

Maternal smoking and ethnic origin, association with birth weight and NICU admission

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Abstract

Introduction: Despite anti-smoking campaigns, smoking in pregnancy is common and has adverse consequences for the infant. Maternal smoking may vary according to ethnic origin. Our aims were to determine if indeed maternal smoking habits varied according to ethnicity, and whether adverse effects of maternal antenatal smoking on infants, as indicated by reduced birthweight and need for NICU admission, varied according to ethnic origin.

Material and methods: A maternal and infant database was interrogated. Midwives asked mothers about their ethnic origin and smoking habits and entered data prospectively. The number of cigarettes smoked used in the analysis was the minimum number the mothers admitted to smoking; heavy smokers were those smoking more than five cigarettes per day. Data were analysed from 3595 women. The majority were either Caucasian (39%), Asian (5%), Caribbean (17%) or African (36%). Seven hundred and forty of the women were smokers.

Results: A greater proportion of Caucasian (34%) and Caribbean (28%) women admitted to smoking compared to Asian (7%) and African (5%) women ($P < 0.001$). Heavy smoking was most common amongst Caucasian women ($P < 0.001$). Maternal ethnicity ($P < 0.001$) and smoking ($P < 0.001$) significantly influenced birth weight. Among women who smoked between 5 and 10 cigarettes per day, there was a dose-dependent adverse effect on birth weight. Multivariate analysis demonstrated that significant associations of NICU admission were gestational age, birth weight and parity of the mother, but not maternal ethnicity or smoking.

Conclusions: Heavy smoking is associated with a dose-dependent adverse effect on birth weight and is most common in Caucasian women.

Key words: nicotine, infant, ethnicity.

Introduction

Despite anti-smoking campaigns, smoking in pregnancy is common, with up to 20% of pregnant women smoking [1-4]. Unfortunately, smoking in pregnancy results in adverse infant outcomes including reduction in birth weight of between 165 [5] and 357 g [1]. Maternal smoking may also increase the need for neonatal intensive care unit (NICU) admission [6-8]. It has been estimated that 6.6% of all admissions to the NICU in the United States were the result of maternal smoking and those admissions

Table I. Percentages of women smoking or non-smoking and smoking status according to the number of cigarettes smoked

Non-smokers	Number (percentage) 2855 (79.4%)
<1/day	400 (11.1%)
1-5/day	144 (4.0%)
5/day	44 (1.2%)
6-10/day	97 (2.7%)
11-20/day	47 (1.3%)
>20/day	8 (0.2%)

represented 8.5% of the total expenditure on NICU services [9].

There is some evidence to suggest that maternal smoking varies according to ethnic origin [2, 10, 11]. In New South Wales, Caucasian and aboriginal women were more likely to smoke than Asian women [2]. Data regarding the smoking habits of Afro-Caribbean women, however, are conflicting. In one study [10], smoking was more common in Europeans than in women of Afro-Caribbean, Asian or oriental origin, but in another [11] 30% of both European and Afro-Caribbean women smoked. Neither study [10, 11], however, determined whether the smoking habits of African and Caribbean women differed.

An aim, therefore, of this study was to determine if smoking habits of pregnant women differed according to ethnic origin, in particular between African and Caribbean women. In addition, we wished to determine if the adverse effects of maternal antenatal smoking on infants, as indicated by their birth weight and need for NICU admission, differed according to ethnic origin, such results being important to identify if there were groups who should be particularly targeted for smoking cessation programmes.

Material and methods

The maternal database (Euroking) at King's College Hospital (KCH) London was interrogated. Maternal medical histories obtained at the first antenatal visit were entered by the midwife and prospectively updated with the course and outcome of the pregnancy. Women were asked about their ethnic origin. Mothers were classified as "smokers" if they smoked during pregnancy, that is, they admitted to smoking at least from the booking visit

and to within a few weeks of delivery. Women were asked about the number of cigarettes they smoked; they were not asked to give the precise number but rather indicate from a series of ranges (Table I). The number of cigarettes smoked used in the analysis was the minimum number admitted by the mother.

Analysis

Data were analysed from women in the following ethnic groups: Caucasian, Asian, Caribbean, African, Vietnamese-Filipino, Chinese and other. Data from women of mixed ethnic origin were excluded from the analysis. The outcome variables, birth weight and admission to the neonatal unit were modelled in terms of smoking and ethnicity of the mother, while adjusting for the effect of other potentially important factors such as gestational age and maternal data (age, parity, number of still births and successful pregnancies). The univariate analysis consisted of analysis of variance and simple linear regression for birth weight or χ^2 test and logistic regression for neonatal unit admission. The corresponding multiple regression models, fitted in a stepwise manner, were then undertaken in order to explore the concurrent effects of all the potential important independent variables and their interactions. Given the large size of some of the ethnic groups in the sample, random sampling was used in order to have 90% power for our group comparisons to detect differences in birth weight of 150 g [12].

Subjects

Data from 4869 women who consecutively delivered during a one-year period in 2005 were examined. There was no information on the outcome of the babies of 165 women; 1109 women were found to be of mixed ethnic origin. The remaining 3595 women were included in the analysis. Their infants had a median gestational age of 38.9 (range 23-46) weeks and birth weight of 3279 (range 480-5080) g.

Results

Thirty-nine percent of the women were Caucasian, 5% Asian, 17% Caribbean and 36% African. Only 3% of the women were Vietnamese-Filipino, Chinese or another ethnic origin; hence their results are not specifically reported. The Caucasian women delivered at an older age than the other three groups ($P < 0.001$) (Table II). A greater proportion of the Caucasian and

Table II. Age and smoking status by ethnic origin

	Caucasian	Asian	Caribbean	African
Mean age [years]	31.6	28.6	29.2	29.8
Proportion smoking [%]	34	7	28	5
Proportion heavy smokers [%]	9	0	3	1

Data are presented as mean or percentage

Table III. Multiple linear regression for birth weight (g)

	Co-efficient	95% confidence intervals (CI)		P
Gestational age	173.3	166	180	<0.001
Maternal age	3.5	0.5	6.5	0.02
No live births	36	21	51	<0.0011
Smoking level	-301	-386	-216	<0.001
Ethnicity				<0.001
• Caucasian vs. African	110	67	153	<0.001
• Caribbean vs. African	-104	-154	-54	<0.001
• Asian vs. African	-154	-240	-68	<0.001
• Chinese vs. African	-106	-282	70	0.24
• Vietnamese-Filipino vs. African	-120	-320	79	0.24
• other vs. African	95	-45	235	0.18

Caribbean women admitted to smoking compared to the other groups (P<0.001) (Table II). Only approximately 5% of women overall admitted to smoking more than five cigarettes per day (heavy smokers) (Table II). A greater proportion of the Caucasian women were heavy smokers compared to the other groups (P<0.001) (Table II).

The infants whose mothers were smokers had a mean of 60 g [95% confidence interval (CI), 7 to 113] lower birth weight than those of non-smoking mothers. Further analysis demonstrated that there was no significant difference in the birth weights of infants of non-smoking mothers and those who smoked a maximum of five cigarettes per day, whereas infants of women who smoked between 6 and 10 cigarettes a day had a reduction in birth weight for each additional cigarette per day smoked by their mother. Smoking more than five cigarettes per day was associated with a 307 g (95% CI, 163-451) reduction in birth weight. Birth weight also differed according to ethnic origin, being greatest in infants born to Caucasian mothers [mean birth weight 3.364 (SD 0.655) kg] (P<0.001) [African mothers mean infant birth weight 3.270 (SD 0.65) kg, Caribbean 3.141 (SD 0.665) kg, Asian 3.076 (SD 0.588) kg]. Multiple linear regression modelling demonstrated that gestational age was the most important determinant of birth weight (Table III). After adjusting for gestational age, other factors significantly associated with birth weight were maternal age (P=0.02), the number of pregnancies (P=0.02) and live births had by the mother (P<0.001), maternal smoking (P<0.001) and ethnicity (P<0.001). Although there was a significant association between heavy smoking and ethnicity, there was not a significant smoking by ethnicity interaction effect on birth weight.

Univariate analysis demonstrated that factors significantly associated with NICU admission were birth weight, gestational age, ethnicity and the number of live births had by the mother, but not

Table IV. Multiple logistic regression for neonatal unit admission

	Odds ratio	95% CI	P
Birth weight	0.32	(0.2, 0.4)	0.0001
Maternal age	1.03	(1.0, 1.1)	0.09
Gestation (37- vs. 37+)	4.7	(3.1, 7.3)	0.0001
Number of live births	0.84	(0.7, 0.98)	0.03

maternal age or smoking. A greater proportion (8.5%) of infants of Asian origin were admitted to the neonatal unit. Multivariate analysis (Table IV) demonstrated that factors significantly associated with admission were birth weight, numbers of live births had by the mothers and gestational age; ethnicity no longer remained a significantly associated factor.

Discussion

We have demonstrated a high incidence of smoking among Caucasian and Caribbean pregnant women and that African and Caribbean women have very different smoking habits. Previous studies [11] have reported African and Caribbean women together and hence missed differences between the two groups. Although only 3% of Caribbean women admitted to heavy smoking, the high proportion who admitted to smoking is of concern, as it has been suggested there may be differences in nicotine metabolism according to ethnic origin [13]. In non-pregnant smokers, higher serum cotinine levels were found in blacks compared to whites, even after controlling for a number of behavioural and personal characteristics, including self-reported cigarette doses [13]. Similarly, in pregnant smokers, black compared to white women had higher serum cotinine levels at each level of self-reported cigarette consumption [14]. After controlling for maternal factors and smoking behaviour including self-

reported cigarette consumption, there was no significant difference in the relationship between serum cotinine level and birth weight reduction according to birth weight origin; hence cigarette smoking among blacks may have a greater effect on birth weight [14]. Our results further emphasize that Caribbean mothers should be particularly targeted for smoking cessation programmes.

The babies whose mothers were smokers were a mean of 60 g lower birth weight than those of non-smoking mothers. A previous study has suggested the difference in birth weights of smoking and non-smoking mothers to be larger [11]. This discrepancy in the two studies may reflect the fact that the majority of mothers in this study admitted to smoking very few cigarettes per day. As smoking status was based on questioning the mother rather than cotinine analysis, it is possible that, as shown previously [11], the women under-reported their smoking habits. Nevertheless, when we related birth weight to the number of cigarettes smoked we saw no reduction if the mother smoked less than five cigarettes per day, but a "dose-dependent" association of reduction in birthweight in the babies whose mothers had smoked more than five cigarettes per day. Importantly, heavy smoking was most common in Caucasian women.

Univariate analysis highlighted that ethnicity was one of the factors that influenced admission to a neonatal intensive care unit. A greater proportion of infants of Asian origin were admitted to a neonatal unit. Only 5% of the study population, however, were Asian and ethnicity no longer remained a significant risk factor when multilinear regression modelling was undertaken. We did not find smoking to be a risk factor for NICU admission, which may reflect the small number of cigarettes smoked by our mothers and their relatively low maternal age [8]. We have, however, highlighted a dose-dependent association with reduction in birth weight of infants of the heavy smokers, and smoking increases pregnancy complications [6-9, 12, 15-17]. In addition, the proportion of low and depressed infant Apgar scores has been shown to be related to the extent of maternal cigarette usage during pregnancy [18]. In particular, the three pack level of smoking (41 to 60 cigarettes per day) was reflected in a near quadrupling of low and depressed one and five minute Apgar scores [18]. It has also been demonstrated that the frequency of low Bayley scores at eight months was linearly related to maternal cigarette usage [19].

There are several limitations to this study. As discussed before smoking status was based on questioning the mother rather than cotinine analysis; nevertheless, we demonstrated a dose-dependent association. We took into account only some of the factors that might affect birthweight, yet we found

a significantly dose-dependent association of maternal smoking and reduction in birthweight. A strength of the study, however, is that the data were collected at the first antenatal visit and prospectively updated with the course and outcome of the pregnancy.

In conclusion we have detected differences in the smoking habits of Caribbean and African women, with smoking being commoner in the former. In addition, we found that in heavy smokers there was a dose-dependent adverse association with reduction in infant birth weight. Caucasian women were more likely to be heavy smokers. Health promotion campaigns should take these results into account and particularly target high risk women.

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