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RESEARCH ARTICLE

THE EFFECT OF MATERNAL ANTHROPOMETRIC CHARACTERISTICS AND SOCIAL FACTORS ON BIRTH WEIGHT OF CHILD IN SMALL TOWN HOSPITAL OF GANDEVI BLOCK OF NAVSARI DISTRICT

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ABSTRACT

Background: In India low birth weight (LBW) (<2500 g), is the strongest determinant of infant morbidity and mortality.

Objective: To quantify the effect of maternal anthropometry, education and socio-economic status on birth weight.

Materials and Methods: Study Design: Prospective, Observational, Hospital based study.Study Setting: Gram Seva trust Hospital at Gandevi Block of Navsari district.Study Period: Sep 2009.Study Population:105 women who delivered in this hospital.Study Variable: Age of the mother at time of delivery, socio-economic status, education, parity, height and weight of mother, no. of ANC visits, sex of the delivered child.Outcome Variable: Low birth weight (LBW).Statistical analysis: Receiver Operative Characteristic (ROC)curve, chi square test, multivariate logistic regression

Results: Low birth weight was found in around 35 % of infants. Bivariate analysis revealed that Maternal age less than 20 years (p= 0.02), education (p= 0.009), socio economic status (p =0.001) was significantly associated with low birth weight. Maternal age <20 years, number of years of education < 7 found to increase risk of LBW. Maternal height, weight, BMI, parity, sex of the child, number of ANC visits and type of family had no statistically significant effect on determining the risk for LBW. However, adjusted Odds ratio was found significant for only BPL status and pre term.

Conclusion: Maternal age, Education, Economic states and Pre term were found to be the most important maternal parameters, which influence birth weight and the risk for LBW. However, Multivariate Logistic analysis revealed only BPL status and preterm had effect on LBW.

Key Words: Low Birth Weight; Multivariate Logistic Regression; Receiver-Operating Characteristic

INTRODUCTION

Low birth weight (LBW) (<2500 g) is the strongest determinant of infant morbidity and mortality in India. By NFHS-3 report, proportions of low birth weight (LBW) babies were found 23% for rural and 19% for urban population.[1] Large body of literature showing that Biological factors like Gestational Age (GA), Maternal Weight and Height,[2] Education,[3] Parity of mother, Sex of delivered child[4] should influence birth weight. Wasunna et al.[4] found that maternal education and household income were important factors affecting birth weight. Women with low education, poverty and poor

nutritional status were found in rural part of India and therefore they were at increased risk of adverse reproductive outcomes including LBW and preterm birth. The identification of such factors during pregnancy was therefore important in order to determine the level of care and priorities for referral to centers where reasonable obstetric and neonatal care are available.

Aim and Objective: To assess the influence of maternal anthropometry, education and socio-economic status on birth weight.

METHODS

- **Study Design:** Prospective, Observational, Hospital based study.
- **Study Setting:** Gram Seva trust Hospital at Gandevi Block of Navsari district.
- **Study Period:** Sep 2009.
- **Study Population:** 105 women who delivered in this hospital.
- **Study Variable:** Age of the mother at time of delivery, socio-economic status, education, parity, height and weight of mother, no. of ANC visits, sex of the delivered child.
- **Outcome Variable:** Low birth weight (LBW)
- **Data Collection Method:** This was hospital based prospective cohort study carried out in the Gandevi Block of South Gujarat. 105 infants who delivered in Gram Seva Trust hospitals of Gandevi Block during September 2009 were recruited for the study. Daily visit of the hospital had carried out for data collection. Selected infant's mothers were interviewing using pre designed and pre tested questionnaires.
- **Protocol:** In order to exclude inter-observer variation the all measurements of study participants were taken within 24 hours of birth by single investigator in the postnatal wards. A standard scale measured maternal anthropometry like weight and height. Infants' weight was measured with the salter scale (UNICEF). The gestational age was calculated from the last menstrual period in completed weeks of gestation.
- **Data Management and Analysis:** Means and standard deviations (SD) were calculated for all maternal anthropometric parameters, gestational age and birth weight. Receiver Operating Characteristic curves (ROC) were drawn to determine optimal cut-off values of the maternal anthropometric parameters that can point to the risk for LBW. The optimal cut-off points were defined by the highest numbers of correct classifications considering the LBW rate. The 95% confidence intervals of the area under the normalized ROC curve (AUC) were calculated as described by Hanley and McNeil.[5] The relationship between maternal anthropometric parameters, gestational age and birth weight were investigated by Chi square test. A multivariate logistic regression analysis with backward selection to identify significant influencing factors was performed to investigate the effect of maternal characteristics on preterm birth and LBW. Statistical analysis was performed using EPI Info software.

RESULTS

Characteristics of the Mothers and their Newborns

Table-1: Age, Anthropometric Parameters, Years of Education, Social Class, Parity of the Mothers

Mother's Characteristics	Mean (SD)	Range
Age (years)	22.9 (3.8)	16 to 40
Weight (kg)	48.8(7.2)	40 to 69
Height (cm)	153.7 (5.9)	130 to 177
Number of years of education	6.7 (4.3)	0 to 15
Social class BPL (Below Poverty Line) APL (Above Poverty Line)	N (%) 75 (72.1%) 29(27.9%)	
Parity Primipara Multipara	N (%) 47(44.8%) 58(55.2%)	

Maternal age, anthropometric measurements (Weight and height), years of education and social status of 105 women were shown in Table 1. Mean maternal age at time of delivery was

22.9±3.8 years (Range: 16 - 40 years), mean years of schooling was 6.7±4.3 years, mean height and mean weight was 153.7±5.9cm, 48.8±4.8kg respectively. Around 72% mothers were Below Poverty Line, as the study was done in a rural set up. Around 45% mothers were primiparous.

Table-2: Characteristic of their Newborns

Infants Characteristics	Mean (SD) or N(%)	Range
Gestational age (weeks)	38.2 (2.6)	30 to 42
Birth weight (g)	2584.7 (457.7)	1000 to 3600
Sex of Child Male Female	 57 (53.3%) 48 (45.7%)	
LBW (< 2500 g)	37 (35.2%)	
Preterm infants (<37 weeks)	32 (30.2%)	

The gestational age (GA) ranged between 30 and 42 complete gestational weeks and the birth weight ranged between 1000 and 3600 gm. 32 (30.2%) infants were delivered before 37completed gestational weeks (preterm infants) and 37 (35.2%) infants were of LBW (<2500 gm).

ROC curves were drawn and an optimal cut-off point for each parameter was obtained as shown in Table 3. The discriminative power of the maternal characteristics to estimate the risk for LBW was assessed by the area under the curve (AUC). As shown in Table 3 only maternal age, years of education, economic status and gestational weeks had statistically significant discriminative ability to distinguish between normal and LBW infants. Sensitivity and specificity of the defined cut-off points are shown in table 3. Using the cut off points shown in Table 3 the influence of maternal characteristics on birth weight was investigated by calculation of the Odds ratio for LBW. Obviously, if the measurements of maternal characteristics are below the cutoff point there is a trend to increase the risk of LBW.

Bivariate Analysis was done of those maternal parameters that came out to be significant in ROC curve analysis. Accordingly the maternal age less than 20 years, years of education up to 7, low socio economic status and pre term have 2.4 times, 3 times, 3.2 times and 6.8 times risk of LBW as compared to normal birth weight respectively.

Table 3: ROC analysis of maternal age and maternal anthropometric parameters in the estimation of the risk for LBW

Parameters	Cut off	Sensitivity	Specificity	AUC (95% CI)	p value
Maternal Age (year)	20	78.38	72.06	0.63(0.53 to 0.72)	0.023
Years of Education	7	72.97	58.82	0.64(0.55 to 0.74)	0.009
Economic Status	BPL	86.49	33.82	0.60(0.50 to 0.69)	0.072
Completed Gestational week	37	66.00	65.45	0.698(0.601 to 0.784)	0.0001
Maternal Weight (kg)	50	84.85	31.25	0.56(0.46 to 0.66)	0.327
Maternal Height (cm)	155	55.17	62.07	0.57(0.46 to 0.67)	0.300
Parity	Primi	54.05	60.29	0.58(0.48 to 0.68)	0.15
Sex of Child	Male	62.16	50.00	0.56 (0.46 to 0.66)	0.29
Number Of ANC Visit	3	16.22	92.65	0.52(0.42 to 0.62)	0.72
Type of Family	Nuclear	17.14	85.29	0.51(0.41 to 0.61)	0.86

The p-value calculated according Hanley and McNeil [6] indicates whether the area under the normalized ROC curve (AUC) is statistically different from 0.5 (no discrimination). If the p value is statistically not significant then there is no evidence that the parameter has the ability to influence the risk for LBW.

Logistic Regression Analysis

Additional to the Bivariate analysis the effect of birth order, maternal anthropometry, the years of education, preterm birth and LBW was investigated using a multivariate logistic regression model. The evaluation showed that statistically significant model (p = 0.002) could be obtained describing the influence of maternal characteristics on the probability of LBW.

$$p(BW<2500) = 1/1+e^{z}$$

where, Z = 49.28+1.49*Preterm-1.6*EST-0.35*AGEM-0.08EDUM
0.31*PARA+0.62*SEXC+0.31*HTM+0.53*WTM

This Gold Standard model is statistically significant (p=0.002).

Where EST is the dichotomized parity (0=Above poverty line, 1=Below poverty line), AGEM is the maternal age in years, EDUM is number of years of education, PARA is parity of mother, SEXC is sex of delivered child, HTM is the maternal height in cm and WTM is the maternal weight in kg. However, some parameters in this model were strongly correlated with each other (e.g., AGEM and EDUM) so that they did not give additional information and were therefore eliminated by the backward selection method.
The backward selection of this model showed that the only statistically significant predictors for risk of LBW were Economic status (BPL) and Pre term birth (<37 weeks) and the logistic regression model can be simplified to:

$p(BW<2500)= 1/1+e^{-z}$ with
Z= 1.16 + 1.39 Pre term – 1.70 EST

This model showed that the probability of LBW is mainly influenced by Weeks of Gestations and Economic status of Mothers and this result agrees well with the results of the previous Bivariate evaluation results shown in table no 4.

Table-4: Bivariate Analysis of Maternal Parameters and LBW

Parameters	LBW N=37	Normal Birth Wt N=68	Odd's Ratio (95% CI)	p value
Maternal Age up to 20 years	18	49	2.44 (0.98 to 6.14)	0.03
Years of Education (up to 7)	21	21	2.93 (1.28 to 6.73)	0.009
Economic Status	32	45	3.27 (1.12 to 9.51)	0.02
Pre Term Up to 37	21	11	6.80 (2.49 to 19.00)	0.0000

Table 5 describes the result of multivariate logistic analysis. Though significant in bivariate analysis, the significance of maternal age up to 20 years and education could not be established through Multivariate analysis. Only economic status and preterm were found statistically significant during multivariate analysis.

Table-5: Logistic Regression Analysis

Parameters	Odd's Ratio (95% CI)	Adjusted Odd's Ratio (95% CI)	p value
Maternal Age up to 20 years	2.44 (0.98 to 6.14)	1.14 (0.42 to 3.10)	0.79
Years of Education (up to 7)	2.93 (1.28 to 6.73)	0.81 (0.24 to 2.71)	0.73
Economic Status	3.27 (1.12 to 9.51)	3.27 (1.12 to 9.51)	0.02
Pre Term Up to 37	6.80 (2.49 to 19.00)	3.87 (1.45 to 10.30)	0.006

DISCUSSION

In the present study, out of 105 women, 30.2% delivered low birth weight babies i.e. less than 2500 gm. This was very high as compared with NFHS-3 data with 23% of LBW in rural India.[1] Deshmukh JS study (210 pregnant women) documented 30.3% of LBW,[6] Velankar DH[12] study with 282 pregnant women in Mumbai reported 45.2% LBW. Negi et al[7] reported incidence of LBW to be 23.8% whereas Trivedi et al[9] and Kamaladoss et al[8] reported 20.37% and 24.6% LBW respectively in their studies. Similarly Joshi et al also reported 34.4% LBW in their study with 256 newborns.

The mean birth weight in the present study was 2584.7 (± 457.7) gm, which was quite low when compared to the study conducted by Negi et al[7] and Ramankutty et al.[11]

The incidence of LBW was high among mothers of age 20 years or less. Similar observations were also reported by Negi KS et al..[7] Kamaladoss et al,[9] Anand et al,[10] and Velankar DH[12] in their respective study. However, when applying multivariate analysis maternal age was found insignificant for LBW.
The duration of maternal education was found insignificantly affect the risk for LBW. VelankerDH[12] showed the same result. Karim et al.[13] found that birth weight increases with higher maternal education.

In present study, Bivariate analysis showing the association of preterm delivery (>37 weeks) and LBW ($p<0.000$) and same also prove by Multivariate logistic analysis ($p<0.05$). Similar finding also reported by Negi KS et al[7] and Deshmukh J S et al.[6] In contrast to present study, Velankar DH[12] found insignificant association of pre term with the low birth weight.

Economic status was found significant in both Bivariate and multivariate analysis. It might be due to the study conducted in rural part of Gujarat and majority of study population was tribal and below poverty line. This finding was supported by number of studies done on LBW babies all over the India.

Bivariate analysis reported that low maternal age (up to 20years), economic status (BPL), low maternal education and pre term had significant influence on low birth weight.

The relationship between height and birth weight was found to be insignificant. This was also reported by Amin et al.[14] On the contrary, Kraemer[15] and Trivedi[8] reported a significant association between maternal height and low birth weight. The relationship between gestational weight and LBW was also insignificant in this study. Several studies[9-13] have also reported the similar association between gestational weight and LBW.

CONCLUSION

The Pre term and socio-economic variables have long been known to influence on reproductive performance, outcome and the condition of the infant at birth. In our study using both Bivariate analysis and confirming by multivariate logistic regression model, we could demonstrate that Gestational age and economic status have role in estimating the increased risk for LBW. However, we could not demonstrate that maternal anthropometric characteristics can predict the increased risk for preterm delivery as already shown by Voigt et al.[2] et al in Germany.

Maternal Age, Education, economic status etc have apparent association with LBW in bivariate analysis. They might be either confounders or insignificantly associated when tested using Logistic Regression analysis. Bivariate analysis may not showing correct picture. One cannot conclude the association between the two variables simply by using bivariate analysis in situation where many Biological variables are interacting with each other. But it's better to apply advanced statistical techniques and confirm the correct association and explore the confounders and interaction terms if possible.

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