Low Birth Weight at Term: Relationship with Maternal Anthropometry

Ojha N1, Malla D S1
1Maternity Hospital, Thapathali, Kathmandu, Nepal

ABSTRACT

The objective of this study was to determine the relationship of maternal anthropology with low birth weight at term. This study was conducted at the Maternity Hospital, Thapathali, from 6th December 2004 to 30th January 2005. It was a prospective, hospital based, comparative study, carried out in 308 women who had delivered singleton live babies at term. The study population was divided into two groups based on baby’s weight. During the study period, 154 women, who had delivered term low birth weight (LBW) babies (<2500gm), were taken as cases. For each case, a comparative case (matching in age and parity) who had delivered normal birth weight (NBW) baby (2500gm) was selected and served as control. Maternal anthropometric measurements were compared between the two groups. The variables studied were post-delivery maternal weight, height, body mass index (BMI) and mid upper arm circumference (MUAC). The incidence of low birth weight during the study period was 12.76% (329 of 2577 total births). The incidence of term low birth weight was 8.15% among the 2283 term births.

In mothers with low weight (<45.0kg), low birth weight babies were three times more common than in mothers with normal weight (OR 3.5 95% CI 1.82-6.77) and with low MUAC (<22.0cm), it was twice as common (OR 2.04 95% CI 1.14-3.63). In mothers with low height (<145.0cm), LBW babies were higher but could not reach significant level (OR 1.87 95% CI 0.98-3.75). Similarly, in mothers with low BMI (<18.5kg/m2), the difference was not significant (OR 1.9 95% CI 0.61-5.65). On multiple logistic regression analysis, only low maternal weight was powerful enough to remain significant (OR 2.84 95% CI 1.34-5.99). From these results, it can be concluded that low maternal anthropometric measurements have a definite role in causing LBW babies at term. Among the studied variables, maternal weight showed the strongest influence on low birth weight.

Key words: Maternal anthropology, Low birth weight, Normal birth weight.

CORRESPONDENCE:
Dr. Neebha Ojha
Maternity Hospital, Thapathali
Kathmandu, Nepal.
E-mail: ojhasp@yahoo.com

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INTRODUCTION
Birth weight is closely associated with the health and survival of the newborn. The relationship between maternal malnutrition and consequent low birth weight babies and the perinatal morbidity and mortality is now an accepted fact. Asia has the lowest mean birth weight babies in the world. Almost a third of the newborn in South East Asia Region is low birth weight.\(^1\)

WHO defines low birth weight as birth weight less than 2500 gm. The definition of low birth weight (LBW) does not take into account the gestational period. These groups of fetuses have failed to achieve their growth or are constitutionally small. It is interesting to know that in 1935, the American Academy of Pediatrics had defined babies weighing 2500 mg or less as preterm. WHO in 1961 added gestational age as criteria instead of birth weight.

In Nepal, the LBW prevalence is relatively high, ranging from 14 to 32 percent, as documented from various hospital and community-based studies.\(^2\)\(^3\)\(^4\) When LBW incidence is less than 10% (mean 6%) preterm infants represent the major component of LBW; however, if the rate is more than 10%, it is mostly due to intrauterine growth retardation (IUGR), while prematurity remains almost unchanged at 5 to 7 percent.\(^5\) In the study done by MIRA in 2000 in Nepal, at Maternity Hospital, the LBW rate was 27%. Among these, term LBW babies constitute 70% and preterm 30%.\(^3\)

Many risk factors contributing to LBW have been recognized, which include, in order of importance, low maternal weight, low body mass index, low maternal height, short birth interval, primiparity, adolescent mother, rural residence and others.\(^3\)

Child malnutrition is largely determined during the period of fetal and infant growth, when maternal nutrition has its strongest influence.\(^6\) Thus a LBW newborn comes to this world insufficiently equipped and has a higher risk of morbidity and mortality relative to the risk in an infant of normal birth weight. These babies are at an increased risk of developing perinatal asphyxia, hypoglycemia, polycythemia-hyperviscosity, hyperthermia, etc., and are more prone to impaired neurodevelopment, diabetes mellitus and hypertension in adult life.\(^7\)

Anthropometric measurement is one of the various methods used to assess the maternal nutritional status. The objective of the study was to determine the relationship of maternal anthropometry (maternal weight, height, BMI, MUAC) with LBW at term and to determine the parameters that predict the LBW.

MATERIALS AND METHODS
This study was a hospital based, comparative study conducted in Paropakar Shree Panch Indra Rajya Laxmi Devi Maternity Hospital, Thapathali, Kathmandu, Nepal. This study was conducted from 6\(^{th}\) December 2004 to 30\(^{th}\) January 2005. The study population was all the cases who had delivered term low birth weight babies (birth weight less than 2500g as per WHO criteria). For each case enrolled, a comparative case (matching in parity and age) who had delivered a term baby of normal birth weight (2500 g or more) was selected and which served as control. The cases were enrolled as per inclusion and exclusion criteria.

INCLUSION CRITERIA
- Mothers who had singleton live birth at term (37 completed weeks to 41 weeks).

EXCLUSION CRITERIA
- Women with medical disorders
- Diagnosed case of infection
- Mothers who had delivered babies with congenital abnormalities.

Informed verbal consent was taken before proceeding with the interview and examination. Information regarding mother’s identification, marital history, past and present obstetric history, personal history, mode of delivery and outcome of pregnancy was confirmed and recorded. Physical examination of the mother was carried out. Postpartum weight was taken as a proxy for prepregnancy weight. Maternal height and MUAC were also measured. Examination of the baby was done to exclude any congenital anomaly and to confirm maturity, applying the Ballard Score.

Permission to conduct the research in the Maternity Hospital, Thapathali, Kathmandu, was taken from the hospital authority before starting the project. All the patients included in the study were informed about the nature and purpose of the study. SPSS version 10 was used for calculations and tabulations.

RESULTS
During the 56 days of the study period, a total of 329 low birth weight babies were born among 2577 births, making the incidence of low birth weight 12.76%. Among the 329 LBW births, 134 (40.7%) were preterm, 186 (56.5%) were term and nine (2.7%) were post term. The incidence of term low birth weight was 8.14% among the 2283 term babies.
Table No I

Distribution of mothers according to gestational age

<table>
<thead>
<tr>
<th>Gestational age (weeks)</th>
<th>LBW(%)</th>
<th>NBW(%)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>31 (20.1)</td>
<td>17 (11.0)</td>
<td>p = 0.03</td>
</tr>
<tr>
<td>38</td>
<td>37 (24.0)</td>
<td>34 (22.1)</td>
<td>p = 0.685</td>
</tr>
<tr>
<td>39</td>
<td>43 (27.9)</td>
<td>44 (28.6)</td>
<td>p = 0.899</td>
</tr>
<tr>
<td>40</td>
<td>29 (18.8)</td>
<td>48 (31.2)</td>
<td>p = 0.012</td>
</tr>
<tr>
<td>41</td>
<td>14 (9.1)</td>
<td>11 (7.1)</td>
<td>p = 0.531</td>
</tr>
<tr>
<td>Total</td>
<td>154 (100)</td>
<td>154 (100)</td>
<td>p = 0.055</td>
</tr>
</tbody>
</table>

Table No II

Mean maternal anthropometric measurements in relation to LBW and NBW babies

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NBW (mean SD)</th>
<th>LBW (mean SD)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal weight (kg)</td>
<td>49.4 ± 6.6</td>
<td>53.7 ± 7.5</td>
<td>p = 0.000</td>
</tr>
<tr>
<td>Maternal height (cm)</td>
<td>149.5 ± 5.5</td>
<td>151.3 ± 5.9</td>
<td>p = 0.005</td>
</tr>
<tr>
<td>Maternal BMI (kg/m²)</td>
<td>22.2 ± 2.9</td>
<td>23.4 ± 2.9</td>
<td>p = 0.001</td>
</tr>
<tr>
<td>Maternal MUAC (cm)</td>
<td>23.0 ± 2.1</td>
<td>23.9 ± 2.3</td>
<td>p = 0.001</td>
</tr>
</tbody>
</table>

Table No III

Univariate analysis: Odds Ratio for exposures with respect to LBW as the outcome variable

<table>
<thead>
<tr>
<th>Exposure</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low maternal weight (&lt; 45.0 kg)</td>
<td>3.5</td>
<td>1.82 - 6.77</td>
<td>0.0002</td>
</tr>
<tr>
<td>Low maternal height (&lt; 145 cm)</td>
<td>1.87</td>
<td>0.98-3.75</td>
<td>0.058</td>
</tr>
<tr>
<td>Low maternal BMI (&lt; 18.5 kg/m²)</td>
<td>1.9</td>
<td>0.61-5.65</td>
<td>0.28</td>
</tr>
<tr>
<td>Low maternal MUAC (&lt; 22.0 cm)</td>
<td>2.04</td>
<td>1.14-3.63</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Table No IV

Multiple logistic regression results for the effects of combined exposure to maternal anthropometry

<table>
<thead>
<tr>
<th>Exposure</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal weight (&lt; 45.0 kg)</td>
<td>2.84</td>
<td>1.34 - 5.99</td>
<td>0.006</td>
</tr>
<tr>
<td>Maternal height (&lt; 145.0 kg)</td>
<td>1.32</td>
<td>0.66 - 2.66</td>
<td>0.433</td>
</tr>
<tr>
<td>Maternal BMI (&lt; 18.5 kg/m²)</td>
<td>1.31</td>
<td>0.68 - 2.51</td>
<td>0.419</td>
</tr>
<tr>
<td>Maternal MUAC (&lt; 22.0 cm)</td>
<td>1.17</td>
<td>0.36 - 3.85</td>
<td>0.793</td>
</tr>
</tbody>
</table>
Among 186 term low birth weight babies, 154 mother-baby pairs that fulfilled the criteria were enrolled into the study. Another 154 mother-baby pairs with normal birth weight baby were taken as the comparative group matching in parity and age.

Among LBW babies 94.4% were in weight category 2000-2499 gm and among NBW babies 50% were in 2500-2999 gm. Out of the total 154 cases in each group, 16.9% were <20 yrs age group, 74% were primipara and the mean parity was 1.4 ± 0.8.

Table I shows the patients according to their gestational age. At 37 weeks, 20.1% were in LBW and 11% in NBW (p = 0.003), which is statistically significant. At the other end, at 40 weeks, 18.8% were in LBW and 31.2% in NBW (p = 0.012), which is also statistically significant. As the gestational age increases there is more chance of having normal birth weight babies.

The mean maternal weight, height, BMI and MUAC were significantly less in mothers with LBW than in NBW babies (p = <0.05) (Table II).

In Table III, the exposures are presented in magnitude as odds ratio. The findings suggest that women with low maternal weight are three times more likely to have LBW babies (OR 3.5). Similarly, mothers with low MUAC are twice as likely to give birth to LBW babies (OR 2.04). Mothers with low height and BMI have higher risk of delivering LBW babies (OR 1.87 and 1.9 respectively) but these variables could not reach statistical significance.

In Table IV, multiple logistic regression analysis describes the net effect of combined exposure to all studied variables after controlling for the effect of other variables. In this model, only maternal weight retained significant risk for LBW babies (OR 2.84) (p = 0.006), while the other variable MUAC, which was significant in univariate analysis, lost its significance (p = 0.793).

**DISCUSSION**

Low birth weight remains a recognized indicator of well being of neonates and women of reproductive age and it has been shown to be a leading determinant of the chances of survival of the newborn infant. This study was carried out to find out the relationship of maternal anthropometry with low birth weight at term.

The mean weight, height, BMI in this study was less in mothers with LBW than with NBW babies, which was statistically significant (p < .05). A similar result was seen in the case-control study done by Arif et al., 8 (54.8 ± 9.5 kg vs 62.5 ± 10.8 kg, 152.4 ± 5.1 cm vs 154.5 ± 4.8 cm, 23.5 ± 3.7 kg/m² vs 26.2 ± 4.3 kg/m²) (p <0.01).

This study has used the cut-off point for low maternal weight at <45.0 kg. At this cut-off, the undernourished women were three times more likely to have a LBW infant as compared to those who had weight 45.0 kg (OR 3.51 95%CI 1.74-7.15). With the similar cut off point (<45.0 kg) in a study done by MIRA (2000), they were twice as likely to have LBW (RR 2.2 95% CI 1.91-2.57). A study conducted by Zhang et al., 9 in China, noted that maternal malnutrition contributed to LBW with OR = 3.42. Ehrenberg et al., 10 showed that subjects with pregravid maternal weight of <100 pounds were at an increased risk of having LBW babies (RR 1.8 95% CI 1.1-2.9). All these studies showed that undernourished mothers posed a significant risk factor for having LBW babies.

In the present study, among the mothers with low height (<145 cm), the odds ratio for low birth weight in comparison to NBW babies was 1.87 (95% CI 0.98-3.75) (p = 0.058), which is statistically not significant. Study done by Fikree et al., 11 showed short stature (<145 cm) was associated with term IUGR (OR 2.7 95% CI 1.1-6.1). However, in a study by Mohamed et al., 12 low maternal height (150 cm) had no association with LBW (OR 0.6 95% CI 0.1-2.5). Similarly, in a study by Wessel et al., 13 low maternal height (154 cm) was associated with LBW but could not reach significance (RR 2.2 95% CI 0.7-6.9). These could be due to higher cut-off point taken for maternal height.

In mothers with low BMI (<18.5kg/m²), the odds ratio for LBW was 1.9 95% CI 0.61-5.65 which is statistically not significant (p = 0.280). Ehrenberg et al. 10 found the association with LBW at a higher cut-off point of pregravid BMI <19.8kg/m² (RR 1.13 95% CI 1.0-1.27). Abenhaim et al. 14 concluded that mothers with prepregnancy BMI of <20 kg/m² were more likely to have IUGR infants (OR 1.54 95%CI 1.37-1.73).

In the present study, the odds ratio for LBW with low MUAC (<22 cm) is 2.04 95% CI 1.14-3.63 which is statistically significant. Husaini et al. 15 found OR 1.73 for IUGR at low MUAC of <22.5 cm. Neumann et al. 16 found that at a cut-off point of MUAC of 23.7 cm and 25.5 cm, the OR for LBW ranged from 3.5 to 12.6 during the second and third trimester of pregnancy. Karim et al. 17 from Bangladesh found the best cut off for detecting LBW at MUAC of 23 cm (OR = 5.0).
Multiple logistic regression analysis showed that the only factor significantly associated with risk for LBW was low maternal weight. This effect was strong enough to act as a confounding factor for other nutritional variables like MUAC (attained significance in univariate analysis) and to eliminate its significance in combined exposure. This result is similar to the study by MIRA (2000) in which among the nutritional risk factors, low maternal weight retained its powerful effect on LBW prevalence while other nutritional factors such as height and anemia lost their significance.3

**CONCLUSION**

Low birth weight is a common problem of the developing world, which is an important factor for perinatal morbidity and mortality. Low birth weight babies are more likely to have mother with low anthropometry, especially low maternal weight and mid upper arm circumference. Among various factors, low maternal anthropometric measurements pose a significant effect in producing low birth weight babies.

**REFERENCES**


