

Effect of changes in maternal smoking habits in early pregnancy on infant birthweight

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SUMMARY

Background. The inverse relationship between maternal smoking and infant birthweight is well documented.

Aim. The aim of the present study was to examine whether a change in maternal cigarette consumption in early pregnancy affects the infant's birthweight.

Method. A total of 5980 women who presented to their general practitioners between 1976 and 1979 with an unplanned pregnancy and the babies resulting from these pregnancies were included in the study. Women were divided into four categories: non-smokers, smokers, quitters and reducers.

Results. In terms of mean infant birthweight, the non-smokers had a clear benefit over the smokers whose babies were 153 g lighter ($P < 0.001$), and over the quitters whose infants were 39 g lighter. There was also an advantage in stopping smoking: the smokers had babies whose mean birthweight was 120 g less than that of the quitters ($P < 0.001$). There was no demonstrable benefit from reducing cigarette consumption without entirely stopping.

Conclusion. These findings may have important implications for where best to target health education.

Keywords: smoking habits; birthweight; pregnancy outcome; smoking cessation; patient attitude.

Introduction

An infant's birthweight is an important factor affecting neonatal and postnatal mortality,¹ infant and childhood morbidity,¹ and possibly ischaemic heart disease later in life.² Previous studies have consistently found an inverse relationship between maternal smoking and infant birthweight.^{1,3-5} Since an estimated 30% of pregnant women in the United Kingdom smoke,⁶ educational programmes to reduce the prevalence of smoking may offer an important opportunity to improve the nation's health. Before such programmes are established, however, it is important to determine the potential benefits. For example, what is the effect of stopping or reducing cigarette consumption during pregnancy? So far, the few studies which have examined this issue have produced conflicting results.⁷⁻¹¹

As part of a larger study this paper examined a cohort of women in order to establish whether a change in maternal smoking habits in early pregnancy affects the infant's birthweight.

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Method

Population studied

The joint Royal College of General Practitioners/Royal College of Obstetricians and Gynaecologists attitudes to pregnancy study was established to investigate the consequences of induced abortion, including early sequelae, the outcome of subsequent pregnancy, psychiatric illness and future fertility.¹²⁻¹⁵ Between 1976 and 1979, 1500 general practitioners in England, Scotland and Wales recruited 6188 women who presented with an unplanned pregnancy which was subsequently terminated and a comparison group of 7073 women who also had an unplanned pregnancy but who did not have an induced abortion.

This study examines the experience of those women whose unplanned pregnancy proceeded to the delivery of a liveborn infant. Information collected at recruitment by the general practitioners included the mother's age and height, previous obstetric and medical history, age at which full-time education was completed and the area of residence. Self-reported daily cigarette consumption, both before confirmation of the pregnancy and again at the first antenatal consultation, was recorded. The median gestation at this consultation was 11.3 weeks. Women were classified at each period as non-smokers, light smokers (1-14 cigarettes daily) and heavy smokers (15+ daily).

Of the 7073 women considered for inclusion in this analysis, 1093 (15.5%) were excluded for the following reasons: non-viable outcome (788 women), birthweight unknown (84), pregnancy duration less than 32 weeks (63), multiple births (62), cigarette consumption unknown (32), increased cigarette consumption in early pregnancy (32), educational status unknown (31) and maternal height unknown (one). The women who increased cigarette consumption in early pregnancy were excluded from this study since there was an insufficient number for meaningful analysis.

The 5980 women remaining in the analysis were divided into four categories: non-smokers (3411 women) — those who remained non-smokers after conception; smokers (1472) — those who continued to smoke after conception at an unchanged level; quitters (612) — those who stopped smoking after conception; and reducers (485) — those who reduced their cigarette consumption but did not stop.

Analysis

A multiple regression model was used to adjust simultaneously for factors which might influence birthweight. A backward elimination regression procedure was used to determine which variables should be included in the analysis. Starting with all variables in the model, the factor which showed least statistical significance was excluded, followed by the next least significant factor. This procedure was repeated until only those with a significance of $P < 0.05$ remained. The variables included in the final model were length of gestation (weeks), maternal height (cm), maternal age (years), parity (nulliparous or parous), age at which full-time education finished (less than 17 years, 17+ years, or unfinished), and area of residence (Scotland, northern England and north Wales, Midlands and south Wales or southern England).

Results

Table 1 shows the distribution of the 5980 women by their smoking habits before and during pregnancy — 2569 women (43.0%) smoked before they learned of their pregnancy. This was strongly associated with the age at which the women completed full-time education; 47.7% of the 4582 women who had finished by 17 years of age were smokers, compared with 27.2% of the 1289 women who continued their education beyond this age.

Of the 2569 women who smoked before they learned of their pregnancy 612 (23.8%) had stopped smoking by the time of their first consultation with the general practitioner. This was also related to educational status. Fewer women who finished their education by the age of 17 years stopped smoking than those who continued with their education (21.4% of 2187 and 38.4% of 350, respectively). None of the other factors examined in the study was associated with the decision to stop smoking during pregnancy.

The mean birthweight of babies born to women who continued to smoke in early pregnancy was 153 g less than for those born to women who were non-smokers from before conception (Table 2). Furthermore, there was a strong gradient with number of cigarettes consumed daily.

Cessation of smoking during pregnancy was beneficial. The mean birthweight of infants born to the smokers was 120 g less than that of babies of quitters (Table 3). The level of smoking

before the pregnancy did not appear to have any important effect.

Although stopping smoking was beneficial, birthweight was always highest in the non-smokers. The mean birthweight of infants born to all quitters was 39 g less than the non-smokers (Table 4), although this difference was not significant. However, when the comparison was with those quitters who had been previously heavy smokers the difference became statistically significant.

A reduction in the number of cigarettes smoked during pregnancy did not appear to confer any material benefit; the mean birthweight of infants delivered by heavy smokers who became light smokers during their pregnancy was 22 g less (95% confidence interval -73 g to +30 g) than those born to heavy smokers who did not reduce their consumption (this difference was not significant).

Discussion

The present study confirms previous work¹⁰ which has shown that maternal cigarette smoking in pregnancy adversely affects the infant birthweight. The reduction in mean birthweight of infants born to smokers compared with non-smokers ranged from 142 g for light smokers to 168 g for heavy smokers and was similar to that previously reported.¹⁰ The strength of the association, its consistency with other studies, and the existence of dosage effects all point towards a causal relationship. It has been argued, however, that any effect on birthweight is a manifestation of the person who smokes,^{16,17} or associated stressful life events¹⁸ rather than smoking *per se*, and the effect of stressful life events is partly reflected by smoking.¹⁸ Clearly, smoking cessation programmes can only be helpful if smoking is a causal factor.

This study indicates that pregnant women who stop smoking have heavier infants than those who continue to smoke. This confirms the findings of other workers.^{3,19} The benefits were confined to smokers who stopped completely, confirming previous reports.⁴

One new observation of this study was that infants born to women who were non-smokers from before conception were heavier even than those delivered by women who stopped smok-

Table 1. Distribution of women by daily cigarette consumption before and during pregnancy.

Daily cigarette consumption before pregnancy	No. of women by daily cigarette consumption at first consultation with confirmed pregnancy			
	0	1-14	15+	Total
0	3411	—	—	3411
1-14	379	684	—	1063
15+	233	485	788	1506
Total	4023	1169	788	5980

Table 2. Effect of cigarette consumption on the mean birthweight of infants born to smokers compared with non-smokers.^a

Daily cigarette consumption before and during pregnancy	Number of women	Difference in mean birthweight from non-smokers (g) ^b	95% confidence interval	P value
0	3411	0	—	—
1-14	684	-142	-112 to -172	<0.001
15+	788	-168	-133 to -204	<0.001
Test for linear trend $P < 0.01$				
All smokers	1472	-153	-128 to -178	<0.001

^aSmokers = women who continued to smoke after conception; non-smokers = women who were non-smokers from before conception. ^bAdjusted for length of gestation, maternal height, maternal age, parity, age of completion of full-time education and area of residence.

Table 3. Effect of cigarette consumption on the mean birthweight of infants born to smokers compared with quitters.^a

Daily cigarette consumption	Number of women	Difference in mean birthweight from quitters (g) ^b	95% confidence interval	P value
1-14 before conception:				
Stopped after conception	379	0	—	—
Continued without reduction	684	-94	-37 to -152	<0.001
15+ before conception:				
Stopped after conception	233	0	—	—
Continued without reduction	788	-107	-40 to -173	<0.01
All who stopped	612	0	—	—
All who continued without reduction	1472	-108	-64 to -151	<0.001

^aSmokers = women who continued to smoke after conception; quitters = women who stopped smoking after conception. ^bAdjusted for length of gestation, maternal height, maternal age, parity, age of completion of full-time education and area of residence.

Table 4. Effect of previous cigarette consumption on the mean birthweight of infants born to quitters compared with non-smokers.^a

Daily cigarette consumption before conception	Number of women	Difference in mean birthweight from non-smokers (g) ^b	95% confidence interval	P value
0	3411	0	—	—
Quitters:				
1-14	379	-21	-27 to +70	0.392
15+	233	-67	-7 to -128	<0.05
All quitters	612	-39	0 to -78	0.053

^aNon-smokers = women who were non-smokers from before conception; quitters = women who stopped smoking after conception. ^bAdjusted for length of gestation, maternal height, maternal age, parity, age of completion of full-time education and area of residence.

ing in early pregnancy. The difference approached statistical significance and became significant when comparison was made with previously heavy smokers. This finding is at variance with previous work^{4,8,20} and needs to be repeated before it can be accepted with confidence. Its implication, however, is that while intervention programmes aimed at stopping smoking in pregnancy will have a beneficial effect on birthweight, the greatest potential advantage would be if health education programmes could prevent smoking altogether, or at least during the period when conception might take place. Ideally, these programmes should be targeted at women with lower educational status, since these women are most likely to smoke before and least likely to stop during pregnancy. It is disturbing that the proportion of young women who smoke increased between 1988 and 1990.²¹

A potential inaccuracy in the present study is the fact that cigarette consumption recorded was based only on the statements of the recruited women. It is, however, unlikely that non-smokers would say that they smoked. Thus, any bias caused by inaccurate information from patients would be from smokers claiming to be non-smokers or to have reduced their cigarette consumption. This would dilute the effect of smoking. Despite this the group who admitted to smoking had babies who were significantly lighter than babies of those who had never smoked, and of those who had stopped.

Although passive smoking may be another important factor associated with infant birthweight, its effect could not be investigated in the present study.

The women in this study were recruited from general practice populations throughout England, Scotland and Wales. Forty three per cent of the women were smokers when they became pregnant compared with 29% in a study in the west Midlands which recruited patients from antenatal clinics.¹¹ One possible explanation for this difference is the fact that all the women in our study had an unplanned pregnancy. These women represent only about half of all pregnancies (Frank P, unpublished results) and may be different in terms of smoking habits to those with planned pregnancies. Differences in the social class mix of the two study populations might also be relevant.

The inverse relationship between birthweight and smoking during pregnancy is confirmed by the results of this study. Infants of mothers who stop smoking during pregnancy benefit in terms of birthweight, but those born to smokers who only reduce their cigarette consumption do not. Women who were non-smokers at the start of pregnancy had the heaviest babies; health education programmes should be targeted to increase the proportion of women who do not smoke when they conceive.

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