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A CASE CONTROL STUDY ON RESIDENTIAL ENVIRONMENTAL TOBACCO SMOKE EXPOSURE DURING PREGNANCY AND ASSOCIATION WITH LOW BIRTH WEIGHT OF NEONATES

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Abstract:
Aim: *To determine whether residential environmental tobacco smoke (ETS) exposure during pregnancy is associated with low birth weight (LBW) neonates and establish a dose response relationship.*
Design: *Case control study.*
Setting: *In the Obstetrics and Gynecology Unit-II of Lady Wallington Hospital, Lahore and Department of Pediatrics, Mayo Hospital Lahore for one-year duration from May 2019 to May 2020.*
Methodology: *Mothers giving birth to a newborn LBW (3), multiple pregnancies and stillbirths. 100 cases and 200 controls between the ages of 20 and 30 were included. Information on ETS exposure and other LBW risk factors was collected within 24 hours of delivery. Clinical information such as maternal hemoglobin levels, birth weight and gestational age of the newborn were obtained from hospital records.*
Results: *In univariate analysis, preterm pregnancy, low socioeconomic status, previous neonate with LBW, no use of antenatal care (ANC), severe anemia, and exposure to ETS were statistically significantly associated with newborn LBW and controlled by logistic regression analysis, corrected quotient the odds for the association of ETS exposure with neonatal LBW was 3.16 (95% CI = 1.88-5.28). A dose-response relationship was also found, which was statistically significant (10-20 cigarettes / day: OR = 4.06, 95% CI = 1.78-9.26 and> 20 cigarettes / day, OR = 17.62, 95% CI = 3.76-82.43).*
Conclusion: *Exposure to ETS during pregnancy is associated with neonatal LBW. Therefore, there is an urgent need to raise awareness of the health risks associated with ETS during pregnancy and to introduce appropriate behavioral changes as one of the strategies to reduce LBW.*
Key words: *environmental tobacco smoke, etiology, low birth weight, newborn, passive smoking.*

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INTRODUCTION:

Low birth weight (LBW) is a major public health problem in developing countries such as Pakistan, with a prevalence of 30%. LBW leads to infant growth impairment, resulting in higher mortality, increased morbidity, predisposition to infectious diseases, decreased cognitive abilities, and chronic adult disease. LBW etiology is multifactorial and is associated with maternal, fetal, placental, and environmental risk factors, including antenatal care (ANC) and maternal socioeconomic status. Maternal smoking is an established cause of LBW. It can be expected that secondhand smoke containing the same toxic substances will have a similar effect on the fetus. In Pakistan, while smokers are few, they are exposed to the harmful effects of tobacco smoke due to secondhand smoke at home during pregnancy. Smoking among men in Pakistan is around 33.3%, and environmental conditions such as overcrowding and poor ventilation in the home make the health effects of environmental tobacco smoke (ETS) more pronounced in such places. Studies examining the relationship between maternal ETS exposure during pregnancy and delivery outcomes have produced mixed results in developed countries. Such studies are lacking in developing and underdeveloped countries. The current study was undertaken to investigate the relationship of exposure to ETS in infants with LBW.

METHODS:

This was an in-hospital clinical trial conducted in the Obstetrics and Gynecology Unit-II of Lady Wallington Hospital, Lahore and Department of Pediatrics, Mayo Hospital Lahore for one-year duration from May 2019 to May 2020. Approval was obtained from the Institutional Ethics Committee (IEC). All participants obtained written informed consent prior to enrollment. The cases were mothers in the age group 20 to 30 years who gave birth to one live infant with a birth weight <2.5 kg (LBW). The control was mothers in the age group from 20 to 30 years, who gave birth to one live newborn with a birth weight ≥ 2.5 kg. As teenage pregnancies (30 years old) are at greater risk of developing LBW, mothers between 20 and 30 years of age were enrolled in the study. Only mothers giving birth to single infants were included in the study, as multiple pregnancies are also associated with a higher risk of LBW. The cases and controls excluded (a) women who smoked and chew tobacco (because they are at an increased risk of having a newborn with LBW); (b) high labor (> 3) as such pregnancies were associated with a decrease in the birth weight of the newborn; c) birth weight undocumented; and (d) stillbirths. The sample size was calculated using the Open Epi statistical tool. To assess the odd factor 2.25 for LBW babies with alpha (α) 0.05 and power 0.8, the calculated sample size is 257. Two consecutive controls (birth weight ≥ 2.5 kg) were included for each selected case (LBW). This ratio of 1: 2 case: control resulted in 100 cases and 200 controls. More controls were undertaken to maximize the statistical detection power. Data collection tool: Data was taken from hospital records on maternal hemoglobin level, birth weight and gestational age of the newborn. Preterm labor was considered to be <37 weeks of gestation. A pre-designed questionnaire was used to record ETS exposure and other significant hazards factors such as (a) obstetric history (previous LBW delivery, previous LSCS, abortion / miscarriage, stillbirth, neonatal death); (b) maternal disease (acute and chronic infections, severe anemia (hemoglobin <7 g / dL), cardiovascular disorders, diabetes mellitus); c) maternal complications of the current pregnancy (eclampsia / pre-eclampsia, antenatal hemorrhage); (d) state of antenatal care (ANC); and (e) socioeconomic status. ETS Measurement: In order to measure exposure to ETS in homes, women were asked to complete a pre-designed questionnaire on "active smokers" in their home who During the pilot study, we found that women were more confident in terms of the number of cigarettes they smoked, so we defined categories that can be easily recalled for the average number of cigarettes / water bottles per person per day. The interval was multiplied by the number of smokers to get the "Exposure Index" (EI). The EI was calculated assuming that all women were exposed to second-hand smoke throughout their pregnancy. It was then divided into three groups according to the severity of exposure to ETS during pregnancy This was used to analyze the dose-response relationship between children with E. TS and LBW. Statistical analysis: This data was analyzed using SPSS (version 15). One-dimensional analysis was performed to investigate the frequency distribution of the variables. The Chi-square and t-Student tests were used to test the relationship between categorical and continuous variables. To assess the association between children with LBW and various risk factors, raw wonder coefficients with 95% confidence intervals were calculated. P <0.05 was considered significant. The dose-response relationship between the magnitude of ETS exposure (exposure index) and the risk of children with LBW was calculated using logistic regression. An unconditional logistic regression analysis was performed to evaluate the relationship of ETS exposure to LBW after considering all variables for which a significant relationship (P <0.05) was found in the univariate analysis.

RESULTS:

The present study included 300 (128 females) neonates. Mean (SB) birth weight calculated for the cases (55% of men) and the control group (58.5%

of men) was 2.003 ± 0.343 and 2.946 ± 0.339, respectively. There was no statistically significant difference in the distribution of cases and controls by sex. The demographic and clinical profiles of mothers with LBW (cases) and controls were compared as shown in Table I.

TABLE I PROFILE OF MOTHERS GIVING BIRTH TO NORMAL BIRTH WEIGHT (CONTROLS) AND LOW BIRTH WEIGHT(CASES) NEONATES

Characteristics	*Cases (n=100)*	*Controls (n=200)*	*P value*	
Age (mean± SD)	24.40±2.85	24.95±2.85	0.11	
Parity (mean± SD)		1.54±0.742	0.08	
Preterm* gestation	49 (49.0)	16 (8.0)	11.05 (5.80-21.4)	0.001
Cesarean delivery	48 (48.0)	80 (40.0)	1.38 (0.85-2.25)	0.217
Joint family	82 (82.0)	156 (78.0)	1.28 (0.70-2.36)	0.45
Socio-economic status				
Lower	33 (33.0)	43 (21.5)	3.36 (1.00-10.61)	0.05
Middle	63 (63.0)	140 (70.5)	1.91 (0.62-5.9)	0.26
Upper	04 (4.0)	17 (8.5)	Reference	
Obstetric history				
Abortion	15 (15.0)	27 (13.5)	1.13 (0.57-2.24)	0.73
Still birth/neonatal death	11 (11.0)	11 (5.5)	2.12 (0.89-5.09)	0.10
Previous LBW	7 (7.0)	3 (1.5)	4.94 (1.25-19.54)	0.02
Previous LSCS	15 (15.0)	33 (16.5)	0.89 (0.46-1.73)	0.87
Maternal illness				
Severe anemia[#]	31 (31.0)	38 (19.0)	1.92 (1.10-3.30)	0.02
Acute infection	19 (19.0)	28 (14.0)	1.48 (0.76-2.73)	0.31
Chronic infection	10 (10.0)	17 (8.5)	1.20 (0.53-2.72)	0.67
Pregnancy complications Pre-eclampsia/eclampsia	26 (13.0)	16 (16.0)	1.27 (0.65-2.50)	0.48
Antepartum hemorrhage	2 (2.0)	2.02 (0.28-4.56)	0.60	2 (1.0)
Gestational diabetes	1 (1.0)	3 (1.5)	0.66 (0.07-6.46)	1.00
ANC Utilization				
Any visit	89 (89)	193 (96.5)	0.29 (0.11-0.78)	0.02
1-2 visits	27 (27)	40 (20.0)		
≥3 visits	62 (62)	153 (76.5)	0.60 (0.34-1.06)	0.01

Preterm pregnancy (<37 weeks gestation) and mothers of lower socioeconomic status resulted in an increased risk for the LBW neonate. Pre-existing neonatal LBW and severe anemia were associated with LBW, while use of ANC was a protective factor. ETS exposure was reported by 135 (45%) of the 300 people enrolled in this study (Table II).

TABLE II ASSOCIATION OF ETS EXPOSURE WITH CASES (LBW NEONATES) AND CONTROLS (NORMAL BIRTH WEIGHT)

Variable	*Cases (100) N (%)*	*Controls (200) N (%)*	*OR (95% CI)*	*P-value*
ETS Exposure	65(65)	70(35.0)	3.45(2.08-5.7)	0.001
Exposure Index (EI)				
<10 E.I.	25(25)	55(27.5)	Reference	
11-20 E.I.	24(24)	13(6.5)	4.06(1.78-9.2)	0.001
>20 E.I.	16(16)	2(1.0)	17.62 (3.7-82.4)	<0.001

Women exposed to ETS had a 3.45 times greater chance of having a newborn with LBW compared to non-irradiated women (p <0.001). An exposure with an EI greater than 20 had a greater chance of having an LBW newborn compared to an EI between 10 and 20. Controlling variables with a significant univariate relationship such as premature pregnancy, lower socioeconomic status, previous LBW neonate, severe anemia, no use ANC and ETS exposure, unconditional multiple logistic regression analyzes were performed (Table III).

TABLE III UNCONDITIONAL LOGISTIC REGRESSION TO ASSESS ASSOCIATION OF ETS EXPOSURE TO LBW

Parameters	*Adjusted OR (95%CI)*	*P value*
Preterm pregnancy	11.58 (5.9-22.77)	<0.001
Lower Socioeconomic status	1.71 (0.99-2.93)	0.054
Previous LBW baby	4.72 (1.19-18.69)	0.027
Severe Anaemia*	1.82 (1.04-3.18)	0.035
Utilisation of ANC	0.34 (0.13-0.93)	0.035
ETS Exposure	3.16 (1.89-5.28)	<0.001

The adjusted OR for the association of ETS exposure with LBW neonate was 3.16 (95% CI = 1.886-5.285) (p = <0.001).

DISCUSSION:

This study highlighted the detrimental effect of exposure to ETS during pregnancy on delivery outcomes in Pakistan. Even after adjusting for other confounding factors such as premature pregnancy, lower socioeconomic status, previous LBW infant, severe anemia, and no use of ANC, there was an increased risk for the LBW infant exposed to ETS. A dose-response relationship between ETS exposure and LBW was observed, with a significantly increased risk of LBW at a higher exposure index. Environmental tobacco smoke (ETS), also known as passive smoke or passive smoke, is a combination of side stream smoke (SS) that is emitted from the burning end of a cigarette and the mainstream (MS) smoke exhaled by the smoker. SS smoke contains toxins in higher concentrations than in the mainstream smoke. It has been classified as a class A carcinogen (known man) and its components include toxic substances such as tar, nicotine, benzene, radioactive compounds, etc. ETS exposure has been identified as one of the most common and hazardous environmental exposures and has harmful health effects adults and children. The low birth weight of women exposed to ETS can be attributed to a number of factors, including vasoconstriction properties of nicotine, increased levels of fetal carboxyhemoglobin, hypoxia to fetal tissues, decreased nutrient supply, and increased heart rate and blood pressure. The dose-response relationship between ETS exposure and LBW can be explained by the cumulative effect of inhalation of nicotine and carbon monoxide, which reach the newborn through the placenta and prevent the fetus from obtaining the nutrients and oxygen necessary for growth. Maternal smoking is an established risk factor for infants with LBW [20]. Studies in developed countries have shown that women exposed to ETS have an increased chance of giving birth to LBW, with odds ratios ranging from 1.0 to 2.2. Most of the research done in India looks at the effects of secondhand smoke on the lungs. Studies in Vellore, Nagpur and Chandigarh have shown a decrease in birth weight for mothers exposed to ETS. This study helps establish that there is a stronger association between exposure to ETS during pregnancy and neonates with LBW in a developing country such as India. In India, in addition to cigarettes, bidi is also used for smoking. Bidi is made from raw sun-cured tobacco wrapped in dried Tendu leaf (Dyospyros melanoxylon). Inexpensive and readily available, it is widely used by the lower economic strata of society. A higher content of nicotine and fine tobacco alkaloids was shown in bidi tobacco (37.7 mg / g) compared to Indian or American cigarettes (14-16 mg / g). Most of the patients admitted to our hospital come from the rural villages and towns of Uttar Pradesh, where tobacco smoking takes place in the form of bidi. Overcrowding and poorly ventilated homes, especially in the lower socioeconomic strata of society, are also likely to increase the effects of exposure to ETS. These factors may possibly explain our finding of a higher relationship between ETS and LBW compared to other studies in developed countries. In addition, the calculated odds ratio may be an overestimation of the relative risk (RR) of the population due to the nature of the case-control design. Most of these studies, including this study, used unapproved, person-reported measures to establish maternal ETS exposure, which may have resulted in an underestimation of ETS exposure due to a lack of awareness of maternal exposure or reluctance to declare exposure, and may therefore result in a bias against zero reports. Furthermore, a dose-response relationship was calculated from the approximate and average number of bidis / cigarettes smoked. Since it also depends on the reminder, it can also be subject to bias. In addition, a more accurate method of measuring ETS exposure would be to measure biomarkers (nicotine and cotinine levels) in body fluids / samples such as urine, saliva, hair sample

[26]. Moreover, being a case control study, there is an inherent probability of error resulting from selecting a control group. We tried to minimize this by selecting two consecutive checks after recruiting each case. To minimize the differences between the observers, one person collected all the data using a pre-designed questionnaire. The interview duration was the same for each case and inspection. In addition, this study only looked at exposure to ETS in residential homes, as the home is the main source of exposure for non-working women in rural India during pregnancy. Another limitation of this study is that it did not take into account certain factors, such as periodontal disease, that could have had a significant impact on the outcome. As maternal exposure to ETS in the residential home is a potentially completely preventable entity, unlike some other risk factors, it further emphasizes the need to limit exposure to tobacco smoke in pregnant women. Interventions should be undertaken to ensure smoke-free living conditions and a healthy environment for all family members. Awareness and assessment of ETS exposure should be increased, and steps to avoid it during pregnancy should be an important part of antenatal care (ANC) counseling.

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