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Original Article

Community Medicine Section

Effects of Occupational Tobacco Exposure on Foetal Growth, among Beedi Rollers in Coastal Karnataka

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ABSTRACT

Introduction: Though there is ample evidence on adverse effects of tobacco exposure caused by smoking during pregnancy on foetal outcomes, there is lack of studies done on the effects of exposure caused by transdermal absorption, as is seen among beedi rolling women. Therefore, this study was planned, to assess the effect of maternal exposure to tobacco, in the form of beedi-rolling, on the birth weight and other neonatal anthropometric measurements.

Materials and Methods: A cross sectional study with controls was conducted, with 102 beedi rollers forming the study group and an equal number of matched controls (control group) (total 204). Data was collected by using a pre-tested questionnaire and anthropometric examinations of the neonates were carried out within 48 hours of their births.

Results: Mean birth weight of the newborns was 2.66 (SD=0.32) among those who were born to beedi rolling women and it was 2.63 (SD=0.38) kg among the control group. Crown heel length was 48.09 centimeters (SD=1.93) in the study group and it was 48.12 cm (SD=1.92) in the control group. Beedi rolling beyond the 7th month of gestation and for more than six hours per day was associated with a small but insignificant decline in birth weight and crown heel length.

Conclusion: Beedi-rolling was found to be relatively safe during pregnancy but it could produce adverse effects if it was continued into the third trimester and for longer durations. This study can make the beedi rollers as well as their employers aware of harmful over-exposure to beedi rolling and help them in preventing it.

Keywords: Beedi rolling, Smokeless tobacco, Neonatal anthropometry, Transdermal nicotine, Nicotine replacement therapy

INTRODUCTION

The harmful effects of tobacco exposure caused through smoking have been well documented and exposure to tobacco smoke, active or passive, has a significant impact on women's health. Of particular interest is the effect of smoking on pregnancy outcomes [1]. Smoking during pregnancy is associated with a number of poor birth outcomes, including causation of a negative effect on anthropometric measurements of newborns [2-5]. Similar observations, in terms of adverse foetal outcomes, have been made for smokeless tobacco use during pregnancy, in various parts of the world [6].

There is ample evidence that exposure in the form of active or passive smoking and smokeless tobacco use, lead to increased blood nicotine levels and subsequent adverse foetal outcomes. However, there is a group of women in the beedi rolling industry in India and in other developing countries, who face occupational exposure to tobacco through the dual routes; trandermal and inhalational. There is evidence that these women have increased levels of nicotine in their blood, but whether their exposures have similar effects as smoking and chewing tobacco on the growing foetuses, has not been studied adequately [7]. It is important to find the effect of tobacco exposure on these women, as in India alone, there are around 4 million women beedi rollers [7].

Transdermal exposures are not unknown in the industrialized countries, where transdermal absorption of nicotine occurs among women who undergo nicotine replacement therapy (NRT). Studies done on women undergoing NRT during their pregnancies, have not shown any adverse outcomes of this therapy on foetal growth [8-10]. However, whether women in beedi rolling occupation, during their pregnancies, have similar outcomes, is not known, especially, as they are also exposed via inhalational route as well.

Hence, this study was conducted to find whether occupational exposure to tobacco during pregnancy produced adverse effects on foetal growth and development, among women who were engaged in this profession.

MATERIALS AND METHODS

The study design was cross-sectional with controls and study was conducted during a period of 2 months, from 1st July to 31st August 2010. Study participants were women admitted to post-natal ward, who satisfied the inclusion and exclusion criteria. Inclusion criteria were women in the age group of 20 to 35 years, who had full-term, normal, vaginal deliveries in the hospital. Exclusion criteria were women with confounders, namely; a history of smoking, those who gave birth to pre-term or post-term babies, those who had twin deliveries and those who suffered from complications of pregnancy like pre-eclampsia and other chronic illnesses. Study group consisted of women who were beedi rollers by occupation and the control group consisted of women who were not beedi rollers. The controls were group matched for age, parity, gestational age, exposure to passive smoke and use of smokeless tobacco. Taking prevalence of low birth weight among exposed population as 33% with a 95% confidence level and a 20% allowable error, minimum sample size was calculated to be 203 and 204 subjects were enrolled in the study: 102 beedi rollers and 102 non-beedi rollers.

After appropriate ethical clearance was obtained from the institutional ethical committee, the subjects were approached in the post-natal ward and screened by studying their admission cards. The ones who had given birth within the past 48 hours were divided into 2 groups, based on their occupation, whether they were beedi rollers or not. Those who satisfied the inclusion and exclusion criteria were selected by convenient sampling. After obtaining written informed consents from them, data was collected by holding personal interviews with the mothers and by taking anthropometric measurements of the babies. Observations were recorded on a pretested semi-structured proforma.

Measurements taken of the newborns were birth weight (kg), crown heel length (cm), head circumference (cm), chest circumference (cm) and abdominal circumference (cm). Birth weight was recorded to the nearest 0.01kg by placing the nude baby on an electronic weighing scale. Crown heel length was measured to the nearest 0.5cm by using an infantometer, with the infant lying supine, neck neutral, leg fully extended and ankle flexed. Other anthropometric measurements were taken with the help of a measuring tape to the nearest 0.1cm. Head circumference was measured as the largest dimension around the head, with the measuring tape placed snugly above the ears. Chest circumference was taken at the level of the nipples and abdominal circumference was measured at the level of the umbilicus.

The collected data was entered in and analyzed by using Statistical Package for Social Sciences (SPSS), version 11.5 and Chi-square test, unpaired t-test and Fisher's test were used to check for associations.

RESULTS

The mean maternal ages of the study group and controls were 26. 6 (SD=3.8) years and 25.7 (SD=3.9) years respectively (p=0.096). Mean gestational ages at delivery for the study group and controls were 274.5 (SD=7.3) days and 274.4 (SD=7) days (p=0.875) respectively. The parity statuses of both the groups were similar, with no significant differences being seen. 47.1% beedi rollers and 43.1% controls were primigravida, while 38.2% beedi rollers and 40.2% controls were gravida-two in the respective groups.

The proportion of low birth weight was 32.35% (66) in the study population; in the study group, it was 28.43% (29) and in the control group, it was 36.27% (37), p>0.05.

Among the beedi rollers, the mean duration of exposure was 8.36 yrs (SD=5.17) and the mean number of working hours per day was 5.0 (SD=2.42). Beedi rolling in the present pregnancy, was continued for a mean duration of 6.48 months (SD=2.88).

The anthropometric parameters of the exposed and control groups showed no statistically significant differences and these findings were consistent across all maternal age groups, parity statuses and gestational ages at delivery [Table/Fig-1].

Birth weights and crown heel lengths of the babies in the two groups did not show any particular trend or any statistically significant differences when they were analyzed according to the duration of exposure in years, hours spent in beedi rolling per day and number of months for which beedi rolling was continued, in the present pregnancy [Table/Fig-2].

Parameter	Study Group	Control Group	t score and p-value
	Mean (SD)	Mean (SD)	
Birth Weight (kg)	2.66 (0.32)	2.63 (0.38)	t= 0.61, p= 0.542
Crown Heel Length (cm)	48.09 (1.93)	48.12 (1.92)	t= 0.1, p= 0.922
Head Circum. (cm)	32.69 (1.35)	32.55 (1.56)	t= 0.69, p= 0.49
Chest Circum. (cm)	30.95 (1.56)	30.83 (1.83)	t= 0.5, p= 0.616
Abdominal Circum. (cm)	28.84 (1.57)	28.52 (1.88)	t= 1.33, p= 0.185

[Table/Fig-1]: Anthropometric measurements of the newborns in study group (n=102) and control group (n=102)

Duration of Exposure (years)	N	Birth Weight (kg)	Crown heel length (cm)
		Mean (SD)	Mean (SD)
0-1	5	2.74 (0.13)	48.60 (1.29)
1-2	8	2.48 (0.41)	47.22 (2.22)
2-4	11	2.66 (0.28)	47.50 (1.87)
4-6	22	2.65 (0.31)	47.57 (1.94)
>6	56	2.69 (0.32)	48.49 (1.87)
F score, p-value		F= 0.89, p= 0.472	F= 1.81, p= 0.132
Average duration of Exposure per day (hours)	**N**	**Birth Weight(kg)**	**Crown heel length (cm)**
		Mean (SD)	Mean (SD)
0-2	16	2.67 (0.41)	48.25 (2.37)
2-4	27	2.64 (0.28)	47.94 (2.10)
4-6	21	2.73 (0.35)	48.29 (1.91)
6-8	28	2.69 (0.25)	48.23 (1.73)
>8	10	2.53 (0.34)	47.45 (1.28)
F score, p-value		F= 0.81, p= 0.522	F= 0.43, p= 0.788
Beedi-rolling in present pregnancy (months)	**N**	**Birth Weight (kg)**	**Crown heel length (cm)**
		Mean (SD)	Mean (SD)
1-3	27	2.61 (0.32)	47.62 (1.90)
4-6	12	2.73 (0.18)	48.37 (1.05)
7	11	2.84 (0.24)	49.27 (2.41)
8	5	2.74 (0.59)	49.0 (1.94)
9	47	2.63 (0.31)	47.91 (1.91)
F score, p-value		F= 1.39, p= 0.244	F= 1.95, p= 0.109

[Table/Fig-2]: Birth weight & Crown heel length of newborns in study group (n=102) and control group (n=102) according to maternal exposure to beedi-rolling

DISCUSSION

Women in the beedi rolling industry spend hours sitting, making beedis, surrounded by tobacco dust. They are known to have various health problems [7,11] but the consequence of their exposures during their pregnancies on foetal growth and development has been leftlargely unexplored. With a large number of women being engaged in this industry in India and in other developing nations, it becomes important to know the effects of maternal occupational tobacco exposure on the foetus.

The prevalence of low birth weight in the study population, of 32.35%, was similar to the National Neonatology Forum finding of 32.8% for India. Their finding was based on the data for the year, 1995, which was based on 37,082 live births (nearly 0.1% births in the country), obtained from 15 participating centres [12]. Interestingly, the proportion of low birth weight in the control group was higher by almost 8% as compared to the that in the study group, though it was not significant. This was similar to the finding of Wisborg et al., [13] who also reported an insignificant, yet lower rate of low birth weight in the group which used nicotine patches as compared to that seen in controls.

None of the anthropometric parameters in the present study were significantly different in the two groups, and this finding was consistent across all maternal age groups, parity statuses and gestational ages at delivery. This was in contrast to the finding of a previous study done in Sholapur [14], which reported a decrease in mean birth weight by 310 g in the beedi rollers. This finding was surprising, since other studies had not observed a decrease in birth weight of this magnitude, even among heavy smokers who had smoked more than 25 cigarettes per day during their pregnancies [15,16].

Since, the tobacco exposure caused by beedi rolling is mostly transdermal in nature, it could be compared with the effect of transdermal nicotine patches used during pregnancy. Various studies which have evaluated the safety of use of these patches during pregnancy, have concluded that their use was not associated with any adverse maternal or foetal outcomes [8-10]. However, one cannot expect the same result in beedi rolling women, as they are also exposed to tobacco dust via inhalational route.

The slightly higher birth weights seen among the exposed group in the present study can be compared with the findings of two

randomized control trials, that showed birth weights to be significantly higher (186 g and 337 g) among women smokers who used nicotine patches or nicotine gum as compared to those who received placebo [13,17].The authors suggested that nicotine could produce an anti-inflammatory effect by inhibiting the production of thromboxane, which could increase birth weight by reducing placental vasoconstriction and platelet aggregation [13].

No statistically significant relationship was found between the neonatal anthropometric measurements and the number of years of exposure; as the exposure increased beyond six hours per day, birth weight and crown heel length declined, albeit this was statistically not significant. This could be due to the effect of higher levels of nicotine being maintained in the blood for longer durations of time.

Similarly, though overall, no significant relationship existed between the duration for which beedi-rolling was continued in the present pregnancy and neonatal anthropometric measurements, we observed that beyond seven months, there were progressive declines in birth weight and crown-heel length, as the beedi rolling was continued in the 8th and 9th months of gestation. These findings were similar to the effects created by smoking during pregnancy, which were found to be more pronounced in the late second trimester and third trimester [18].

It is known that apart from nicotine, other toxic components present in the cigarette smoke e.g. carbon monoxide, may be equally important for the growth retardation seen in children of smoking mothers, and the level of nicotine which was attained in the body was likely to be of vital importance with respect to possible adverse effects [8,19]. Since the beedi rollers are exposed to only nicotine and not to the other harmful components of cigarette smoke, this form of exposure is similar to the use of nicotine patches during pregnancy, which on account of their safety, are being increasingly prescribed during pregnancy [20].

Our study had few limitations. It was not possible to obtain data on some of the important parameters, such as history of a previous low-birth-weight infant, maternal pre-pregnancy weight, BMI and the weight which was gained during pregnancy. They were potential confounders that were not available for matching or stratification, as the mothers did not have knowledge about their pre-pregnancy measurements and neither did they have pre-recorded values that could be used. Also, due to lack of resources and the short duration of study, we could not do plasma cotinine estimation in the beedi rollers. The relatively small sample size of this study may have also influenced its results. There may also have been few known or unknown but important factors that could have altered the results, though most of the known confounders were taken care of in the study.

Yet, this study brought out a very interesting and different perspective in the subject of occupational exposure to tobacco among pregnant women and its effect on foetal growth. The knowledge on this relationship could help in improving the health statuses of the babies that are born to mothers who work as beedi rollers. It can help in formulating policies to protect the women who are in this occupation, if they and their unborn children face clear risks. Though this study did not find major effects of occupational exposure to tobacco among pregnant women or their newborns; there were situations where exposure during the last trimester and more than 6 hours a day showed small but definite negative effects. This could form the basis for educating the beedi rollers and their employers on cutting down their working hours during pregnancy, especially in the third trimester. The beedi rollers could further reduce the exposure to tobacco by wearing protective full-sleeved clothing, masks and gloves.

There is a need of doing more in depth, large scale, and prospective studies, preferably with cotinine level measurements, to find the effect of maternal tobacco exposure, in the form of beedi-rolling during pregnancy, on foetal growth. The effect of beedi-rolling on the incidence of pre-term or post-term births was not studied by us, but it needs to be explored.

CONCLUSION

The findings of this study point towards the relative safety of doing beedi-rolling during pregnancy, due to the absence of major adverse effects on birth weights and other anthropometric parameters.

However, insignificant yet definite negative effects were seen in terms of declines in crown heel lengths and birth weights on exposures beyond 6 hours per day and in the last trimester. These indicated that beedi rolling during pregnancy may not be as safe as one would expect. Hence, there is a need of doing further, large scale, prospective studies, to find the effect of maternal transdermal exposure to environmental tobacco on foetal growth.

Meanwhile, efforts ought to be made, to raise awareness among women who are in beedi rolling occupation, on the potential dangers of their work and policies that would make their employers more accountable for limiting their exposures during pregnancy.

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CONFERENCE PRESENTATION

The results of the study were presented at the 18th International Student Congress of Medical Sciences (ISCOMS) at University Medical Center Groningen (UMCG), Goningen, The Netherlands on June 6th, 2011 by Dr. Chetan Mandelia and was awarded the Best Paper award in Public Health.

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