Asian Journal of Medicine and Health

Volume 21, Issue 4, Page 32-41, 2023; Article no.AJMAH.97313
ISSN: 2456-8414

Low Birth Weight and Associated Factors among Newborn Babies - A Comparative Cross-Sectional Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2023/v21i4806

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/97313

Original Research Article

Received: 01/01/2023
Accepted: 04/03/2023
Published: 06/03/2023

ABSTRACT

Objectives: Mortality and morbidity rate of low-birth-weight babies are major public health concerns worldwide. The main objective of this study was to determine the associated factors that are related to low birth weight.

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Methods: A comparative cross-sectional study was carried out from January 2021 to December 2021 among 208 mothers who delivered babies in two tertiary level hospitals in Dhaka city. Data were collected by using a pretested semi-structured interview-guided questionnaire and analyzed by SPSS 23 version software.

Results: Significant associations were found between the low birth weight and some factors: babies delivered in rural areas (p=0.021), less educated mothers (p=0.018), and mothers having a low monthly income (p=0.007). Moreover, birth weight of the neonates was significantly associated with the number of antenatal visits (p=0.016) and intake of nutritional supplements by the mothers in last pregnancy (p=0.000). The mothers who took nutritional supplements in their last pregnancy had a lower proportion to deliver LBW (40%) that were significantly associated with nutritional status and birth weight (p=0.000). The mothers having low BMI had a higher rate of delivering LBW neonates (75%). A significant positive correlation was found between BMI of the mother and birth weight of the index child (r=0.243, p<0.001).

Conclusion: These study findings will guide us in paying special attention to the associated risk factors of low birth weight that will assist to formulate an intervention to prevent LBW by improving antenatal care and overall maternal health.

Keywords: Low birth weight; neonates; antenatal care.

1. INTRODUCTION

"The birth weight of a newborn is the most important predictor of its chances of survival, healthy growth and development [1]. Low birth weight is a preventable public health problem" [2].

"Low birth weight (LBW) has been defined by the World Health Organization (WHO) as birth weight of less than 2500 grams irrespective of the gestational age" [3,4]. "Weight of the newborn should be taken preferably within first hour of life before significant weight loss has occurred" [5]. "The average birth weight of a newborn in developing countries is lower than in the Western world" [6].

More than 20 million infants worldwide, representing 15.5 % of all birth, are born with low birth weight (LBW), and 95.6% of them are in developing countries [7]."Half of all low birth-weight babies are born in South-central Asia, where more than a quarter, 30% in Bangladesh and in India, 21% in Nepal and 19% in Pakistan" [8]. "LBW is linked to fetal and perinatal mortality and morbidity, stunted growth and cognitive development, and later-life chronic diseases. At the population level, the proportion of babies with an LBW is an indicator of a multifaceted public health problem that includes long-term maternal malnutrition, ill health, hard work, and poor health care during pregnancy" [7]. "Low birth weight is influenced by many socioeconomic factors like habitat, living areas, age, education, birth order, substance abuse by mother, religion and caste, nutritional status, body mass index, quality of antenatal care (ANC) received and spacing of pregnancies. LBW babies pose challenges to the families as well as to the pediatric population considering their mental, and physical developmental disputes" [8].

Maternal health is a very influential criteria for heathy infant [4]. "Intervention during pregnancy aimed to limit weight gain throughout gestation, are more likely to deliver low-birth weight baby than women who gain the right amount of weight" [9]. "As maternal nutrition and weight gain are linked with birth weight, eating a healthy diet and gaining the proper amount of weight in pregnancy is essential" [10]. "Children born with LBW have a higher incidence of diseases, retardation in cognitive development and undernourishment. There is also evidence that LBW or its determinant factors are associated with a predisposition to higher rates of diabetes, cardiac diseases and other future chronic health problem" [8]. "Mortality rates of very low birth weight babies have been shown to be very high in several studies. Findings of a community-based longitudinal study conducted in rural villages during 1993-1994 in Bangladesh revealed that 73% of the 34 infants who died before 12 months of age were LBW babies" [11]. "Antenatal care (ANC) is recognized as an essential element for the screening, primary or secondary prevention and treatment of pregnancy complications. The WHO technical working group committee has recommended four antenatal visits for a woman with normal pregnancy. They have also set the standard of quality ANC" [12]. "Reduction of LBW incidence was one of the major goals of the 'World Fit for

Children' plan adopted by the United Nations General Assembly in 2002. LBW remains a formidable public health challenge for the 21st century" [13]. It is a prerequisite for the successful implementation of population control program and a major determinant in the achievement of Millennium Development Goals (MDG). Bangladesh has made praiseworthy progress in achieving Millennium Development Goals 4. "Since 1990, there has been a remarkable reduction in the child mortality with an estimated 57% reduction in child mortality" [14]. But further enhancement activities need to improve newborn health that might reduce LBW.

This study aimed to find out the associated factors related with the socio-demographic & antenatal care of mothers to deliver LBW neonates that might help to formulate an appropriate guideline to prevent LBW in future.

2. METHODOLOGY

This comparative cross-sectional study was carried out at Sir Salimullah Medical College Hospital (SSMCH) and Dhaka National Medical College & Hospital (DNMCH) in obstetrics and gynecological department during the period of January 2021 to December 2021.

To determine the sample size, following formula was considered for study design: [15]

$$\eta_0 = (Z_\alpha + Z_\beta)2 \quad X \quad \frac{(p_1 q_1 + p_2 q_2)}{(p2\text{-}p1)2}$$

Where,

Zα = 1.96 (at 5% Level of Significance)
Z_β = 0.84 (for 80% power of detecting difference)
p_1 =Proportion of mothers with LBW having antenatal care in the last trimester of pregnancy.
= 85.2% [11] = 0.85
p_2 = Proportion of mothers with NBW having no antenatal care in last trimester of pregnancy.
= 68.3% [11] =0.683
$q_1 = 1\text{-}p_1$=0.148
$q_2 = 1\text{-}p_2$=0.

So, the desired sample size calculated is,

$$\eta = (Z_a + Z_b)^2 \quad X \quad \frac{(p_1 q_1 + p_2 q_2)}{(p2\text{-}p1)^2}$$

$$= (1.96+0.84)^2 \; X \; \frac{(0.126+0.216)}{(0.683 - 0.85)^2}$$

=7.84 X 17.1
= 134.06
= 134 (in each group)

So, for the study purpose 134 mothers with their LBW neonates were considered to compare with 134 mothers with their normal birth weight neonates. But due to unavailability of the mothers during data collection period, finally 105 mothers were studied as control and 103 mothers as compare group. Data were collected by face-to-face interview using pretested semi-structured questionnaire. Nonprobability purposive sampling was done according to the availability of the mothers. Mothers who gave full term live birth in hospitals were selected and mothers who delivered stillborn babies, multiple babies, and premature babies were excluded from the study. A checklist was used to get necessary information about the mother's anthropometry and related facts. Informed written consent was taken after explaining the purpose and procedure of the study. Ethical committee clearance was obtained from two institutions. After completion of data collection, it was verified, edited, processed and finalized.

Then data were analyzed accordingly in the respect of specific objectives of the study by using the SPSS 23 version. Cross-tabulation was prepared, and a comparison had been made between different variables of low birth weight. Descriptive statistics included frequency, percentage, mean and standard deviation were used as per need. For inferential statistics, Chi-Square test, fishers exact test, and correlation test were done.

3. RESULTS

This comparative cross-sectional study was conducted in two tertiary level hospitals in Dhaka city among 208 delivered neonates to determine the factors related to low birth weight. Data were presented through tables and graphs.

Table 1 shows the association between normal & low birth weight considering some demographical variables of the mother. The majority (59.7%) of the mothers were age of 16-20 years who delivered LBW neonates followed by 44.5% who were in age of 21-30 years whereas 55.5% were in age of 21-30 years who delivered normal birth weight (NBW) neonates. It was not found to be significant (p=0.134). Again, about 67% of LBW neonates were delivered by illiterate mothers followed by Class I-V (54.3%) whereas 77.3%

and 71.4 % of NBW neonates were delivered by mothers in class XI-XII and graduate groups respectively. Birth weight of neonates was found to be significantly associated with an educational status of mothers (p=0.018). Considering the distribution between the birth weight of the neonates and monthly family income of mothers it is found that a higher income level is related to a lower proportion of LBW neonates. The majority (62.9%) LBW neonates were delivered by mothers who had a less monthly family, income taka (1001-10000) whereas the majority (75%) NBW neonates were found in higher monthly income family, taka (30001-40000). Birth weight was found to be significantly associated with the monthly family income of the mothers (p=0.007). Moreover, the mothers living in the rural areas gave birth (63.2%) LBW and (36.8%) NBW neonates. Among the mothers from semi urban area, 45.2% neonates were LBW, and 54.8% neonates were NBW and the mothers living in urban area, delivered 42.6% LBW and 57.4% NBW neonates. Overall, LBW neonates were found to be born more in rural areas compared to the neonates born in an urban area and the association was significant (p=0.021).

In Table 2, the proportion of LBW neonates was found to be more among the mothers who delivered a single neonate that was 51.1% but LBW and NBW neonates were equal which was 50% among the mothers who delivered more than one neonate. No significant association was found between LBW neonates and parity of the mothers (p=0.876). Among those who received nutrient supplements during pregnancy delivered 60% were NBW neonates and 40% were LBW neonates. On the other hand, among those who did not receive nutrient supplements 25 (32.1%) had NBW neonates and 67.9% had low birth weight babies. A highly significant association was seen between birth weight and nutrient supplementation during pregnancy (p<0.05).

Table 1. Association between normal & low birth weight considering demographical variables of the mother

Demographical variables of the mother	**Neonatal weight**			**Significance**
Age (Years)	**LBW F (%)**	**NBW F (%)**	**Total F (%)**	
16-20	43 (59.7)	29 (40.3)	72 (100)	χ^2=4.012
21-30	49 (44.5)	61 (55.5)	110(100)	df=2
31-40	13 (50.0)	13 (50.0)	26(100)	p=0.134
Total	**105 (50.5)**	**103 (49.5)**	**208(100)**	(pns)
Education				
Illiterate	28 (66.7)	14 (33.3)	42 (100)	
Class I-V	25 (54.3)	21 (45.7)	46 (100)	Fisher's Exact
Class VI-X	43 (49.4)	44 (50.6)	87 (100)	Test
Class XI-XII	5 (22.7)	17 (77.3)	22 (100)	value=12.941
Graduate	2 (28.6)	5 (71.4)	7 (100)	p=0.018
Postgraduate	2 (50.0)	2 (50.0)	4 (100)	
Total	**105 (50.5)**	**103 (49.5)**	**208 (100)**	
Monthly family income (Taka)				
1000-10000	66 (62.9)	39 (37.1)	105 (100)	
10001-20000	29 (41.4)	41 (58.6)	70 (100)	χ^2=14.255
20001-30000	6 (33.3)	12 (66.7)	18 (100)	df=4
30001-40000	1 (25.0)	3 (75.0)	4 (100)	p=0.007
40001-100000	3 (27.3)	8 (72.7)	11 (100)	
Total	**105 (50.5)**	**103 (49.5)**	**208 (100)**	
Area of residence				
Rural	48 (63.2)	28 (36.8)	76 (100)	
Semi-urban	14 (45.2)	17 (54.8)	31 (100)	χ^2=7.763
Urban	43 (42.6)	58 (57.4)	101 (100)	df=2
Total	**105 (50.5)**	**103 (49.5)**	**208 (100)**	p=0.021

Table 2. Association between normal & low birth weight considering antenatal variables of the mother

Antenatal variables of the mother	Neonatal weight			Significance
Number of parities	**LBW F (%)**	**NBW F (%)**	**Total F (%)**	
Single neonate	47 (51.1)	45 (48.9)	92 (100)	χ^2=0.024
More than one neonate	58 (50.0)	58 (50.0)	116 (100)	df=1
Total	**105 (50.5)**	**103 (49.5)**	**208 (100)**	p=0.876 (pns)
Birth space between last and index neonates (Years)				
<1	2 (66.7)	1 (33.3)	3 (100)	Fisher's Exact
1-2	8 (57.1)	6 (42.9)	14 (100)	Test
>2	20 (46.5)	23 (53.5)	43 (100)	value=0.922
Total	**30 (50)**	**30 (50.0)**	**60 (100)**	p=0.657 (pns)
Birth order of the neonates				
1st child	53 (52.0)	49 (48.0)	102 (100)	Fisher's Exact
2nd child	37 (50.0)	37 (50)	74 (100)	Test
3rd child	15 (46.9)	17 (53.1)	32 (100)	value=0.706
Total	**105 (50.5)**	**103 (49.5)**	**208 (100)**	p=0.824 (pns)
Nutrient supplement in last pregnancy				
Did not receive	53 (67.9)	25 (32.1)	78 (100)	χ^2=15.233
Received	52 (40.0)	78 (60.0)	130 (100)	df=1
Total	**105 (50.5)**	**103 (49.5)**	**208 (100.0)**	p=0.000

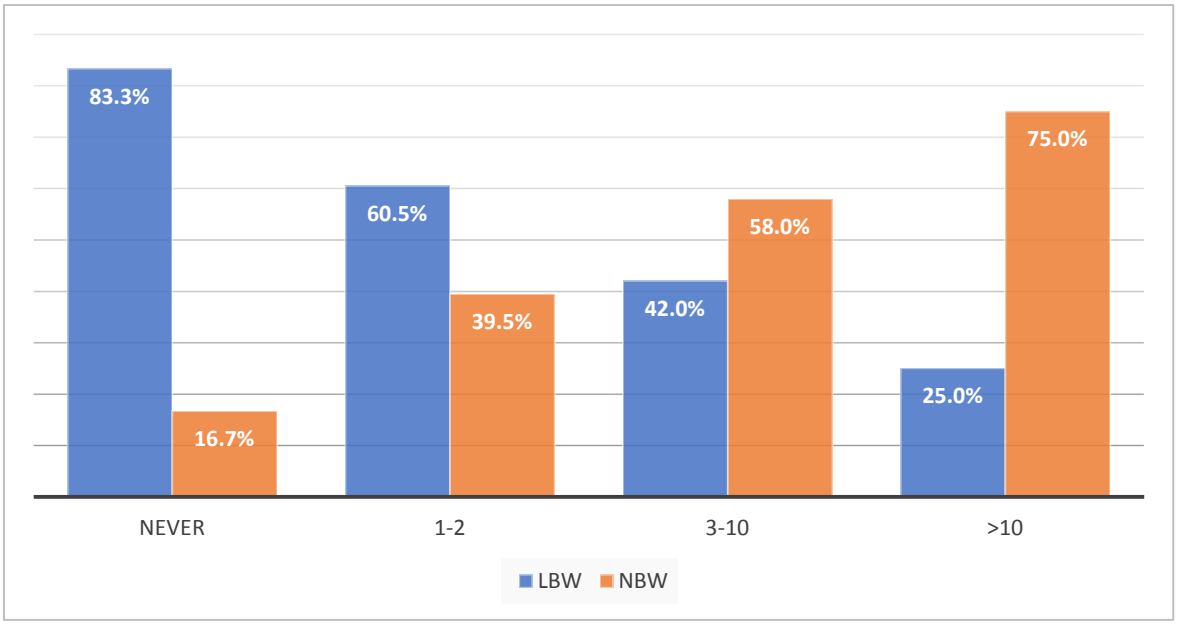

Fig. 1. Number of antenatal visit (times)

The birth weight of the neonates was found to be significantly associated with a number of antenatal visits (p=0.016). Greater the number of antenatal visits (>10 times) lower the proportion of LBW neonates (25%) whereas the proportion of LBW was higher (83.3%) among the mothers who did not never receive antenatal visits during the last pregnancy followed by 60.5% who received 1-2 times antenatal visit (Fig. 1). In Fig. 2, BMI of mothers among LBW neonates revealed that 75% were underweight (BMI <18.5) followed by 70% were normal weight (BMI 18.5-24.99) whereas the BMI of mothers among NBW neonates revealed that 66% were obese (BMI ≥30.00) followed by 58.8% were overweight (BMI 25.0-29.00). A highly significant association was seen between BMI of the mothers and birth weight (p=0.000).

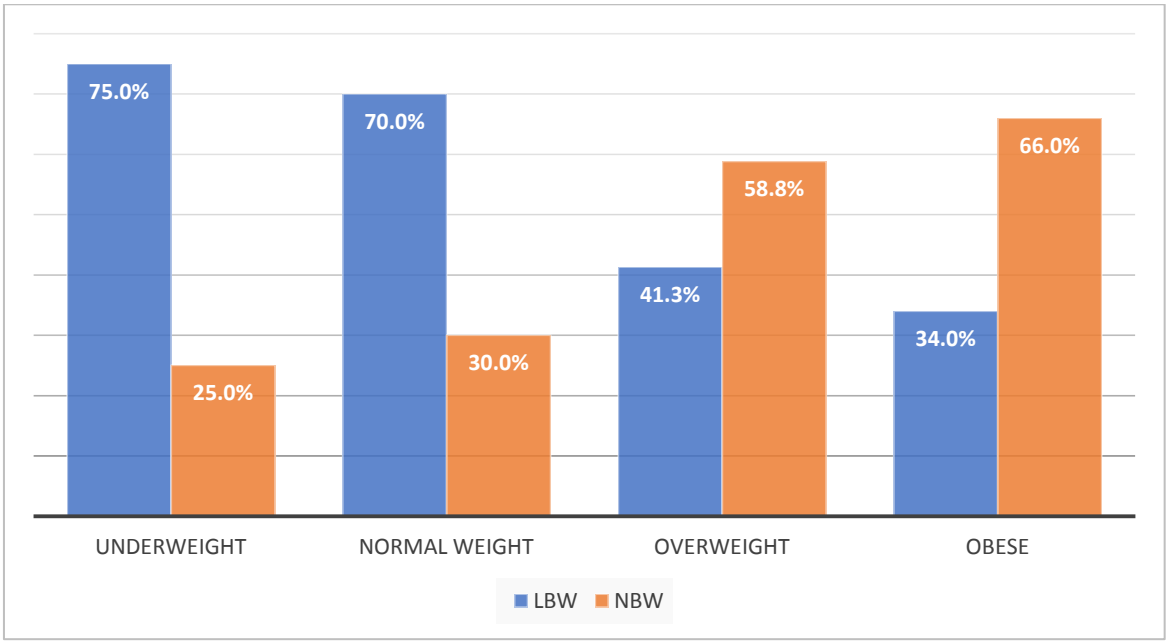

Fig. 2. BMI in last pregnancy

Table 3. Correlation between BMI of the mothers and birth weight of the neonates

		BMI	Birth weight of the neonates(gm)
BMI	Pearson Correlation	1	.243**
	Sig. (2-tailed)		0.000
	N	208	208
Birth weight of the index child (gm)	Pearson Correlation	.243**	1
	Sig. (2-tailed)	0.000	
	N	208	208

Correlation of the body mass index (BMI) of the mothers and birth weight of the neonates was done. Significant positive correlation was seen between the two variables (r=0.243, =0.000).

4. DISCUSSION

This comparative cross-sectional study was conducted to find and compare attributes related to LBW neonates among the mothers who recently delivered their children in the department of Obstetrics and Gynaecology at Sir Salimullah Medical College and Hospital and Dhaka National Medical College Hospital during the period of January 2021 to December 2021. Of these 208 mothers gave birth to 105 neonates with LBW and 103 had normal birth weight (NBW). The proportions are almost equal due to the fact that almost equal mothers were chosen for comparison. Of the mothers from rural areas, 63.2% had LBW neonates and 36.8% had NBW neonates whereas 57.4% of NBW neonates were found among the mothers who lived in urban areas. Overall, LBW neonates were found to be born more to mothers of rural areas than mothers of urban areas and this association was significant(p=0.021). A study conducted by Tema [16] showed that the place of residence of the mothers was associated with LBW. Mothers residing in rural areas were more likely to have LBW neonates when compared to those mothers who live in urban. This might be due to the accessibility of medical services, health information, and nutritional awareness which are more prominent in mothers residing in urban areas than in rural areas.

A majority (59.7%) of the mothers were in age 16-20 years who delivered LBW neonates followed by 44.5% were in age 21-30 years whereas the maximum (55.5%) were in age 21-30 years who delivered NBW neonates. It was not found to be significant (p=0.134). The proportion of LBW neonates was high among mothers of age less than 20 years, in this study maternal age was not found to be associated

with birth weight. Possible reasons behind this finding might be due to the fact that more numbers of mothers were below 20 years of age in the study. A case-control study was conducted among 4728 children in Bangladesh and found that low birth weight was associated with maternal age of <20 years at birth also (adjusted OR vs. 20-29 years: 1.40, 95% CI 1.09-1.78) [17]. This result differs from the present study and it might be due to the larger sample size and stronger study design of the latter study.

Maternal educational status has a great influence on birth weight of neonates. Bangladesh has according to UNESCO, an adult literacy rate of 72.89% [18]. Among illiterate mothers, about 67% had LBW neonates and 33.3% had NBW neonates whereas 77.3% of NBW neonates were delivered by mothers in class XI-XII group followed by graduates (71.4%) respectively. The reasons may be due to the fact that higher educated families are more health conscious and they can afford the hospital and other expenses than the poor classes. Education of the mothers was found to be significantly associated with birth weight of their neonates (p=0.018). Khatun et al., in their study on socio-economic determinants of low birth weight, found that mother's education was associated with birth weight of the baby (p<0.02) [11]. Gage et al., in their study, found mean birth weight increases significantly (by 27–108 g) with higher maternal education [19].

The majority (62.9%) LBW neonates were found whose mothers' monthly family income was taka (1001-10000) whereas the majority (75%) NBW neonates were found whose mothers' monthly family income was taka (30001-40000). Birth weight was found to be significantly associated with the monthly family income of the mothers (p=0.007). In a similar study, it was also seen that mothers from wealthier families were less likely to give birth to an LBW infant [20]. Mothers belonging to higher socioeconomic classes had fewer chances of having LBW.

Parity was one of a number of factors that significantly wedged neonates' birth weight. The proportion of LBW neonates was found to be more among the mothers who delivered their first child which was 51.1% but LBW and NBW neonates were equal which was 50% among the mothers who delivered more than one child. In this study, no significant association was found between Birth weight and parity of the mothers. A possible explanation behind the findings was a lack of antenatal care knowledge and first pregnancy occurs at a teenage. While Amin et al. in their study showed the percentage of low birth weight babies decreased with an increase in parity up to 3 and again it was more for 4th parity (25%). A significant association was found between parity and birth weight of baby (p<0.05) [21].

The birth weight of the newborn was found to be significantly associated with number of antenatal visits (p=0.016). Greater was the number of antenatal visit (>10 times) lower the proportion of LBW neonates (25%) whereas the proportion of LBW was higher (83.3%) among the mothers who did not never receive antenatal visit during the last pregnancy. Regular antenatal follow-up by pregnant mothers might help for early detection and appropriate management of such disorders during pregnancy. In a study, it is found that ANC and delivery assistance by quality health workers were significantly associated with LBW [20]. Florey and Tylor conducted a cohort study of 846 primiparas living in the City of Dundee, Scotland, whose first antenatal visit was between 1 May 1985 and 30 April 1986. The result showed that the earlier in pregnancy the first antenatal visit, the greater the infants' birth weights tended to be (p < 0.01) [22].

The proportion of LBW neonates was found to be higher among the mothers whose birth spacing was less than one year (66.7%) and 1-2 years (57.1%) whereas the mothers whose birth space was more than two years delivered a higher proportion of NBW neonates (53.5%) and the association was found to be not significant (p=0.657). The reasons behind the study due to interval of pregnancy were less than one year, the mothers were not physically fit. Digole et al. in their study showed the percentage decreased to 19.83% and 15.38% when pregnancy interval was increased to 2 and 3 or more. A significant association was found between pregnancy interval and birth weight of baby (p<0.05) [23].

Birth weight was found to be not significantly associated with birth order of neonates (p=0.824). Out of 208 neonates, the proportion of LBW neonates was higher (52%) among the mothers whose first birth order of the neonates was followed by a third child (46.9%). On the other hand, the proportion of LBW (50%) and NBW (50%) were found equal among the mothers who delivered chronologically second child. The findings behind the study are due to a lack of health education, and teenaged

pregnancy which occurred in first pregnancy. A significant association was found between pregnancy interval and birth weight of baby ($p<0.05$) [18]. In another study M.W. Khan found that mothers with an inter-pregnancy interval of less than one year were more likely to deliver LBW baby [24].

In this study, a highly significant association was found between intaking of nutrient supplementation during pregnancy with birth weight babies ($p=0.000$). Mothers who did not receive nutrient supplementation during pregnancy, proportion of LBW neonates was high (67.9%). Similar results were found in different other studies. Khan found that mothers who used multivitamins and folic acid during pregnancy had fewer chances of having LBW [24]. Jahan found that iron and vitamin supplementation during pregnancy were significantly less among the mothers of LBW neonates 69.6% (23 out of 33) and it was more in mothers of NBW neonates 82.4% (80 out of 97) [25]. The explanation behind the study is that improved maternal nutrition by mediation effects on neonates.

The BMI of mothers among LBW neonates revealed that 75% were underweight (BMI <18.5) followed by70% were normal weight (BMI 18.5-24.99) whereas the BMI of mothers among NBW neonates revealed that 66% were obese (BMI ≥30.00) followed by 58.8% were overweight (BMI 25.0-29.00). A highly significant association was seen between BMI of the mothers and birth weight($p=0.000$). Abir et al., found in their study in Bangladesh, that maternal BMI increased, and the birth weight also increased ($p<0.05$) which was similar to this study's findings [26].
A correlation between the body mass index (BMI) of the mothers and birth weight of the neonates was done. A significant positive correlation was seen between the two variables ($r=0.243$, $p<0.001$).

5. CONCLUSION

Low birth weight is now a global concern and the greatest serious problem in the world, especially in developing and developed countries. The state is really alarming, especially in Bangladesh. This hospital-based comparative cross-sectional study was conducted to determine the factors related to LBW among neonates. This study identified that the majority of the LBW neonates were born to mothers in rural areas. The percentage of female neonates were born with LBW more than males. The majority of LBW was born at the mother's teenage age. Illiterate mothers gave birth to the majority number of LBW neonates and educational status of the mothers was significantly associated with birth weight. Service holders were more common to have LBW neonates than housewife mothers. Mothers from nuclear families have more LBW neonates than mothers from joint families. Mode of delivery was significantly associated with birth weight. Lack of antenatal check-ups and food supplementation during pregnancy is also significantly associated with LBW. The findings of the present study will help as guidelines to initiate programs to improve maternal and child health. As it is a hospital-based study and the number of cases in our study is small but it revealed comparable factors of LBW and NBW. Further nationwide studies with a large sample and appropriate design regarding this issue need to be done to evaluate the different factors associated with LBW neonates.

6. RECOMMENDATIONS

1. Identify and reduce factors associated with low birth weight emphasizing the importance of risk reduction in the period between pregnancies and making health professionals more aware of the possibilities in the periods before and between pregnancies for improving the outcome of pregnancy by providing appropriate services, and health education.
2. Implement an awareness program by the stakeholders to encourage pregnant mothers to have adequate antenatal visits to reduce LBW.
3. Improve the maternal nutritional status with low BMI, which in turn will decrease overall infant mortality and morbidity.
4. Measure progress towards the reduction of LBW by repeated LBW surveys in our country.

7. LIMITATIONS OF THE STUDY

1. The study was conducted in tertiary hospitals in Dhaka city. Therefore, it might not reflect the real scenario of the whole country.
2. It was a comparative cross-sectional study, which itself is a weak analytic to describe association. Moreover, purposive sampling was not in favor of avoiding selection bias.
3. Maternal factors responsible for low birth weight might be affected by many other factors which could not be excluded.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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