Pregnancy smoking, child health and nutrition
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Summary

Maternal smoking during pregnancy is a major public health problem and significant cause of maternal and infant morbidity with later childhood health problems. In Liverpool Merseyside the prevalence of pregnancy smoking is high. Research into the prevalence of pregnancy smoking habits in relation to birth and childhood health outcomes is important in order to assess the overall magnitude of the health impacts of pregnancy smoking. As smoking in pregnant women is a particularly frequent occurrence in women in Merseyside, this project aimed to assess the child health impacts of this major public health problem.

Chapter 1 General Introduction and study objectives

The problem of pregnancy smoking as a major public health problem and prevalence in the United Kingdom is presented. The rationale for this study in Liverpool is presented and the study aims and objectives.

Chapter 2 Asthma in children in relation to pre-term birth and fetal growth restriction

Sequential studies were undertaken to assess the impact of parental asthma on risk of pre-term birth (PTB) and intrauterine growth restriction, and their association with childhood asthma. Three cross-sectional surveys in 1993(n=3746), 1998(n=1964) and 2006(n=1074) were performed in the same 15 schools in Merseyside. The same respiratory health questionnaire was completed by parents for the three surveys. Between 1993 and 2006, prevalence of PTB varied between 12.4% to 15.2% and of small for gestational age babies (SGA) from 2.1% to 4.6%, and maternal asthma prevalence from 8.1% to 13.4%. For the combined surveys mothers with asthma were more likely to have a PTB than non-asthmatic mothers (OR 1.39, 95% CI 1.10-1.95, p<0.001), and in 2006 more likely to have an SGA baby. Maternal smoking was not a risk factor for later childhood respiratory morbidity. 40.9% of PTBs of asthmatic mothers developed doctor diagnosed asthma compared to 34.3% for term babies (adjusted OR 1.65, 1.34-2.04, p<0.001). The corresponding estimates for the symptom triad of cough, wheeze and breathlessness were 19.4% and 17.6 % (adjusted OR 1.78, 0.79-3.98). Conversely SGA babies were less likely to develop doctor diagnosed asthma (adjusted OR 0.49, 0.27-0.90, p<0.021), or the symptom triad (adjusted OR 0.22, 0.05-0.97, p<0.043), whether or not the mother was asthmatic. Maternal asthma is an independent risk factor for PTB which predisposes to childhood asthma. Intrauterine growth restriction was associated with protection from childhood asthma.

Chapter 3 Dose response association of pregnancy cigarette smoke exposure, childhood stature, overweight and obesity

The combined dose-response effects of pregnancy cigarette smoke exposure on childhood overweight, obesity and short stature have not been reported. A community based cross-sectional survey of 3038 children aged 5–11 years from 15 primary schools in Merseyside, UK was undertaken. Self-completed parental questionnaires were used for family characteristics, socio-economic status and parental smoking practices. Children were measured for height and weight and anthropometric z-scores calculated for different parental smoking categories. Of 689 (34.0%) mothers who smoked during pregnancy 50.5% smoked ten or more cigarettes daily (heavy smokers). Children of maternal non-smokers had prevalence estimates for overweight, obesity and short stature of 25%, 9.6% and 3.2%, respectively. Prevalence estimates were higher in children of mothers who were heavy
smokers during pregnancy, 31.5% \( (p = 0.001) \), 15.6% \( (p < 0.001) \) and 5.5% \( (p = 0.001) \), respectively. Mean height for age z-scores was lower among heavy maternal \( (p < 0.001) \) and paternal smokers \( (p < 0.01) \) compared to non-smokers. Childhood overweight, obesity or short statures were all associated with heavy maternal smoking during pregnancy \( (all \; p < 0.001) \). Mean body mass index (BMI) z-scores were higher in boys of mothers who smoked \( (p = 0.043) \). The adjusted odds ratio for short stature in children of heavy maternal smokers was 2.76 \( (95\% \; CI \; 1.21–6.33) \) and 4.28 \( (1.37–13.37) \) if both parents were heavy smokers. The adjusted OR for obesity in children of maternal smokers was 1.61 \( (1.19–2.18) \). The population attributable risk for short stature was 8.8% \( (1.1–22.7) \) for heavy maternal smokers. A dose–response association was observed between pregnancy smoking exposure, short stature and obesity.

Chapter 4 Childhood obesity and parental smoking as risk factors for childhood ADHD in Liverpool children

ADHD prevalence has risen in parallel with rising prevalence of pregnancy smoking and childhood obesity. The objective was to determine the epidemiological association of pregnancy smoking and childhood obesity with ADHD. A cross-sectional community study was conducted in 2006 using a parental questionnaire. A total of 1,074 schoolchildren aged 5–11 years were enrolled from 15 primary schools in a lower socio-economic area of Merseyside. ADHD was defined by the question ‘‘does your child have Attention Deficit Hyperactivity Disorder, (ADHD), which has been diagnosed by a doctor?’’ The prevalence estimates for childhood obesity, maternal smoking during pregnancy and childhood ADHD were 14.9% \( (116/777) \), 28.0% \( (269/955) \), and 3.4% \( (32/945) \), respectively. ADHD prevalence increased five-fold in children with obesity \( (RR, \; 4.80, \; 95\% \; CI \; 2.2–10.4, \; p<0.001) \) and more than two-fold in children of mothers who smoked during pregnancy \( (RR, \; 2.44, \; 95\% \; CI \; 1.2–4.9, \; p=0.02) \). Regression analysis adjusting for obesity, overweight, maternal smoking during pregnancy, heavy maternal smoking, household member smoking during pregnancy, doctor-diagnosed asthma, pre-term birth, and low birthweight showed significant independent associations of ADHD prevalence with obesity \( (AOR, \; 4.66, \; 95\% \; CI \; 1.57–13.89, \; p = 0.006) \) and pregnancy smoking \( (AOR, \; 3.19, \; 95\% \; CI \; 1.08–9.49, \; p = 0.04) \). There was a positive dose–response association of ADHD with the number of maternal cigarettes smoked during pregnancy. Measures to reduce both smoking among pregnant women and childhood obesity might reduce prevalence of childhood ADHD.

Chapter 5 Parental smoking and increased likelihood of female births

A recent decline in the male : female (M:F) sex ratio may relate to pregnancy cigarette smoke exposure. The aim of the analysis was to assess trends and cigarette exposure dose–response effects on the sex ratio. A retrospective analysis was carried out of deliveries at the Liverpool Women’s Hospital between 1998 and 2003, and of deliveries reported in community surveys from the same area in 1998 and 2006. For the hospital sample, the M:F sex ratio was 1.14 if no parent smoked, and 0.77 when both parents smoked during the mother’s pregnancy \( (p < 0.001) \). Heavy maternal smokers (>10 cigarettes per day) were more likely to deliver a female baby than light smokers \( (p < 0.001) \). Smoking was associated with increased likelihood of female birth controlling for birth year, socio-economic status, alcohol exposure, maternal haemoglobin and body mass index \( (adjusted \; OR: \; 1.41, \; 95\% \; CI \; 1.12–1.92, \; p <0.001) \). In the community sample controlling for socio-economic status the ratios were 1.13 \( (95\% \; CI \; 1.03–1.24, \; p =0.015) \) in 1998 and 1.31 \( (95\% \; CI \; 1.16–1.48, \; p < 0.001) \) in 2006. Secular trends showed decreasing ratios in hospital and community samples for both
smokers and non-smokers. Pregnancy cigarette smoking increased the proportion of female births with evidence for a dose–response association.

Chapter 6 Trends in prevalence of childhood and parental asthma in Merseyside 1991-2006

To determine changes in prevalence of parental and childhood asthma in Merseyside between 1991 and 2006. Four standardized cross-sectional respiratory surveys using a parent-completed questionnaire were completed in 1991 (n = 1171), 1993 (n = 2368) 1998 (n = 1964) and in 2006 (n = 1074) among primary school children attending the same schools in lower socioeconomic areas of Merseyside. Main outcome measures were prevalence of doctor diagnosed asthma (DDA) and the symptom triad of cough, wheeze and breathlessness (C+W+B+). Results between 1991 and 1998 prevalence of DDA increased (p< 0.001), but in 2006 this decreased from 29.8 to 19.4% (p< 0.001). Prevalence of C+W+B+ increased from 7.8 to 8.0% by 1998, then decreased to 6.7% in 2006 (p = 0.39). Between 1998 and 2006 childhood hospital admissions for respiratory illness decreased from 11.3 to 9.7% (p = 0.23). During this period paternal asthma prevalence increased from 8.6 to 10.7% (p = 0.001) and maternal asthma from 11.2 to 13.4% (p = 0.09). An increase in the prevalence of DDA and asthmatic respiratory symptoms occurred in children prior to 1998, but this had decreased by 2006. Prevalence of parental asthma increased and prevalence of parental smoking decreased during the same period.

Chapter 7 Parental compliance- an emerging problem in community surveys

Compliance is an important issue for school based epidemiological surveys and it is increasingly difficult to achieve high compliance in community surveys. The objective of the analysis was to determine the trends in parental compliance for four respiratory health surveys among primary school children in Merseyside from 1991 to 2006 using the same respiratory health questionnaire. Four cross sectional respiratory health surveys were completed in 1991 (n=1872), 1993 (n=3746), 1998 (n=1964) and 2006 (n=1074) among primary school children (5-11 years) attending the same 10 schools in Bootle and the same 5 schools in Wallasey, Merseyside. The same questionnaire was used and the core questions were similar for all surveys. Amongst respondents changing response rates to the same question provided insights into questionnaire compliance. The parental questionnaire compliance for the four surveys was 92% (1872/2035) in 1991, 87.4% (3746/4288) in 1993, 78.1% (1964/2514) in 1998 and 30.3% (1074/3540) in 2006. Mean Townsend Score as an assessment of socio-economic status was comparable across the four surveys: 5.50 in 1991 and 5.26 in 2006. Out-migration in the previous three years had not changed between 1991 and 2006 (p=0.256). It is quite unlikely that the methodological differences between the surveys explained changes in compliance between the surveys as the same survey instruments, methodology and schools were used for all the sequential surveys. The decrease in parental compliance may relate to increasing frequency of questionnaire surveys occurring in schools related to various audits, monitoring and evaluation activities, lack of available time for employed parents, lengthy questionnaires, change in demographic characteristics of the surveyed sample and changing attitudes of respondents to sensitive questions. Parental compliance is an emerging major problem for cross-sectional community surveys of childhood health and has to be factored into survey design when using community survey methodologies.
Chapter 8  General Discussion

The main findings of the study and their health implications are discussed. Their relevance for smoking cessation programs are considered and priorities for future research outlined.