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Research Article

Effect of Prenatal Exposure to Kitchen Fuel on Birth Weight

Dr. Mayur Vala[1], Devanshi Raval[2], Dr. Khushboo Chauhan[3]
[1]Assistant Professor, Community Medicine Department, GMERS Medical College, Dharpur – Patan, Gujarat, India 384265
[2]MBBS Student, GMERS Medical College, Dharpur – Patan, Gujarat, India

***Corresponding author**
Dr. Mayur Vala
Email: mayurvala@yahoo.com

Abstract: The birth weight of an infant is the single most important determinant of its chances of survival, healthy growth and development. LBW is a multi-faceted problem; with some known and few unknown reasons. Women spend considerable time in kitchen, where they are exposed to fumes of various fuels used in kitchen stove. Maternal exposure to kitchen fuel smoke may lead to impaired fetal growth through hypoxia. So this cross-sectional, obser vational, hospital based study was carried out, from May 2015 to July 2015, to study the effect of exposure to various kitchen fuels on birth weight. Among all the confounders studied, sex of newborn, education and weight gain of mothers were significantly associated to birth weight of newborns. On the other hand, maternal age, religion, occupation, parity, type of family, type of delivery, initial weight and diet were statistically not significant. Also the effect of duration of cooking on birth weight of newborn was not significant. Among all cooking fuels studied, prenatal exposure to wood fuel is a significant risk-factor for LBW.
Keywords: LBW, prenatal exposure, kitchen fuel.

INTRODUCTION

The birth weight of an infant is the single most important determinant of its chances of survival, healthy growth and development. The average birth weight of infants is lower in many developing countries than it is in developed countries [1]. For live births, birth weight should preferably be measured within the first hour of life before significant postnatal weight loss has occurred [2]. In India prevalence of low birth weight (LBW) newborns is 28% of all live births and more than half of these are born at term [3]. By international agreement LBW has been defined as a birth weight of less than 2500 g (up to and including 2499 g), the measurement being taken preferably within the first hour of life, before significant postnatal weight loss has occurred [4]. LBW is a multi-faceted problem; with some known and few unknown reasons. The etiology of LBW is also complex; with demographic, nutritional, reproductive, and socio-economic factors, each potentially playing a role. These causes can be enlisted as maternal Hemoglobin (Hb) level, hard manual work during antenatal period, maternal nutrition, economic condition, antenatal care, parents' education, tobacco use, maternal age, and parity [5]. In 2012, the World Health Assembly Resolution 65.6 endorsed a Comprehensive implementation plan on maternal, infant and young child nutrition [6], which specified six global nutrition targets for 2025 [7]. This policy brief covers the third target: a 30% reduction of LBW. The purpose of this policy brief is to increase attention to, investment in, and action for a set of cost-effective interventions and policies that can help Member States and their partners in reducing rates of LBW. It is observed that at birth, female newborns are lighter than male [6]. To improve the situation multi-pronged interventions are required. Women spend considerable time in kitchen, where they are exposed to fumes of various fuels used in kitchen stove. Half of world's population uses solid fuel for cooking [8]. Two-thirds of households in developing countries still rely on bio fuels and it is women of childbearing age who perform most cooking tasks [9]. Wood fuel is still widely used, especially in rural areas and semi urban areas. Maternal exposure to kitchen fuel smoke may lead to impaired fetal growth through hypoxia [10]. Thus, the inhaled particulate matter from smoke impairs fetal growth by damaging cells through oxidative stress [11]. To find out the effect of kitchen fuel on the birth weight, there is need to control the effect of other factors. For that purpose, the study was planned in a hospital setting to, so that it will be possible to take care of confounding factors and correct recording of birth weight would be carried out. Effect of prenatal exposure to kitchen fuel on birth weight is different in

different geographical locations. India, the most populous country in South Asia shares a very high prevalence of LBW. Currently nation-wide data on birth weight in different states and districts is not available because a majority of births occur at home and these infants are not weighed soon after birth. To the best of our knowledge no data exists regarding the same from Patan. In this area most of the people come from lower socio-economic status leading to more prenatal exposure to kitchen fuel smoke.

MATERIAL AND METHODS

This cross sectional, observational, hospital based study was conducted from May 2015 to July 2015 (2 months) at GMERS Medical College and Hospital, Dharpur, Patan located in north Gujarat.

This hospital provides curative and preventive health services to people on and around the adjoining areas. Total 121 mothers and their newborns were studied. Mothers who delivered in the last week of data collection were also included. Inclusion criteria for mothers were those who have registered in first trimester with minimum four visits, full term and singleton delivery. Mothers having Pregnancy Induced Hypertension (PIH), or any other illness such as diabetes, tuberculosis, and having addiction (i.e., tobacco chewing or tobacco mishri burnt tobacco application to brush teeth) were excluded from the study. Mothers were informed about the purpose of study and their informed consent was taken. They were assured about their confidentiality and anonymity.

A preformed and pretested interview schedule was used to collect the information in the form of questionnaire containing socio-demographic variables like name, age, religion, residence, occupation, literacy, family income, past obstetrics history, contraception history, past medical/surgical history, family history, personal & social history, and drug & allergy history. Information about newborn, type of cooking fuel, duration of exposure was collected. Each interview lasted for about 15 – 30 minutes. Information was collected from mother within 48 hours of delivery and birth weight of newborns was recorded using pediatric weighing machine. All mothers were counseled regarding importance of diet, sleep, rest, iron prophylaxis etc. the collected information was entered into Microsoft Excel and inference was drawn by applying appropriate statistical test.

RESULTS

A total 121 mother aged between 20 years and 38 years participated in the study. Out of 121 mothers, majority i.e. 89 (73.55%) were housewives, followed by laborers 14 (11.57%), farmers 9(7.44%), self-employed 5(4.13%) and in service 4(3.3%). Thirty six (29.75%) mothers were illiterate, 41 (33.88%) had primary education, 14 (11.57%) had secondary education, 9(7.44%) had higher secondary education, 15 (12.4%) were graduate and 6 (4.96%) were post graduate.

Out of 121 newborns, 61(50.41%) were males and 60(49.59%) females. Males were heavier than females and the observed difference was significant. Religion wise there were 96(79.34%) Hindu mothers and 25(20.66%) Muslim mothers. Mean birth weight was more in case of Muslim mothers as compared to Hindu mothers. However, the observed difference was not significant [Table 1].

Mean birth weight of different age groups was compared. The highest mean birth weight was found in mothers having age≥30years and lowest n mothers of 25-29years. The observed difference was not significant.

Lowest mean birth weight was observed in mothers who were farmers. Mean birth weight of self-employed mothers was highest. However, the observed difference was not significant. Lowest mean birth weight was observed in illiterate mothers while the highest mean birth weight was observed in mothers who were post graduate. However, the observed difference was not significant [Table 1].

Parity wise there were 56(46.28%) primipara, 49(40.5%) second para and 16(13.23%) were multipara. Mean birth weight of second para was better, followed by multi-para and then primipara. However, the observed difference was not significant. [Table 1].

According to type of family, majority of mothers, i.e., 89(73.55%) belonged to joint family and the rest 32(26.45%) belonged to nuclear family. Mean birth weight of mothers from joint family was better. However, the difference was not significant. [Table 1].

According to type of delivery, 68 (56.2%) mothers had undergone normal delivery and 53(43.8%) had undergone cesarean section (CS). Mean birth weight of mothers that had undergone CS was found higher than mothers who undergone normal delivery. However, the difference was not significant [Table1].

The range of initial weight was 30kg to 73kg. Mean birth weight of new borns was higher in mothers with higher initial weight than mothers with lower initial weight. However, the observed difference was not significant. Weight gain was in the range of 5-15kg. Mean birth weight of the new borns in mothers having less weight gain (5-10kg) was significantly lower than those with better weight gain (11-15kg),[Table1].

Out of 121mothers, 47(38.84%) used LPG, 35 (28.92%) wood fuel,1(0.83 %) kerosene, 23(19.01%) both LPG and wood fuel and 15 (12.4%) both wood fuel and kerosene. Percentage of LBW new borns was highest in mothers using wood fuel alone (28.57%), followed by those using wood fuel along with kerosene (20%), then LPG users (12.76%), and followed by those using LPG along with wood fuel. The observed difference was between wood and other fuel was found. Statistically significant To assess further the effect of kitchen fuel on birth weight, mean birth weight of new born sex posed to various kitchen fuels were compared. The highest mean birth weight was in LPG users (2950.94±507.62) and lowest in kerosene users (2500g) [Table2], with increasing duration of exposure there was decline in mean birth weight. New borns of mothers with more than 4hr exposure were lighter by 287.09g than new borns of mothers with ≤2hr exposure. However, the observed difference was statistically not significant. [Table-3].

Table 1: Effect of confounders on birth weight

Confounders		Total Number	Number of LBW newborn	Mean birth weight (g)	SD	Significance
Sex of newborn	Male	61	6	2903.12	517.52	$\chi^2 = 4.85$, $p < 0.05$
	Female	60	15	2689.27	516.93	
Age (in years)	20-24	59	9	2788.51	498.32	$\chi^2 = 0.75$, $p > 0.05$
	25-29	42	9	2781.43	517.61	
	≥ 30	20	3	2855.2	503.41	
Religion	Hindu	96	17	2790.48	515.7	$\chi^2 = 0.04$, $p > 0.05$
	Muslim	25	4	2822.4	503.41	
Occupation	Housewife	89	18	2768.36	516.93	$\chi^2 = 2.01$, $p > 0.05$ (df = 2)
	Laborer	14	1	2843	498.4	
	Farmer	9	2	2562.23	529.32	
	Self-employment	5	0	3300	503.74	
	Service	4	0	3175	520.02	
Education	Illiterate	36	13	2529.78	515.7	$\chi^2 = 13.03$, $p < 0.05$ (df = 2)
	Up to primary	41	3	2914	518.79	
	Up to Secondary	14	0	3060.71	500.31	
	Up to Higher Secondary	9	2	2877.78	518.99	
	Up to Graduate	15	3	2703.33	511.86	
	Up to Post Graduate	6	0	3100	568.07	
Parity	Primipara	56	11	2760.18	518.91	$\chi^2 = 0.5$, $p > 0.05$
	Second para	49	8	2845.43	515.7	
	Multi-para (≥ 3)	16	2	2778.13	514.8	
Type of family	Joint	89	15	2804.4	516.93	$\chi^2 = 0.05$, $p > 0.05$
	Nuclear	32	6	2776.69	517.61	
Type of delivery	Normal	68	8	2783.85	516.93	$\chi^2 = 3.38$, $p > 0.05$
	CS	53	13	2814.04	519.29	
Initial weight (Kg)	< 45	39	9	2640.3	515.7	$\chi^2 = 1.85$, $p > 0.05$
	45-60	70	10	2818.34	515.7	
	≥ 60	18	2	3138.33	503.4	
Weight gain (Kg)	5-10 kg	74	19	2763.78	519.29	$\chi^2 = 9.19$, $p < 0.05$
	11-15 kg	47	2	2849.49	498.32	
LBW: Low Birth Weight						

Table 2: Distribution of newborns according to birth weight & fuel type

Type of fuel	No of newborn (%)		Total (%)	Mean birth weight (g)	SD
	< 2.5 kg	> 2.5 kg			
LPG	6 (12.76%)	41 (87.24%)	47 (100 %)	2950.94	507.62
Wood	10 (28.57%)	25 (71.43%)	35 (100 %)	2615.77	515.06
Kerosene	0 (0.00%)	1 (100%)	1 (100 %)	2500	
LPG & wood	2 (8.69%)	21 (91.31%)	23 (100 %)	2886.09	501.5
Wood & kerosene	3 (20%)	12 (80%)	15 (100 %)	2621.33	535.5
Total	21 (17.36%)	100 (82.64%)	121 (100 %)	2797.07	515.7
$\chi 2$ (wood vs others) =4.32, $p < 0.05$					

Table 3: Effect of duration of cooking on birth weight

Duration of cooking (hr)	No of newborn (%)		Total (%)	Mean birth weight (g)	SD
	< 2.5 kg	> 2.5 kg			
≤ 2	1 (14.29%)	6 (85.71%)	7 (100 %)	2985.71	498.37
2.1-4	15 (17.65%)	70 (82.35%)	85 (100 %)	2815.13	517.52
> 4	5 (17.24%)	24 (82.76%)	29 (100 %)	2698.62	515.06
Total	21 (17.36%)	100 (82.64%)	121 (100 %)	2797.07	515.7
$\chi 2$ =0.051, $p > 0.05$ (df = 2)					

DISCUSSION

Birth weight is influenced by various factors. For assessing the effect of prenatal exposure to cooking fuel on birth weight, there is need to take care of confounding factors. For that purpose, care of known confounders for LBW was taken at various levels of study. In the first step care of few confounding factors were taken by excluding mothers having certain conditions known to affect birth weight. Further, for some other confounding factors like, sex of child, maternal age, education, occupation, parity, analysis was carried out to know their effect. In this study, sex of the newborn had significant effect on birth weight as male newborn were heavier than female. According to other studies also, male newborn were heavier than female [12].

The effect of maternal age on birth weight was not significant in present study. While in study by Samiran Bisai et al., the rate of LBW was high in mothers aged less than 19 years and older than 30 years [5]. The reason for non-significant effect of maternal age on birth weight may be the lower numbers of mothers in the age group of less than 19 years and more than 30 years.

Parity is another factor that affects birth weight [13]. The average birth weight tends to increase with parity [14]. In this study, significant effect was not observed. Along with age of mother and parity, other confounders like religion, occupation, type of family and type of delivery had no significant effect on birth weight.

It has been well established that increased maternal education contributes to increased birth weight, as well as reduced risk for low or very low birth weight offspring [15]. In the present study, same has been observed, i.e. education has significant effect on birth weight of newborns.

Pre-pregnancy weight is a crude reflection of nutritional status of mother. To assess nutritional status of mother, pre-pregnancy weight is important, which is very difficult to get in clinical practice and hence, initial weight recorded during early pregnancy at the time of diagnosis of pregnancy was considered [16]. In this study, it was observed that initial weight had no significant effect on birth weight. Weight gain during pregnancy was one more factor, which was found to be affecting birth weight significantly in this study.

To find out the effect of various kitchen fuels on birth weight, newborns were classified according to birth weight, i.e. LBW and normal birth weight. In this study, frequency of LBW was highest in wood users and similar findings were noted in other studies [9, 10, 17, 18]. The difference between wood users and others were found statistically significant. Percentage of LBW new borns was highest in mothers using wood fuel alone, followed by those using wood fuel along with kerosene, then LPG users, and followed by those using LPG along with wood fuel. In this study, relationship between duration of exposure and birth weight was also studied. It was found that, with increasing duration of exposure there was decline in mean birth weight. Newborn so mothers with more than 4hr exposure were lighter by 287.09 g than new borns of mothers with ≤2hr exposure.

CONCLUSION

The present study clearly indicates that maternal exposure to high pollution cooking fuels affects birth weight of newborns significantly. Among all cooking fuels studied, prenatal exposure to wood fuel is a significant risk-factor for LBW.

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