Research Article

Maternal risk factors for low birth weight in neonates – A community-based prospective study in rural area of Puducherry

Rajkumar Subramanian[1], Surendar Rengasamy[2], Arthi Sakthi[2]

[1]Department of Community Medicine, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu, India, [2]Department of Community Medicine, Sri Venkateshwaraa Medical College Hospital and Research Centre, Pondicherry, India

Correspondence to: Rajkumar Subramanian, E-mail: rajkumar.mbbsmd@gmail.com

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ABSTRACT

Background: The health of childbearing women and infants is a major area of concern, which needs special attention. The pregnancy outcome depends on the maternal characteristics which include the utilization of Reproductive and Child Health (RCH) services during pregnancy period. In view of the above, an attempt has been made to study the maternal characteristics and its impact on perinatal outcomes among rural women in India. **Objectives:** The objectives of this study were to find the incidence of delivering low birth weight (LBW) infants and to examine the association between delivering LBW infants and maternal characteristics. **Materials and Methods:** A community-based longitudinal study was conducted in Bahour Commune Panchayat of Puducherry, for 1 year and 3 months from January 1, 2012, to March 31, 2013. A total of 258 pregnant women registered in the Anganwadi centres serving Bahour Commune Panchayat from 1st January 2012 to 31st May 2012, and they were selected by universal sampling method, of those 244 pregnant women were responded. They interviewed with the help of questionnaire and followed until delivery. **Results:** The incidence of delivering LBW infants was 8.6%. Maternal characteristics including utilization of RCH services such as maternal body mass index (BMI), weight gain during pregnancy, maternal hemoglobin, and blood pressure level, history of previous abortion status, and intake of iron and folic acid tablets during pregnancy were significantly associated with the birth weight of the infants by univariate analysis. Some of the above factors such as religion, blood pressure level, and maternal BMI were found to be significantly associated with multivariate analysis also. **Conclusions:** Overall, integrated approach is needed to improve the health care and utilization of RCH services during pregnancy to reach the better outcomes.

KEY WORDS: Birth Weight of the Infants; Maternal Characteristics; Pregnant Women

INTRODUCTION

The health of childbearing women and infants is a major area of concern, which needs special attention due to higher vulnerability or special risk group. The health of the mother and child is so closely linked that each has the capacity to influence the other. The connection between them starts from childbearing in the case of women and growth, development, and survival in the case of infants and children.[1] The outcome of pregnancy in terms of healthy newborn is dependent on the physical, physiological, mental, and nutritional state of the mother during pregnancy and rather than that there are some specific health interventions jointly protect pregnant women and the babies (e.g., immunization and nutritional supplementation). To improve the antenatal care and counseling throughout the world, the global safe motherhood was launched in 1987. The modifiable factors influencing the maternal and

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neonatal outcome are nutritional intake and the weight gain during pregnancy.[2]

According to the WHO, globally 5,29,000 women die of pregnancy-related causes every year. Global observations show that the maternal mortality ratio averages at 8/100,000 live births in the developed regions, but in the developing regions, the figure is 450/100,000 live births. This difference between developed countries and developing countries is due to the access to special care during pregnancy and childbirth.[1]

India is one of the most populous countries in the world with a population of approximately 1.21 million. Of these, women of childbearing age are 15–44 years constituting 22.2%. Every year in India, roughly 30 million women experience pregnancy and 27 million have live births. Every year, over 100,000 pregnancy-related maternal deaths occur in the country. Millions more suffer from pregnancy ill health. It is mainly due to >50% of the deliveries conducted at home and most of them by untrained persons. In addition to this, there is a lack of knowledge and adequate referral facilities, mostly in the rural areas to provide emergency obstetric care for complicated cases.[3]

The pregnancy outcome depends on the maternal characteristics such as maternal body mass index (BMI), hemoglobin level, and blood pressure status and also includes the utilization of Reproductive and Child Health (RCH) services during pregnancy period. Low birth weight (LBW) is defined as live birth <2.5 Kg weight. Prevalence of LBW baby is an important indicator of reproductive health and general health of the nation. Low birth weight is a significant risk factor for childhood infections and malnutrition. There are many studies which proved that there is a significant association between LBW and poor academic performance and problems related to behavioral and mental health. One of the important risk factors for LBW is maternal health. The maternal risk factors are biologically and socially interrelated and most of the factors are modifiable. The government of India has launched several programmes to meet the successful outcome of pregnancies in terms of maternal and infant survival and wellbeing. Even after the implementation RMNCH+A, the adverse prenatal outcome tends to be very high, particularly in rural areas. Many community based research on this issue has been successfully conducted in many parts of the world and a number of instruments have been developed to quantify the extent, nature, severity and frequency of different forms to measure the pregnancy outcome and low birth weight. A very few studies have evaluated the pattern of pre-pregnancy body mass index and its impact on pregnancy outcomes and low birth weight in rural areas. In this context, this study aims to focus on the effect of maternal characteristics and its impact on birth weight of the infant in the Bahour commune Panchayat, a rural area of Pondicherry UT.

Aims and Objectives

The aims and objectives of this study were as follows:

- To find the incidence of delivering infants too small or too large for gestational age.
- To find the association between delivering LBW infants and maternal characteristics.

MATERIALS AND METHODS

This community-based longitudinal study was organized after completion of a successful pilot study to assess the feasibility and sensitivity of the questionnaire and procedure. The study was undertaken after getting the clearance from the Institutional Human Ethical Committee. The study was conducted between 1st January 2012 and 31st March 2013 (1 year and 3 months). All pregnant women registered in the Anganwadi centers belong to Bahour Commune Panchayat between January 2012 and May 2012 were enrolled for data collection.

Universal sampling method was used for data collection. All pregnant women registered in Anganwadi centres, serving in the Bahour Commune Panchayat between 1st January 2012 to 31th May 2012 were included in the study. Base line data was collected and then followed up at regular intervals for collecting remaining data till delivery. Baseline data were collected and then followed up at regular intervals for collecting remaining data.

For sample size, the pregnant women who were registered during January 2012–March 2012 in the underdefined Anganwadis and given consent were used for the study. A total of 258 pregnant women were registered and given consent for participation in the study. Of all 258 women, 244 was followed up until after delivery and 14 were not followed up (9 got abortions and 5 were lost to follow-up). All pregnant women registered in Anganwadi centers, serving in the Bahour Commune Panchayat between 1st January 2012 and 31th May 2012, were included in the study.

Pregnant women registered with defined Anganwadi centers but not given written consent for participating in the study were excluded in the study. For sample size, the pregnant women who was registered during January 2012-March 2012 in the under defined Anganwadis and given consent was used for the study. Total 258 was registered and given consent for participation in the study. Out of all 258 women, 244 was followed up till after delivery and 14 were not follow up (9 got abortions and 5 were lost to follow up). Pregnant women registered with defined anganwadi centres but not given written consent for participating in the study were excluded in the study.

After explaining about the purpose of the study to the study participants written consent was obtained. Data was collected twice in a week in the initial five months and followed by

once in a week for the next four months with the help of anganwadi workers and ANM. The details of the registered pregnant women were obtained from the anganwadi workers. Data about socio-demographic characteristics like age, sex, literacy, occupation and socio-economic status, housing and to assess the clinical conditions of the pregnant women, antenatal services provided during pregnancy and pregnancy outcome were obtained by semi structured questionnaire. There were about 8-10 women interviewed in each visit. Interview done at private place either at home or anganwadi centres where she feels comfortable for active participation. Pregnant mothers who were found sick during the visits are referred to MGMC&RI or nearby health facilities for further treatment.

Statistics

Following the data collection, the collected information regarding individual participants was entered in Microsoft Excel sheet for the completeness of data initially. The frequency of all variables was checked for the completeness and mistakes in data. Then, to know the proportion and association using dependent variable (birth weight of the infants) and independent variable (age at marriage, sociodemographic characteristics, consanguinity marriage, maternal characteristics such as weight gain during pregnancy, maternal BMI, haemoglobin level, blood pressure level, and utilization of antenatal services), Chi-square test, Fisher's exact test, and logistic regression were used for association. Fisher's exact test was used when at least one expected value was <1 or 20% of values were <5. $P < 0.005$ was consider as statistically significant.

RESULTS

Women in the age group of 16–35 years were divided into four groups with 5 years' gap. Majority of women (58%) were between 21 and 25 years. 25% of the women were between 26 and 30 years. Nearly 6% of the women were in the age group of 31–35 years and about 11% were between 16 and 20 years. Majority of women (90%) were Hindus, 3.3% were Christians, and 7.4% were Muslims in the study population. Based on modified B.G. Prasad's classification[4] for socioeconomic status (January 2018), nearly 40% of the women belong to Class IV, 14% of women to Class II, 27% of women to Class III, and 19% of women to Class V in the study population. Of 244 mothers, 14% marriage was consanguineous type and rest was non-consanguineous as per this study. As per this study, 41.4% of the women conceived for the first time. 51.2% were given birth to one child, followed by 7% of the women had two children and 0.4% of the women had three children in the study population. Moreover, 6.6% of the pregnant women were underweight, 27.8% were pre-obese, followed by 5.8% were obese, and 59.8% of the women were belonged to normal BMI category in the study population. In the present study, the Chi-square homogeneity test was found to be significant for all the variables in Table 1 with $P < 0.001$.

Table 1: Distribution of demographic and antenatal variables

Variables	Frequency (%)
Age group (years)	
16–20	27 (11.1)
21–25	141 (57.8)
26–30	62 (25.4)
31–35	14 (5.7)
Religion	
Hindu	218 (89.3)
Christian	18 (7.4)
Muslim	8 (3.3)
Socioeconomic status	
Upper high (Class I)	0 (0)
High (Class II)	34 (13.9)
Upper middle (Class III)	67 (27.4)
Lower middle (Class IV)	97 (39.8)
Poor or BPL (Class V)	46 (18.9)
Type of family	
Nuclear	164 (67.2)
Joint family	80 (32.8)
Marriage	
Consanguineous	34 (13.9)
Non-consanguineous	210 (86.1)
Parity status	
0	101 (41.4)
1	125 (51.2)
2	17 (7)
3	1 (0.4)
BMI category	
Underweight (<18.49)	16 (6.6)
Normal (18.5–22.99)	146 (59.8)
Pre-obese (23–27.49)	68 (27.8)
Obese (>27.5)	14 (5.8)
Anemic status	
Normal (>11)	73 (30.0)
Mild (10–10.9)	40 (16.4)
Moderate (8–9.9)	110 (45)
Severe (<8)	21 (8.6)
Blood pressure (third trimester)	
Normotensive	196 (80.3)
Pre-hypertension	37 (15.2)
Hypertension	11 (4.5)
Mode of delivery	
Spontaneous vaginal delivery	178 (73.0)
Assisted	6 (2.4)
Cesarean section	60 (24.6)

BMI: Body mass index

In Table 2, statistical association between age, education, socioeconomic status, consanguinity, gravida status, previous abortion status, iron and folic acid (IFA) tablets, mother's

Table 2: Association between maternal variables and birth weight of the child

VARIABLE	Low birth weight *n* (%)	Normal weight *n* (%)	Fischer's exact test
Age (years)			
<30	19 (7.8)	211 (86.5)	0.609
>30	2 (0.8)	12 (4.9)	
Education			
Illiterate	3 (1.2)	27 (11.1)	0.75
Primary	3 (1.2)	23 (9.4)	
Middle	11 (4.5)	107 (43.9)	
HSC and above	4 (1.6)	66 (27)	
Religion			
Hindu	17 (6.9)	201 (82.3)	0.21
Muslim	0 (0.0)	8 (3.3)	
Christian	4 (1.6)	14 (5.7)	
Socioeconomic status			
Class II	3 (1.2)	31 (12.7)	0.61
Class III	4 (1.6)	63 (25.8)	
Class IV	11 (4.5)	86 (35.2)	
Class V	3 (1.2)	43 (17.6)	
Consanguinity			
Yes	9 (3.7)	25 (10.2)	0.001
No	12 (4.9)	198 (81.1)	
Gravida status			
<2	14 (5.7)	188 (77.0)	0.04
>2	7 (2.9)	35 (14.3)	
Previous abortion			
Yes	6 (2.5)	27 (11.1)	0.03
No	15 (6.1)	196 (80.3)	
IFA tablets during pregnancy			
<50	2 (0.8)	2 (0.8)	0.003
50–100	9 (3.7)	44 (18.0)	
>100	10 (4.1)	177 (72.5)	
Mother's BMI			
Underweight	14 (5.7)	2 (0.8)	0.001
Normal	7 (2.9)	139 (56.9)	
Pre-obese	0	68 (27.9)	
Obese	0	14 (5.7)	
Mother's anemia status			
Severe	2 (0.8)	19 (7.8)	0.001
Moderate	18 (7.4)	92 (37.7)	
Mild	0 (0.0)	40 (16.4)	
Normal	1 (0.4)	72 (29.5)	
Blood pressure (third trimester)			
Normotensive	4 (1.6)	192 (78.7)	0.001
Pre-hypertension	13 (5.3)	24 (9.8)	
Hypertension	4 (1.6)	7 (2.9)	
Weight gain during pregnancy (kg)			
<8	21 (8.6)	75 (30.7)	0.001
>8	0 (0.0)	148 (60.7)	

IFA: Iron and folic acid

BMI status, and anemia status with LBW were tested using Fischer's exact test. There was association between consanguinity, gravida status, previous abortion status, IFA tablets, Mother's BMI status, anaemia status and maternal blood pressure with low birth weight which was statistically significant (p<0.05). In multiple logistic regression, only religion, maternal BMI, and blood pressure were associated with LBW of infants.

DISCUSSION

The present longitudinal study aimed to find the incidence of delivering infants too small or too large for gestational age and to know the maternal factors associated with the birth weight of the infants.

In the present study, majority of women (83.2%) were between the age group of 21 and 30 years, while 11.1% was between 16 and 20 years [Table 1]. The highest percentage of these comprised of Hindus (89.3%) which can be attributed to Hinduism being the predominant religion of the country. Nearly 71% of women who participated in the study were housewives and about 67.2% of women belonged to nuclear families. The former stresses the fact that women at a large scale are still working within the household. On the other hand, the latter suggests that a significant number now resides within nuclear families as compared to joint families. This might be due to growing self-dependency contributing to changing mind-sets. Maternal characteristics including utilization of RCH services such as maternal BMI, weight gain during pregnancy, maternal hemoglobin, and blood pressure level, history of previous abortion status, and the intake of IFA tablets during pregnancy were significantly associated with the birth weight of the infants by univariate analysis. Some of the above factors such as religion, blood pressure level, and maternal BMI were found to be significantly associated with multivariate analysis also.

According to the present study, the mode of delivery was found to be normal vaginal delivery in 73% of women and instrumental delivery in 2.4%. The percentage of women who had a caesarean section was 24.6% [Table 1]. The National Family Health Survey-4[5] report of India showed that 17% of children born in India in 5 years before the survey were delivered by cesarean section. The proportion of deliveries by cesarean section was high in urban areas (28%) compared to rural areas (13%).[5] As compared to the national level survey, our study presents a phenomenal increase in deliveries by cesarean section in rural areas.

The main reason for non-utilization of full ANC services in our study was due to inadequate intake of IFA tablets, and these components should be emphasized by educating and motivating the women for the better intake of IFA tablets during the course of pregnancy. The incidence of low birth weight (LBW) in the present study was 8.6% which was

Table 3: Multivariate analysis for factors associated with birth weight of infants

Characteristics	Estimate	Standard error	Wald	Sig.	Exp (B)	95% Confidence interval	
						Lower bound	Upper bound
Intercept	−4.889	5.695	0.737	0.391			
Age	−0.903	1.039	0.756	0.387	2.468	0.322	18.919
Education	0.622	0.396	2.466	0.116	0.537	0.247	1.167
Religion	1.322	0.589	5.050	0.025	3.753	1.184	11.893
Socioeconomic status	0.926	0.720	1.653	0.199	2.524	0.615	10.353
Consanguinity marriage	−1.368	1.093	1.566	0.211	0.255	0.030	2.170
Gravida status	−4.09	0.841	0.236	0.627	0.664	0.128	3.455
Anemic status	−0.576	0.632	0.829	0.363	0.562	0.163	1.942
High blood pressure	4.692	1.372	11.68	0.001	109.04	7.402	1606.46
Body mass index*	−4.860	1.205	16.26	0.000	0.008	0.001	0.082

BMI: Body mass index, BMI *p* value is 0.001

more than NFHS-4 data where the incidence was 18% [Table no.2]. Low Maternal BMI (BMI<18.5) is a marker for minimal tissue nutrients reserve for the foetus and hence these mother's are at a high risk of adverse pregnancy outcomes.[6] In our study, we found that 50% of the LBW babies were born to underweight mothers [Table 2]. Similarly, a study by Verma and Shrimal,[7] Singh *et al.*,[8] and Misra and Patrika[9] on maternal BMI and pregnancy outcome has also shown that the association between maternal BMI and pregnancy outcome was significant. One of the possible explanation for this association is Low BMI mothers have a poor reserve of nutrients and calories which in turn affects birth weight of the infants because of inadequate supply nutrition from mothers.[10] In the present study, it has been found that maternal anemic level was associated with birth weight of the infants by univariate analysis and the incidence of LBW babies born to anemic mothers is significantly higher when compared to non-anemic mothers [Table 2]. In comparison with a study conducted by Kawathalkar and Joshi,[10] Misra and Patrika,[9] Addo,[11] and Bangal *et al.*[12] observed that the maternal hemoglobin level is strongly associated with birth weight of the infants and the LBW babies born to anemic mothers were significantly higher to non-anemic mothers which is concordance with our study findings. Overall, the nutritional status of the mother, especially in rural areas, is to be improved by health education and motivation of the mothers to take IFA tablets regularly. This study showed that hypertension during pregnancy was highly associated with the birth weight of the infants by univariate analysis [Table 2], which was also confirmed by multivariate analysis [Table 3]. A similar study conducted in rural India by Phalke *et al.*[13] and Yazdani *et al*.[14] states that there is a significant association between hypertension during pregnancy and the birth weight of the infants. To avoid such adverse outcomes from being repeated, integrated approach such as early registration, regular antenatal checkups with regular blood pressure monitoring, health education, salt restricted diet, and lifestyle modifications is needed to avoid the adverse pregnancy outcomes. The comparison of BMI to the other studies was done only on the basis of international BMI classification. In the present study, it has been found that both classifications of BMI (International and Asian) were highly associated with birth weight of the infants by univariate analysis [Table 2], which was also confirmed by multivariate analysis [Table 3]. Similarly, a study conducted by Verma and Shrimali[7] in 2012, on maternal BMI and pregnancy outcome, also showed that the maternal BMI was statistically significant with birth weight of the infants which was also reinforced by Shahla *et al.,*[15] 2012, who concluded that the maternal BMI was strongly associated with the pregnancy outcomes. This study showed that there was a highly significant association between weight gain during pregnancy and birth weight of the infants by univariate analysis [Table 2]. Similarly, a study conducted by V. N. Addo *et al*[11] 2012, elucidates that weight gain during pregnancy is significantly associated with birth weight of the infants. This study clearly indicates that women over the decades have become more conscious about their health during pregnancy. The maternal characteristics such as BMI, weight gain during pregnancy, status of anemia and hypertension during pregnancy, consanguinity marriage, intake of IFA tablets during pregnancy, and previous abortion status are closely related to the birth weight of the infants. However, on the other hand, the demographic profile of the mother does not play a factor in the pregnancy outcome. Strengths of the study: It is a prospective follow-up study.

Limitations

Some mothers registered their pregnancies in the Anganwadi centers by the second and third trimesters.

CONCLUSION

Overall, maternal characteristics such as BMI, weight gain during pregnancy, maternal hemoglobin level, blood pressure level, and also the utilization of RCH services during pregnancy are highly and positively associated with

the outcome of pregnancy. Thus, an improvement in public awareness on maternal health services will not only reduce the reproductive morbidities but it will also trim down child mortality. This is not an overwhelming goal and can be achieved with efforts targeted toward health education, especially in less literate and the lower socioeconomic groups of the community.

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