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Primary care

Smokeless tobacco use, birth weight, and gestational age: population based, prospective cohort study of 1217 women in Mumbai, India

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Abstract

Objective To study the effect of using smokeless tobacco during pregnancy on babies' birth weight and gestational age at birth.
Design Population based, prospective cohort study using a house to house approach.
Setting Eight primary health post areas in the city of Mumbai (Bombay), India.
Participants 1217 women who were three to seven months pregnant and planning to deliver in the study area. 1167 women (96%) were followed up.
Main outcome measures Birth weight and gestational age in singleton births.
Results Smokeless tobacco use was associated with an average reduction of 105 g in birth weight (95% confidence interval 30 g to 181 g) and a reduction in gestational age of 6.2 (3.0 to 9.4) days. The odds ratio for low birth weight was 1.6 (1.1 to 2.4), adjusted by logistic regression for maternal age, education, socioeconomic status, weight, anaemia, antenatal care, and gestational age. The adjusted odds ratio for preterm delivery (<37 weeks) was 1.4 (1.0 to 2.1); for delivery before 32 weeks it was 4.9 (2.1 to 11.8) and before 28 weeks it was 8.0 (2.6 to 27.2).
Conclusions Consumption of smokeless tobacco during pregnancy decreases gestational age at birth and birth weight independent of gestational age. It should receive specific attention as a part of routine prenatal care.

Introduction

Low birth weight and preterm birth are powerful determinants of morbidity and mortality in newborn babies and infants. It has been known for more than 40 years that babies born to mothers who smoke weigh less than babies whose mothers don't smoke. Smoking during pregnancy also increases the risk for preterm delivery.[1] In South East Asia smoking among women may be rare, but use of smokeless tobacco is common.[2] In the Mumbai cohort study in India of 59 527 lower middle class and lower class women aged 35 years and older, 57.5% currently used tobacco, 99.6% of which was smokeless.[3]

There are indications that using smokeless tobacco could be as detrimental to fetal health as cigarette smoking. Of 1388 singleton births in a hospital in Pune, India, tobacco chewers had babies with a consistent birth weight deficit of 100-200 g, independent of maternal weight, socioeconomic status, and gestational age.[4] In 178 deliveries in a Mumbai hospital, the proportion of low birth weight babies in users was 65%, a rate twice as high as that of non-users.[5] The effect on gestational age at birth of using smokeless tobacco has not been reported. We studied a cohort of pregnant women in the city of Mumbai (Bombay), India, to assess the effect of using smokeless tobacco during pregnancy on babies' birth weight and gestational age at birth.

Methods

About 180 government health posts serve the health needs of mothers and children in Mumbai. We conducted this study in collaboration with eight health posts and their community health volunteers (n = 177), who routinely monitor all women in their respective areas for pregnancy.

Recruitment

We screened the women listed by the community health volunteers during house to house visits for eligibility. Two trained social workers interviewed 1217 eligible women after obtaining oral informed consent between June 2002 and November 2002.

Women in the third to seventh month of their pregnancy were eligible if they were planning to remain in Mumbai for the birth (women in India often move to their mother's home to give birth). We used reinterview by a different social worker as a quality control check in 10% of participants (n = 123).

Measurements at recruitment

We gathered information on demographics, tobacco use, and medical and obstetric histories from the women. We used bathroom scales and a tape measure to obtain their weight and height. Most women did not know their weight before pregnancy. The two social workers extracted blood pressure, haemoglobin measurements, and other medical records from the medical reports and created a summary, based on a structured questionnaire format.

Tobacco use

We included as users all women who had used a smokeless tobacco product at least once a day for the past six months. We categorised the frequency of use as light (one to four times per day) or heavy (five or more times per day). Women in the state of Maharashtra, including Mumbai, commonly use mishri (pyrolysed and powdered tobacco), and its initial use is as a dentifrice. Betel quid (paan) with tobacco, gutka, and paan masala are chewed and generally retained in the mouth for longer periods.

Follow up

The community health volunteers and the social workers monitored the women. Interviews took place on delivery, and birth weight and date of delivery were copied from the infant's immunisation card. If medical records of birth weight were not available from the woman they were obtained from hospital records, as was the case in 10% (89) of all available birth weights. For 40 women, information from both sources was available and

in agreement. Blood pressure and haemoglobin measurements were abstracted from antenatal records, and all women gave self reports of high blood pressure or anaemia during pregnancy. Information on induced birth or elective caesarean section was not uniformly obtainable. The women received advice on breast feeding and immunisation schedules.

Outcome definitions

We used as outcomes low birth weight (<2500 g), preterm birth (<259 days or 37 weeks), early preterm birth (<224 days or 32 weeks) and very early preterm birth (<196 days or 28 weeks).

Data analysis

Of the 1217 recruited women, 208 (17.1%) reported using tobacco regularly during pregnancy. Use of smokeless tobacco predominated (99%, 206 women), mishri being the most common, (80%, 166). Forty six per cent of women (96) chewed tobacco once or twice a day and 24% (49) three or four times a day. Only five women reported that they had stopped using tobacco late in the pregnancy; we did not analyse them separately.

We followed up 1167 women (96%). We excluded two smokers (bidi), eight women who gave birth to twins, 21 who had abortions, and 26 with no date of birth and only secondhand information from neighbours from all analyses. Altogether 1110 women who gave birth after 20 weeks of gestation were therefore available for our analysis of gestational age.

Birth weight was not available in 88 women, 15 (17%) of whom used smokeless tobacco). Forty of these had home deliveries, and for 48 their medical records were not traceable. We excluded 46 stillbirths and two outliers for birth weight (600 g and 4950 g; range 1250-4500 g). Our birth weight analysis therefore included 974 women.

We calculated gestational age as the number of days from the recalled start of the last normal menstrual period to the date of delivery. For 453 women, ultrasound scans before 30 weeks helped date the pregnancy (consistent with self reports in 70% (53 out of 76) of cases for preterm and 95% (359/377) for term deliveries).

Medical reports for haemoglobin (<100 g/l) and self reports for anaemia were available for 889 women; 99.5% (n=885) were consistent with self reports, and only self reports were available for the rest. Medical reports for blood pressure (≥140/90 mm Hg) and self reports for gestational hypertension were available for 825 (consistent with self reports in 54% (18 of 33) of cases for positive and 99.9% (791/792) for negative self reports; only self reports were available for the rest.

HIV status was available for 500 women; all were negative. Only two women reported alcohol consumption. Calculation of socioeconomic status included the educational and occupational status of the father and the per capita income of the family.[6]

We used the independent samples *t* test to evaluate the significance of the differences in means and the Mann-Whitney U test for distributions. We calculated relative risks for the outcomes.

We examined differences in the distribution of sociodemographic, biological, and clinical variables among users and non-users of smokeless tobacco. We considered factors that differed significantly between the two groups as potential confounders (P≤0.05) and entered them into stepwise logistic regression (dichotomised as in table 1), the sociodemographic variable first, followed by the biological and the clinical variable. The final model included only those variables that had independent, significant associations with use of smokeless tobacco. We used SPSS and Epi-Info for statistical analyses.

Table 1 General demographic and other characteristics of participants, by smokeless tobacco use. Values are numbers (percentages) unless otherwise indicated

	Non-user	User	P value (χ^2 test) for difference
Age			
≥20 years	826 (91.0)	181 (89.6)	0.6
<20 years	82 (9.0)	21 (10.4)	
Educational status in years in schooling			
≥10	200 (22.0)	12 (5.9)	0.0001
<10	708 (78.0)	190 (94.1)	
Socioeconomic status			
Middle class*	659 (72.6)	122 (60.5)	0.0001
Low class	249 (27.4)	80 (39.5)	
No of births			
>1	676 (74.4)	172 (85.1)	0.001
1	232 (25.6)	30 (14.9)	
Weight			
≥50 kg	556 (61.2)	138 (68.3)	0.05
<50 kg	352 (38.8)	64 (31.7)	
Height			
≥150 cm	432 (47.6)	105 (52.0)	0.3
<150 cm	476 (52.4)	97 (48.0)	
Antenatal care			
≥5 visits	233 (25.7)	65 (32.2)	0.01
<5 visits	675 (74.3)	137 (67.8)	
History of preterm delivery†			
No	440 (65.1)	108 (62.8)	0.6
Yes	236 (34.9)	64 (37.2)	
Presence of anaemia			
No	644 (70.9)	119 (58.9)	0.001
Yes	264 (29.1)	83 (41.1)	
Gestational hypertension			
No	879 (96.8)	196 (97.0)	0.9
Yes	29 (3.2)	6 (3.0)	
Gestational age at recruitment			
12-20 weeks	342 (37.7)	79 (39.1)	0.6
20-28 weeks	566 (62.3)	123 (60.9)	

*Two women had high socioeconomic status.
†For 848 women with previous pregnancies.

Results

The response rate from the community was 100% as none of the eligible women contacted during the recruitment phase refused to participate. In 123 rechecks (10%) during recruitment the findings of different social workers were 100% in agreement for tobacco use and more than 90% for most other variables.

Women using smokeless tobacco had relatively lower socioeconomic status, weight, and educational status and were less likely to have had optimal antenatal care (a minimum of five antenatal visits are advocated in India for an uncomplicated pregnancy). Proportionately more multiparous and anaemic women (table 1) used smokeless tobacco. We considered these variables as potential confounders in the analyses and also considered the mother's age, a common confounder.

Low birth weight

Babies born to mothers using smokeless tobacco were on average 105 g lighter (2672 g *v* 2777 g, 95% confidence interval for difference 30 g to 181 g; P=0.006) than those of non-users (median decrease 150 g, P=0.02). The entire birth weight distribution in users was shifted to the left (fig 1; two tailed P=0.02), indicating that infants who were already compromised might have been pushed into even higher risk categories.

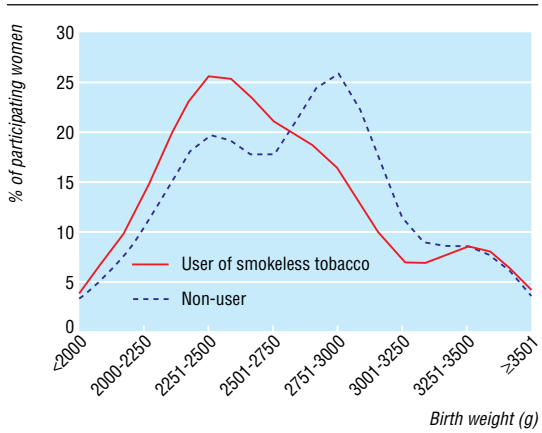

Fig 1 Distribution of birth weight (in g) by smokeless tobacco use of mothers

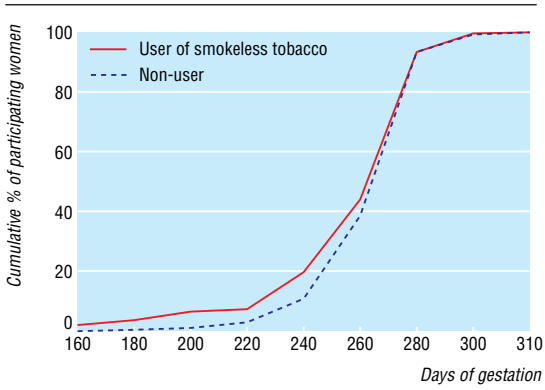

Fig 2 Distribution of gestational age by smokeless tobacco use of mothers (the cumulative percentage for a gestational age is the number of mothers who have given birth up to that gestational age divided by the total number of mothers)

When adjusted for gestational age the birth weight was 87 g lower in users (15 g to 158 g; P = 0.02). A lower birth weight was related to the infant's sex: the reduction was 118 g in baby boys (P = 0.04) and 86 g in baby girls (P = 0.08), and the relative percentage difference (the reduction in birth weight in smokeless tobacco users divided by the mean birth weight) was 4.2 for boys and 3.2 for girls (mean birth weight 2806 g for boys and 2707 g for girls).

The proportion of low birthweight babies was 28.6% (48/168) in tobacco users and 19.9% (160/806) in non-users, giving a crude relative risk of 1.4 (1.1 to 1.9).

The odds ratio for low birth weight remained significant (P < 0.05), with varying confidence intervals, after we adjusted by logistic regression for independent significant confounders (table 2), including gestational age at birth.

The mean decrease in birth weight in light users was 63 g (26 g to 153 g, P = 0.2), and in heavy users 189 g (66 g to 312 g, P = 0.003). The trend of increasing low birth weight with increasing use of smokeless tobacco was highly significant (table 3; χ^2 test 10.3, P = 0.006).

Preterm delivery

Women using smokeless tobacco gave birth an average of 6.2 days earlier than women not using tobacco (271.1 days *v* 264.9 days; 95% confidence interval 3.0 days to 9.4 days; P = 0.0001); preterm deliveries were earlier by 11.6 (4.4 to 18.8) days (P = 0.002). The gestational age distribution in users was shifted significantly to the left and more pronounced at lower gestational ages (fig 2; two tailed P < 0.03).

The proportions of preterm deliveries among women using smokeless tobacco were 26.7% (54/202) and among non-users 18.5% (168/908), giving a crude relative risk of 1.4 (1.1 to 1.9). The crude relative risk for birth before 32 weeks was 3.7 (1.9 to 7.4; 15/202 users *v* 18/908 non-users). The crude relative risk for birth before 28 weeks was 7.2 (2.3 to 22.3; 8/202 users *v* 5/908 non-users).

The odds ratios for preterm delivery remained significant (1.5, 1.009 to 2.2; P = 0.05), after adjustment for age, education, socioeconomic status, and anaemia by logistic regression; the significance level dropped to P = 0.06 after adjustment for weight and antenatal care. The odds ratios for delivery before 32 and 28 weeks remained strong and significant after adjustment for all variables (table 2).

Compared with non-users, light users gave birth an average of 4.9 days earlier (271.1 days *v* 266.2 days; 95% confidence interval 1.2 days to 8.6 days; P = 0.01) and heavy users 8.9 days earlier, (271.1 days *v* 262.2 days; 3.9 days to 13.8 days;

Table 2 Adjusted odds ratios (95% confidence intervals) for low birth weight and preterm delivery in women who used smokeless tobacco

		Preterm delivery†		
	Low birth weight*	<37 weeks	<32 weeks	<28 weeks
Crude odds ratio	1.6 (1.1 to 2.4)	1.6 (1.1 to 2.3)	4.2 (2.1 to 8.5)	8.0 (2.6 to 24.8)
Adjusted odds ratio	1.6 (1.1 to 2.4)	1.4 (1.0 to 2.1)	4.9 (2.1 to 11.8)	8.0 (2.6 to 27.2)
P value	0.05	0.06	0.0001	0.0004

*Adjusted for age, educational and socioeconomic status, weight, anaemia, number of antenatal visits and preterm delivery.
†Adjusted for age, educational and socioeconomic status, weight, anaemia and number of antenatal visits.

Table 3 Frequency of smokeless tobacco use, low birth weight, and preterm delivery. Values are numbers of births unless otherwise indicated

	Birth weight*			
Use of smokeless tobacco	≥2500 g	<2500 g	Crude odds ratio	Adjusted odds ratio (95% CI)
Non-users	646	160	1.0	1.0
1-4 times	85	27	1.3	1.5 (0.9 to 2.4)
5 or more times	35	21	2.4	2.1 (1.1 to 4.0)
	Gestational age at birth†			
	≥259 days	<259 days		
Non-users	740	168	1.0	1.0
1-4 times	106	30	1.2	1.2 (0.7 to 1.8)
5 or more times	42	24	2.5	2.2 (1.2 to 3.9)

*Odds ratios adjusted for age, educational and socioeconomic status, weight, anaemia, and preterm delivery.
†Odds ratios adjusted for age, educational and socioeconomic status, weight, and anaemia.

P = 0.0001). The trend of increasing preterm births with increasing smokeless tobacco use was highly significant (table 3; χ^2 12.7, P = 0.002).

Discussion

Smokeless tobacco use in pregnant women reduces birth weight and increases the number of low birthweight babies. It shortens the gestational period and increases the number of preterm deliveries. These adverse outcomes are dose dependent and similar to those associated with maternal smoking. Smoking during pregnancy reduces birth weight by an average of 250 g; the adjusted relative risks for low birth weight range from 1.5 to 3.5[7 8] and for preterm delivery from 1.2 to over 2.[8]

Limitations

Confounding due to weight gain and over-reporting of gestational hypertension could not be eliminated, which limits the conclusions of our study. Recorded birth weights may not have been highly accurate, but a systematic bias is unlikely. Although menstrual dating of babies' gestational age in 59% of women (n = 657) was subjective, the findings were consistent with those from women for whom ultrasound results were available. The adjusted odds ratio for preterm birth based only on ultrasound estimates (393 non-users *v* 60 users) was 2.1 (1.0 to 4.1).

In a study from the United States, the association between smoking and preterm delivery before 33 weeks' gestation was stronger than for later preterm delivery.[9] In our study we observed a similar stronger association for early preterm births, independent of possible confounders. Preterm births in settings where the neonatal care infrastructure is less developed can imply a higher perinatal mortality. A greater risk of low birthweight has been observed consistently in women using smokeless tobacco during pregnancy: a preliminary study reported an odds ratio of 3.2 (1.5 to 6.9) with use of mishri,[10] and a hospital based study on tobacco chewers observed a reduction in birth weight of 493 g with of use.[11]

Unexpected finding

Unexpectedly, the prevalence of smokeless tobacco use in our sample (17.1%) was rather low compared with the 57.5% reported earlier from Mumbai.[3] This could be because our study included different age groups (< 35 years *v* ≥ 35 years), fewer Marathi speaking women (30% *v* 75%), and women of higher educational attainment (which is inversely associated with smokeless tobacco use; only 24% of women in our cohort were illiterate), representing different cohorts. With a prevalence of 17% and a relative risk of 1.6, 9.3% of low birthweight and preterm deliveries in this population could be attributed to smokeless tobacco use. For babies born before 32 weeks and 28 weeks, the attributable fractions were 37% and 50%.

Tobacco in smokeless form contains several carcinogenic and toxic substances.[12] Exposure to cotinine has been shown in fetuses of mishri users,[13] which indicates that nicotine and other toxic substances can cross the placental barrier.

Outlook

High rates of smokeless tobacco use in young people have been reported worldwide, including in India,[14] and more so among girls.[15] Increasing use of smokeless tobacco could worsen the fragile situation for mothers and babies in developing countries and should therefore receive specific attention as a part of routine prenatal care.

What is already known on this topic

Maternal cigarette smoking reduces birth weight and increases risk of preterm delivery

Smokeless tobacco is being marketed as a less harmful form of tobacco use

Use of smokeless tobacco by women is common in the developing world

Reports show an association of low birth weight with maternal use of smokeless tobacco

What this study adds

Maternal use of smokeless tobacco decreases birth weight and gestational age

Infants of users have a greater risk of having low birth weight (< 2500 g) and being delivered preterm (< 37 weeks of gestation), independent of confounders

Maternal smokeless tobacco use is associated with high risks for early preterm delivery, independent of confounders

Maternal use of smokeless tobacco use should receive specific attention as a part of routine prenatal care

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Contributors: PCG conceptualised the study, designed the field methods, monitored each step of the study, guided analysis and interpretation of the data, revised the article critically for important intellectual content and approved the final version to be published. SS has designed and piloted questionnaires for data collection, coordinated with municipal health authorities, trained field workers, monitored the data collection in the field, did programming for data entry, has analysed and interpreted the data, drafted the article and revised it critically, and was actively involved in the finalisation of the article for publication. Sushama Kadam and Nutan Kiratkar collected data in the field (interviewing pregnant women). PCG is the guarantor.

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Competing interests: None declared.

Ethical approval: The study conforms to the guidelines laid down by the Indian Council of Medical Research for research on human subjects.

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