    a. Can you tell me about the situation or circumstances in which you started smoking again after your baby was born?
    b. How did you feel about starting smoking again?
    c. Has your smoking changed as your baby has gotten a bit older? How has it changed? (e.g. are you smoking more/less/about the same? Being more or less careful about where/when you smoke?)

3. How would you describe smoking in your home, now that you've got the baby?
    a. Do you have any rules or restrictions about smoking inside?
    b. (if yes) Are there ever any exceptions to these rules?
    c. Have you found anything that makes it difficult to restrict smoking in your home?
    d. Has smoking in your home changed since before you had your (most recent) baby? How would you say it has changed?
    e. Has smoking in your home changed now your baby is getting a bit older? How would you say it has changed?

4. What are your views about secondhand smoke/passive smoke and young babies?
    a. Do you think there are any risks to babies being exposed to SHS?
    b. Do you think these change as the baby gets a bit older? (if yes) How would you say that these change?

(If not covered under 4, or smoking rules need further exploration)

    c. Do you have any rules or restrictions about smoking inside?
    d. (if yes) Are there ever any exceptions to these rules?
    e. Have you found anything that makes it difficult to restrict smoking in your home?

(Schedule subject to revision through data collection process)

Pregnancy Lifestyle Survey, mother's views on smoking in the home – SEMI-STRUCTURED INTERVIEW SCHEDULE, Final Version 1.0, 7th May 2013

7.3.5 Demographic questions

Previous pregnancies
Have you been pregnant before?

____

Do you have any other children? If Yes, how many?

____

Social class
What is the occupation of the main income earner in your household?

____

Are you currently in paid work? If Yes, what is your occupation?

____

If No, what was your last employment (if applicable)?

____

Are there any cars or vans available for use by your household?

____

Do you own or rent your house?

____

Partner
Do you have a partner? _________________________

Does your partner live with you? _________________________

If yes, do they smoke? _____________________________

7.4 TRAINING ATTENDED

7.4.1 Internal University of Nottingham courses

- Academics' and Administrators' Professional, Personal and Leadership Experience (APPLE), 16th October 2012
- Speed Reading, 16th November 2012
- Basic Statistics in SPSS, 28th November and 11th December 2012
- Community Health Sciences Post Graduate Research Conference, 7th December 2012
- Introduction to the skills of assertiveness and negotiation, December 2012
- Preparing your first year report and writing scientific abstracts, 27th February 2013
- Advanced Statistics in SPSS, 6th, 13th & 20th March 2013
- Creating and managing long documents in Microsoft Word, 12th February 2014
- Master's in Public Health module: Advanced Statistics, 11th February – 8th April 2014
- Getting going on your Thesis, 14th May 2014
- School of Medicine Post Graduate Researchers Oral Presentation Event, 24th November 2014
- Research Staff Development Conference 2015: Routes to career Excellence, 18th March 2015
- Preparing for your viva, 15th June 2015
- The Nottingham Cochrane Systematic Reviews Course, 16th – 19th June 2015

7.4.2 External courses and training

- UK Centre for Tobacco and Alcohol Studies Conference, 7-9th November 2012, York
- School of Academic Primary Care East Midlands Regional Conference, 25th March 2014, Lincoln
- UK Centre for Tobacco and Alcohol Studies Early Career Researcher Event, 17th June 2014, Leeds
- UK Centre for Tobacco and Alcohol Studies Annual Conference, 18-19th June 2014, Leeds

- Research Methods for Clinical Trials, 14-16 July 2014, University of Birmingham, Birmingham Clinical Trials Unit
- Department of Health Psychology Annual Conference, 10-12th September 2014, York
- UK Society for Behavioural Medicine Annual Scientific Meeting, 3-4th December 2014, Nottingham
- Trent Regional School of Academic Primary Care Conference, 17th March 2015, Nottingham
- Principles of Behaviour Change in Health and Illness, European Health Psychology Society, 1-5th September 2015, Limassol, Cyprus

7.5 PRIZES/AWARDS

- School of Community Health Sciences Postgraduate Annual Event poster prize, University of Nottingham, 2012
- NIHR CLAHRC East Midlands PhD Travel/Research Prize, 2015 (Value £500)