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Original Research Article

Assessing the impact of antenatal care utilization on low birth weight: A hospital-based case-control study

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ABSTRACT

Background: Low birth weight (LBW) being important determinant of child survival and development, is a preventable public health problem. The antenatal care (ANC) as an instrument that can reduce LBW, especially, in developing world with unexpectedly high level. Present study evaluated the effect of utilization of ANC services on LBW.

Materials and Methods: A hospital-based case-control study carried after the ethical approval at university hospital, Varanasi, India during October, 2019 to September, 2021 on mothers delivering singleton baby. The case and control mothers decided 86 and 129 in the ratio of 2:3 at a =5% and (1-b) = 90%. Data was collected on a pre-designed and pre-tested questionnaire. Bivariate and multivariable forward logistic regression was performed. The statistical significance was judged at a = 0.05.

Results: Utilization of ANC services, milk intake, tea and snacks intake and gestational age at birth emerged as the significant contributor to LBW. Likelihood of LBW babies was 2.83 times higher to mothers who hadn't avail ANC services compared to those who had availed complete ANC services. Likelihood of LBW was also 3.73 and 3.16 times higher in mothers who hadn't taken milk and had taken but occasionally compared to regular users. Mothers with tea and snacks frequency once or twice were 3.18 times more likely to birthing LBW babies than the mothers with frequency more than twice. The likelihood of LBW birth was as high as 7.61 times in pre-term birth as compared to full-term.

Conclusion: Complete ANC services be ensured through the gross root health workers. Milk and tea & snacks intake if not possible in mothers of poverty pockets, these be advised to add one extra meal in their routine meal.

1. Background

Low birth weight (LBW) is defined births weighing less than 2500 gm irrespective of gestational age.[1] Globally, child health continues to be a major public health problem, specifically in low middle-income countries (LMICs), because of high prevalence of LBW babies.[2] Worldwide more than 20 million (15%-20% of all children) infants reported LBW at birth, though with wide variations across the regions; the highest 28% in South Asia and the lowest 6% in East Asia and the Pacific region.[3] The main cause of LBW is the intrauterine growth retardation (IUGR) because of insufficient uterine–placental perfusion and fatal nutrition and preterm birth. Preterm birth is also contributed by IUGR, extra-uterine infection, trauma, illness, foetal infection, and anomalies.[4,5]

These LBW babies are the consequential effect of poor maternal health, poor nutrition, poor healthcare delivery,

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and the poverty, and are at high risk of death and illnesses.[6] Across the globe, these LBW babies contributing 60–80% of neonatal deaths and high in LMICs, in fact due to poor utilization of ANC services and limited access to emergency obstetric.[7] Moreover, the surviving LBW babies are at potential risk of cognitive deficits, motor delays, cerebral palsy, and other behavioural and psychological problem.[8–12] LBW born in developed regions are the lowest; 4.8% in Australia, 5.5% in Canada, 5.8% in United States and 6.0% in the United Kingdom respectively.[13] But in India, as reported from different corners of the country, it ranges from 10% to 35%[14–26] for which preterm births are mostly responsible. Across the world, estimated preterm birth was 15 million each year and India stood on the top with 3.5 million preterm births. This high prevalence and preterm birth in India is in fact due to mothers giving births below age 20 years, living in poor socio-economic status (SES), poor weight gain during pregnancy, no additional meal or milk and dairy products or tea and snacks and poor compliance to antenatal care (ANC) services.[14,16,18,19,22,25,27–30] While in developed countries, mostly LBW babies were directly linked with income quintiles of the mothers.[31]

Nearly half (48.1%) of the neonatal deaths from among LBW babies as reported in 2013 is a major concern to the Indian Government[32] The reduction of burden of LBW is the essential concern as it can save cost of household as well as of health system to a greater extent.[33] ANC check-ups in which mothers are monitored for foetus growth, and accordingly advised for enough resting, adequate diet, extra meal intake, intake of milk and dairy product as well as tea and snakes between the meals. Complete ANC check-ups as per guidelines can bring the substantial reduction in LBW. The present study primarily focussed on effect of utilization of complete ANC services on LBW.

2. Materials and Methods

It was a case-control study carried at tertiary care hospital in Varanasi District of Uttar Pradesh, India. The study was approved by the Institute Ethical Committee (No. Dean/2019/EC/1519 dated 25-09-2019). The study population consist of all mothers delivering singleton baby at Sir-Sundar Lal Hospital, Institute of Medical Sciences (IMS), Banaras Hindu University (BHU) during October, 2019 to September, 2021. The study population was divided into case and control groups as per the following definition.

2.1. Case

Mothers delivering singleton live-born baby weighing ≥ 700 gm and ≤ 2499 gm at birth with gestational age ≥ 28 weeks and without any congenital anomalies.

2.2. Control

Mother delivering singleton live-born baby weighing ≥ 2500 gm and ≤ 4000 gm at birth with gestational age ≥ 28 weeks without any congenital anomalies.

2.3. The sample size

The sample size for cases and controls was decided by considering increased risk of LBW among mothers who either did not or had partially availed ANC services compared to those who had availed complete ANC services. This was obtained by analysing 160 singleton deliveries sorted from Medical Record Section of SS Hospital for the month of April, 2018 following criteria of cases and control. Among mothers who gave birth to LBW and normal birth weight (NBW) babies, 29.83% and 54.34% respectively had either not or had partially availed ANC services. This indicated that mothers who either had not or had partially availed ANC services were 2.80 times more likely to give birth to LBW babies. By using statistical principle to sample size calculation for case control study design; the sample sizes in the ratio of 2:3 of cases and controls at a =5% and (1-b) = 90% were decided as 86 cases and 129 controls.

2.4. Data collection

Data collection was done on a pre-designed and pre-tested structured questionnaire. Information collected were demographic (age, gravida and surviving male children), socio-economic (education and occupation), physical activity performed and resting duration (day rest and night sleep), presence of any chronic disease during pregnancy (diabetes, hypertension, heart disease and urogenital infection), dietary pattern (meal type, meal timing, milk intake and frequency of tea and snacks) and gestational age at birth and birth weight.

2.5. Statistical analysis

The analysis was carried using the software SPSS version 29.0.2.0 (20). Quantitative variables were presented for their means and standard deviations (SD's) separately for cases and controls. Similarly, qualitative variables were presented for their frequencies along with their percent separately for cases and controls. The statistical difference in means between cases and controls was tested using t test and the association of qualitative variables with birth weight using c2 test. To identify the significant contribution of the variables on birth weight, multivariable logistic regression was performed by including only those variables which were found significantly associated in bivariate analysis. The statistical significance was judged at a = 0.05.

2.6. Ethical issue

The study was approved by Ethical Committee of the Institute of Medical Sciences, Banaras Hindu University, Varanasi (UP), India vide-letter No. Dean/2019/EC/1519 dated 25-09-2019. Informed consent was obtained from mothers to participate in the study. The confidentiality of each selected mother was maintained.

3. Results

ompared the characteristics of mothers of cases and controls. The mean age of cases(26.94 ± 4.29 years) and controls (27.45 ± 4.19 years) were comparable (p = 0.390). The mean gravida of cases and control groups were also comparable which were slightly higher than 2.0 in each group (p = 0.687). Mothers with no male surviving children were more than 1.5 times in case group (34.9%) compared to 19.4% in mothers of control group (p = 0.011). Substantial differences were seen in level of education and occupation between mothers of cases and controls. As against 32.6% in case group, almost twice of the mothers in control group (62.8%) were with education graduation or above (p < 0.001). Similarly, compared to 7.0% mothers of case group, more than twice (17.8%) of the mothers of control group were doing some job either in private or public sector (p = 0.002). Presence of any of the chronic disease was statistically similar in cases and controls which were in around 20% mothers in each group (p = 0.587). In both the groups, most of the mothers (> 95%) had performed moderate physical activity during pregnancy (p = 0.556). Resting hours ≥ 8 was significantly higher in mothers of control group (67.4%) as compared to 51.2% of case group (p = 0.017). Almost two third (65.1%) mothers of case group had either not availed or availed ANC services partially; while such mothers were only 27.9% in control group (p < 0.001). More than twice of the mothers (37.2%) in control groups had their fixed meal timing as against 17.4% mothers of case group (p = 0.002). Mothers in both the groups were equally distributed for the consumption of meal type and meal numbers a day (p = 0.737 for type of meal; p = 0.406 for number of meals a day). Wide gap existed with regard to milk intake during pregnancy; almost twice of the mothers (78.3%) of control group as compared to only 43.0% mothers of the case group had taken milk regularly (p < 0.001). Similarly, more mothers (86.0%) of control group compared to 67.4% mothers of case group had taken tea and snacks more than twice during their pregnancy period. Preterm deliveries were almost 3.5 times higher in mothers of cases as against only 18.6% mothers of control group (p < 0.001).

To evaluate the impact of utilization ANC services on LBW; firstly, we evaluated the mother's characteristics that impacted ANC services utilization. In forward LR method, only the education from among mother's level of education, occupation, gravida and history of any disease during pregnancy emerged to influence utilization of ANC services (**Table 2**). Hence, education of mother was not included in forward LR method while evaluating the effect of utilization of ANC services. The variables included were those that differed significantly in bivariate approach between case and control groups and were mother's occupation, resting duration during pregnancy, utilization of ANC services, meal timing, milk intake, frequency of tea and snacks, and delivery status. The result presented in **Table 3** are only for those variables that had significant contribution to LBW. Mothers, who hadn't availed ANC services were 2.83 times (95% CI: 1.29 – 6.22) more likely to give birth to LBW babies as compared to those who had availed complete ANC services; while no difference was seen for mothers who had availed ANC services even partially. Milk intake as well as tea and snacks during pregnancy serving as extra source of energy other than routine meal also had substantial impact on LBW. Mothers who hadn't taken milk and who had taken occasionally were 3.73 times (95% CI: 1.49 – 9.34) and 3.16 times (95% CI: 1.16 – 9.34) more likely to give birth to LBW babies as compared to mothers who had taken milk regularly. Further, mothers with frequency of tea and snacks once or twice were 3.18 times (95% CI: 1.30 – 7.76) more likely to birthing LBW babies than those whose frequency was more than twice. The likelihood of LBW birth was as high as 7.61 times (95% CI: 3.69 – 15.70) in pre-term birth as compared to full-term. Rest of the characteristics such as occupation of mothers, resting duration during pregnancy and meal timing did not emerge as the significant contributor to LBW born babies.

The characteristics that did not appear significant in the model were mother's occupation, resting duration, and meal timing.

Since, major contributor to LBW babies was pre-term births; further we carried forward LR method to look at the mother's characteristics that impacted preterm births. The characteristics considered were mother's education, mother's occupation, utilization of ANC services, meal frequency a day, meal timing, milk intake and frequency of tea and snacks a day which were statistically dissimilar between pre-term and full-term births. Out of these none except utilization of ANC services emerged as the significant contributor to pre-term birth. Mothers who hadn't availed ANC services were 3.21 times (95% CI: 1.75 – 5.88) more likely to deliver pre-term babies compared to mothers who had availed complete ANC services. While preterm births were similar among mothers who had availed even ANC services partially (AOR = 1.36; 95% CI: 0.47 – 3.93) compared to mothers who had availed complete ANC services (**Table 4**).

Table 1: Background studied characteristics of cases and controls

Characteristics	Cases (n = 86)	Controls (n = 129)	P value
Age (Mean ± SD) years	26.94 ± 4.29	27.45 ± 4.19	0.390
Gravida (Mean ± SD)	2.09 ± 1.08	2.16 ± 1.34	0.687
Number of surviving males			
0	30 (34.9)	25 (19.4)	0.011
≥1	56 (65.1)	104 (80.6)	
Education level of mothers			
≤ High-school	41 (47.7)	13 (10.1)	< 0.001
Intermediate	17 (19.8)	35 (27.1)	
≥ Graduation	28 (32.6)	81 (62.8)	
Occupation of mothers			
House wife	80 (93.0)	106 (82.2)	0.022
Service (Private/Government)	6 (7.0)	23 (17.8)	
Medical history during pregnancy*			
Yes	20 (23.3)	26 (20.2)	0.587
No	66 (76.7)	103 (79.8)	
Physical activity during pregnancy			
Moderate	82 (95.3)	125 (96.9)	0.556
Mild	4 (4.7)	4 (3.1)	
Resting duration (day resting + night sleep)			
< 8 hours	42 (48.8)	42 (32.6)	0.017
≤ 8 hours	44 (51.2)	87 (67.4)	
ANC services availed**			
No	46 (53.5)	28 (21.7)	< 0.001
Partial	10 (11.6)	8 (6.2)	
Complete	30 (34.9)	93 (72.1)	
Meal timing			
Irregular	71 (82.6)	81 (62.8)	0.002
Fixed	15 (17.4)	48 (37.2)	
Meal type			
Pure veg	38 (44.2)	60 (44.2)	0.737
Non-veg + egg	48 (55.8)	69 (53.5	
Number of meals a day Twice Thrice	1 (1.2) 85 (98.8)	5 (3.9) 124 (96.1)	0.406
Milk intake			
No	34 (39.5)	14 (10.9)	< 0.001
Occasional	15 (17.4)	14 (10.9)	
Regular	37 (43.0)	101 (78.3)	
Tea and snacks			
Once or twice a day More than twice a day	28 (32.6) 58 (67.4)	18 (14.0) 111 (86.0)	0.001
Delivery status			
Pre-term	55 (64.0)	24 (18.6)	< 0.001
Full-term	31 (36.0)	105 (81.4)	

* Suffering with any or multiple diseases like hypertension/diabetes mellitus/heart disease/recurrent urinary tract infection during pregnancy. ** No ANC: Neither ANC check-up nor intake of iron and calcium supplements; Partial ANC: Either ANC visits less than 4 or if ANC visits ≥ 4 but not consumed iron and calcium supplements for minimum 100 days; Complete ANC: ANC visits ≥ 4 as well as consumed iron and calcium supplements for minimum 100 days.

Table 2: Adjusted odds ratios of the studied characteristics contributing significantly to ANC services utilization.

Characteristics	AOR	P values	95% of AOR
Education level of mothers			
≤ High-school	14.04	< 0.001	6.37 – 30.93
Intermediate	6.57	< 0.001	3.15 – 13.72
≥ Graduation	1.00	–	–

Table 3: Adjusted odds ratios of the studied characteristics contributing significantly to birth weight in bivariate analysis

Characteristics	AOR	P values	95% of AOR
ANC services utilization			
No	2.83	< 0.001	1.29 – 6.22
Partial	3.14	0.066	0.93 – 10.63
Complete	1.00	–	–
Milk intake			
No	3.73	0.005	1.49 – 9.34
Occasional	3.16	0.025	1.16 – 8.63
Regular	1.00	–	–
Tea and snacks			
Once or twice a day	3.18	0.011	1.30 – 7.76
More than twice a day	1.00	–	–
Delivery status			
Pre term	7.61	< 0.001	3.69 – 15.70
Full term	1.00	–	–

Table 4: Adjusted odds ratios of the studied characteristics contributing significantly to pre-term birth.

Characteristics	AOR	P values	95% of AOR
ANC services availed			
No	3.21	< 0.001	1.75 – 5.88
Partial	1.36	0.566	0.47 – 3.93
Complete	1.00	–	–

4. Discussion

LBW born are the major cause of infant morbidity and mortality and those surviving face poor mental development.[2,8–12] Government of India had made tremendous effort to reduce burden of LBW by creating huge infrastructure for maternal and child health care (MCH) for both rural and urban areas; but LBW births continue to be high ranging from 10% to 35% which are mostly contributed by premature births that ranges from 30% to 50% across the country. Birth spacing, poor weight gain during pregnancy, extraneous labor; poor utilization of ANC services reported as the leading causes.[14,16,19,22,25,27–30]

National Family Health Survey (NFHS-5) reported poor utilization of complete ANC services i.e., a minimum 4 ANC check-up and a minimum 100 days consumption of iron and calcium which were in below 60% mothers and in below 45% mothers respectively. While in Uttar Pradesh (UP), a major state of the country with 240 million population, these were around 40% and 20% respectively.[34] Consequence of LBW can be recognized as in nearly 0.75 million neonatal deaths, about half (48.1%) were either LBW or premature birth.[32] The unfavourable situation to poor utilization of ANC services in state UP is the literacy of women in reproductive age group, early age pregnancy and continued reproduction even in older ages. About one third mothers are illiterate and two fifth are below the high-school level of education and in spite of legal restriction on marriage age, about 16% girls married below the age of 18 years.[34]

During ANC check-ups, pregnant women are monitored for foetus growth and accordingly advised for rest and improving diet. The diet could be improved either by increasing meal frequency or by adding extra sources of energy such as intake of milk and dairy products or frequent intake of tea and snacks or both to fulfil the foetus need. In hospital-based case control studies on LBW, preterm birth is a major confounder which was adjusted while evaluating the effect of utilization of ANC services. Preterm birth was the highest contributor to LBW; the likelihood of LBW birth in preterm births was as high as 7.61 times (95% CI: 3.69 – 15.70) compared to full-term. The mothers who didn't avail ANC services were 2.83 times (95% CI: 1.29 – 6.22) more likely to give LBW babies compared to those who availed complete ANC services; while there was no difference in LBW among mothers who had taken even partial ANC services. The finding of this study is in consistent with many studies on the role of utilization of ANC services.[35–38] Milk intake during pregnancy also impacted birth weight. Mothers who did not consume milk during pregnancy were 3.73 times (95% CI: 1.49 – 9.34) more likely to give LBW babies; while mothers taken milk even occasionally were also 3.16 times (95% CI: 1.16 – 9.34) more likely to give LBW babies when compared with mothers who had taken milk regularly. A meta-analysis had reported the effects of milk and dairy product intake, mainly during pregnancy, compared with no or very low milk intake.[38] Tea and snacks as an added source of energy also had impact on birth weight. Mothers with frequency of tea and snacks once or twice were 3.18 times (95% CI: 1.30 – 7.76) more likely

to birthing LBW babies than those whose frequency was more than twice. Our study also supports the findings of studies carried in Ethiopia and Ghana regarding tea and snack intake.[39,40]. Thus, utilization of ANC services can play a big role in reducing the burden of LBW which was seen lacking among illiterate or poorly educated mothers. Moreover, these mothers may also lack with regular milk intake and frequent intake of tea and snacks as most of these belong to poor economic status. Therefore, health workers need to contact such mothers well in time for pregnancy check-ups through-out the pregnancy period and advise at least to increase one meal extra in their usual meal, if milk and tea and snacks is unaffordable to them. Further, though the objective was not to evaluate the role of ANC services on preterm birth; but analysis was carried, which indicated that the mother who did not avail ANC services were 3.21 times (95% CI: 1.75 – 5.88) more likely to deliver pre-term babies compared with mothers who had utilized complete ANC services; while no difference was found in mothers who had availed even partial ANC services (AOR = 1.36; 95% CI: 0.47 – 3.93).

5. Conclusion

Present study indicated the role of utilization of complete ANC services in reducing the burden of LBW babies. However, since utilization of complete ANC services is associated with education of mothers and illiteracy rate is higher in India, it becomes pertinent that health personnel deployed at gross root levels should made effort to motivate pregnant mother for complete ANC check-ups and consuming milk and tea and snacks during pregnancy more frequently, if possible. Mothers with poor economic condition for whom intake of milk and tea and snacks be advised to add one extra meal in their routine meal intake.

6. Source of Funding

None.

7. Conflict of Interest

None.

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