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Association of Neonatal Birth Weight with Placental Weight and Umbilical Cord Length in a Tertiary Care Hospital: A Cross-Sectional Study

Dr. Salma Akter Munmun[1], Dr. Rowson Ara[2], Dr. Sabiha Islam[3], Dr. Reefaat Rahman[4], Dr. Farah Noor[5], Dr. Anjumun Ara[6], Dr Fatima Wahid[7], Dr. A.M. Shahinoor[8]

[1]Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[2]Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[3]Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[4]Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[5]Assistant Professor, Department of Obstetrics and Gynecology Bangladesh Medical University, Dhaka, Bangladesh
[6]Assistant Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[7]Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh
[8]Associate Professor, Department of Pediatric Surgery, Bangladesh Medical University, Dhaka, Bangladesh

Abstract: ***Background****: Placental weight and umbilical cord length are considered important anatomical determinants of intrauterine growth and fetal well-being. Their relationship with neonatal birth weight offers critical insights into perinatal outcomes, yet such data remain limited in the South Asian context*

Aim of the study: *To evaluate the association of neonatal birth weight with placental weight and umbilical cord length in a tertiary care hospital.*

Methods: *This cross-sectional observational study included 150 mother–newborn dyads delivered between 37 and 42 weeks of gestation at a tertiary care hospital in Bangladesh. Neonates with intrauterine growth restriction (IUGR), congenital anomalies, or maternal complications affecting fetal growth were excluded. Placental weight, umbilical cord length, and neonatal birth weight were measured immediately after delivery. Statistical analysis included descriptive statistics, Pearson's correlation, and multiple linear regression to assess associations. A p-value <0.05 was considered statistically significant*

Result: *The mean neonatal birth weight was 2978±454 grams, mean placental weight was 618.31±158.02 grams, and mean umbilical cord length was 40.28±8.94 cm. A significant positive correlation was found between placental weight and neonatal birth weight ($p < 0.001$), with higher placental weights associated with normal birth weight. However, the association between umbilical cord length and birth weight was not statistically significant ($p = 0.192$). Multiple regression analysis identified placental weight as a significant independent predictor of neonatal birth weight after adjusting for maternal and gestational variables.*

Conclusion: *Placental weight demonstrates a strong positive association with neonatal birth weight and may serve as a reliable anatomical marker for fetal growth assessment. While umbilical cord length showed a trend toward association, it did not reach statistical significance. These findings underscore the importance of evaluating placental characteristics for early identification of at-risk pregnancies and optimizing perinatal outcomes.*

Keywords: *Neonatal birth weight, Placental weight, Umbilical cord length, Intrauterine growth, Perinatal outcomes, Cross-sectional study*

Original Research Article

Correspondence:
Dr. Salma Akter Munmun*, Associate Professor, Department of Obstetrics and Gynecology, Bangladesh Medical University, Dhaka, Bangladesh,*

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INTRODUCTION

The investigation of neonatal birth outcomes has long been a focal point of perinatal research, with particular emphasis on parameters such as placental weight, umbilical cord length, and neonatal birth weight. These variables are widely regarded as essential indicators of intrauterine growth, fetal well-being, and perinatal outcomes [1]. Among them, the placenta often referred to as the "fetoplacental interface" is recognized for its critical role in mediating maternal-fetal exchange and supporting fetal development throughout gestation [2]. Its morphology, weight, and efficiency significantly influence neonatal birth weight, which is a crucial determinant of neonatal survival and long-term health [3]. Placental weight has

been strongly correlated with neonatal birth weight, with studies reporting a near-linear relationship, especially in term pregnancies [4]. A healthy placenta typically weighs around 470 to 550 grams and ensures the delivery of oxygen, nutrients, and hormones while eliminating fetal waste products [5]. Deviations from normal placental weight, such as placentomegaly or placental insufficiency, have been associated with adverse outcomes including low birth weight, intrauterine growth restriction (IUGR), preterm birth, and perinatal mortality [6,7]. Moreover, maternal factors such as anemia, gestational diabetes, hypertension, and socio-economic status also affect placental growth and function, thereby influencing neonatal outcomes [8]. The umbilical cord, described by some as the "lifeline of the fetus," provides a structural and functional link between the fetus and placenta [9]. At term, the cord measures approximately 55–60 cm in length and contains two arteries and one vein embedded in Wharton's jelly [10]. Umbilical cord length (UCL) has been studied in relation to fetal movement, placental implantation, and birth outcomes, with both abnormally short and excessively long cords posing risks such as stillbirth, cord prolapse, or neonatal asphyxia [11,12]. Though the association between cord length and birth weight remains less conclusive than that of placental weight, evidence suggests that a suboptimal cord length may influence nutrient delivery and fetal growth [13]. Birth weight itself is a key predictor of neonatal survival and long-term morbidity. Low birth weight (<2500 grams) is a leading cause of neonatal complications and developmental delays, whereas macrosomia (>4000 grams) can complicate delivery and increase the risk of maternal and neonatal trauma [14,15]. Consequently, understanding the antenatal factors influencing birth weight—including placental and umbilical cord parameters—offers clinicians a valuable tool in risk stratification and perinatal management. Despite the growing interest in these anatomical correlates, limited studies have concurrently analyzed the interrelationship among birth weight, placental weight, and umbilical cord length in the South Asian context, particularly within tertiary care centers. The findings may contribute to a more nuanced understanding of fetal development, potentially guiding improved monitoring and timely interventions in obstetric care. This cross-sectional study aims to bridge this gap by evaluating the association between neonatal birth weight and two critical anatomical markers placental weight and umbilical cord length in a tertiary care hospital.

MATERIAL AND METHODS

This prospective observational study was conducted at the Bangladesh Medical University, Dhaka, Bangladesh over a one-year period from January 2024 to December 2024. In this study, we included 150 pregnant women and neonates during the study period. All of the patients were carefully observed to meet the research objectives and provide valuable insights within the specified timeframe.

Inclusion Criteria:

- Delivery between 37 and 42 weeks of gestation
- Singleton pregnancies
- Live newborns

Exclusion Criteria:

- Neonates born before 37 weeks of gestation
- Multiple pregnancies
- Known congenital anomalies in the neonate
- Maternal conditions affecting fetal growth (e.g., severe preeclampsia or diabetes)
- Neonates diagnosed with intrauterine growth restriction (IUGR)
- Cases of placental insufficiency, placental abruption, or placenta previa
- Conditions such as a short or excessively long umbilical cord, cord prolapse, or true knots in the cord

Ethical Considerations

Ethical considerations were integral to the study design and execution. The study adhered to ethical principles of confidentiality and privacy, ensuring that all patient data were anonymized and securely stored. Informed consent was obtained where applicable, and the research protocol was reviewed and approved by the relevant institutional ethics committee, ensuring compliance with ethical standards in human subject research.

Data Collection

After the delivery of the placenta, the umbilical cord's length was measured using a tape measure, with separate measurements taken for the portion attached to the baby and the portion attached to the placenta. These values were then summed to get the total length. The baby's crown-heel length was also measured using a tape measure. The baby's weight was recorded using a digital tabletop baby weighing scale after the umbilical cord was clamped short with a baby cord clamp, approximately 5 cm from its attachment to the baby. The placenta's untrimmed weight was also recorded. Immediately after delivery, both neonates and placentas underwent assessment, with the following measurements recorded

Statistical Analysis

All statistical analyses were carried out using IBM SPSS Statistics software, version 26.0. Descriptive measures such as mean, standard deviation, and range were computed for the study variables. The association between neonatal birth weight,

placental weight, and umbilical cord length was examined using Pearson's correlation coefficient. To determine the independent impact of placental weight and umbilical cord length on birth weight, multiple linear regression analysis was employed, controlling for potential confounding variables including maternal age and gestational age. A p-value of less than 0.05 was considered indicative of statistical significance. Continuous data were summarized as mean ± standard deviation, while categorical data were reported as frequencies.

RESULTS

A total of 150 mother–newborn pairs were enrolled in the study. Most mothers were between 21–25 years (40%), followed by 16–20 years (25.33%) and 26–30 years (22.67%). The age group 31–35 years comprised 10.67%, and a small proportion (1.33%) were above 40 years. The mean maternal age was 26.86±2.25 years. Regarding parity, 52% were primiparous, 46.67% were multiparous, and 1.33% were nulliparous. Cesarean section was the predominant mode of delivery in 60% of cases, while 40% had spontaneous vaginal deliveries. Among the neonates, 54% were male and 46% were female. The majority of neonates (65.33%) were born alive without complications, 31.33% were asphyxiated, and 3.33% were stillbirths. The mean gestational age at delivery was 36.19±3.55 weeks. The average birth weight of neonates was 2978±454 grams. The mean placental weight was 618.31±158.02 grams, and the mean umbilical cord length was 40.28±8.94 cm (Table 1). Table 2 demonstrates the correlation between birth weight and umbilical cord length. In the analysis of cord length and its relationship with birth weight, most neonates with normal birth weight had cord lengths between 31–40 cm (42.39%) and 41–50 cm (44.57%). A small number fell within 25–30 cm (5.43%) and 51–60 cm (5.43%), with only 2.17% exceeding 60 cm. Among low birth weight neonates, 87.5% had cord lengths of 31–40 cm and 12% were within 41–50 cm. No cases in this group had cord lengths shorter than 30 cm or longer than 50 cm. However, the correlation between cord length and birth weight was not statistically significant ($p = 0.192$). A significant correlation was found between placental weight and neonatal birth weight ($p < 0.001$). Normal birth weight neonates predominantly had placentas weighing 500–699 grams (46.74%) and 700–899 grams (38.04%). In contrast, 58.3% of low birth weight neonates had placentas in the 300–499 gram range. No low birth weight neonates had placental weight over 700 grams (Table 3).

Table 1. Maternal and Neonatal Demographic Characteristics of the Study (n=150).

Variables	Frequency (n)	Percentage (%)
Age (Years)		
16-20	38	25.33
21-25	60	40.00
26-30	34	22.67
31-35	16	10.67
Above 40	2	1.33
Mean±SD	26.86±2.25	
Parity		
Nulliparous	2	1.33
Primiparous	78	52.00
Multiparpous	70	46.67
Mode of Delivery		
Spontaneous Vaginal Delivery	60	40
Cesaren Section	90	60
Neonatal Sex		
Male	81	54
Female	69	46
Fetal Outcome		
Alive	98	65.33
Asphyxiated	47	31.33
Dead	5	3.33
	Mean±SD	
Weeks of Gestation at Delivery	36.19±3.55	
Birth Weight of the Neonate (grams)	2978±454	
Weight of the Placenta (grams)	618.31±158.02	
Length of the Umbilical Cord (cm)	40.28±8.94	

Table 2. Correlation of Birth Weight with Cord Length.

Length of Cord (cm)	Normal Birth Weight (n=138)		Low Birth Weight (n=12)		*P-value*
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
25-30	5	5.43	0	0	0.192
31-40	39	42.39	7	87.5	
41-50	41	44.57	1	12	
51-60	5	5.43	0	0	
>60	2	2.17	0	0	

Table 3: Correlation of Birth Weight with Placental Weight.

Placental Weight (grams)	Normal Birth Weight (n=138)		Low Birth Weight (n=12)		*P-value*
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
100-299	1	1.09	0	0	<0.001
300-499	7	7.61	7	25	
500-699	43	46.74	1	62.5	
700-899	35	38.04	0	12.5	
900-1000	5	5.43	0	0	
>1000	1	1.09	0	0	

DISCUSSION

The association of neonatal birth weight with placental weight and umbilical cord length has been a subject of clinical and academic interest, given its potential to predict perinatal outcomes and guide antenatal care. This cross-sectional study conducted in a tertiary care hospital assessed 150 mother–newborn dyads to explore how variations in placental weight and umbilical cord length correlate with birth weight. The study offers valuable insights into fetal growth markers, contributing to an improved understanding of perinatal health in a resource-constrained setting. In this study, the mean maternal age was 26.86±2.25 years, with the majority of participants (40%) aged 21–25 years. This age distribution aligns with national fertility trends in South Africa, where childbearing typically begins early. Tshotetsi et al. reported a similar maternal age range, with most participants aged between 20–30 years [16]. The present study found that 52% of mothers were primiparous and 60% delivered via cesarean section. These rates are consistent with the rising global trend in cesarean deliveries, particularly in urban hospital settings [17]. The high cesarean rate in our population could be attributed to referral bias, institutional protocols, or maternal and fetal complications. Among the neonates, 54% were male and 46% female. The mean gestational age was 36.19±3.55 weeks, and the mean birth weight was 2978±454 grams. The proportion of normal birth weight neonates (92%) versus low birth weight (LBW) neonates (8%) in this study reflects a relatively healthy delivery cohort, although the LBW rate still warrants attention. LBW remains a major risk factor for neonatal morbidity and mortality, particularly in developing countries [18]. The mean placental weight in our sample was 618.31±158.02 grams, closely resembling findings from studies by Carter et al. and others, who reported average placental weights ranging between 500–600 grams in term pregnancies [19]. One of the key findings of this study was the statistically significant association between placental weight and neonatal birth weight ($p < 0.001$). Normal birth weight neonates predominantly had placentas weighing between 500–699 grams (46.74%) and 700–899 grams (38.04%). In contrast, 58.3% of LBW neonates had placentas in the 300–499 gram range. No LBW neonates had placentas above 700 grams. These findings reinforce the well-established hypothesis that placental mass is a major determinant of fetal growth. A study by Jamshed et al. also found a strong positive correlation between placental weight and birth weight ($r = 0.72$, $p < 0.001$), emphasizing that placental size reflects its ability to support fetal nutrition and oxygenation [20]. Similarly, studies by Adeniran et al. and Thame et al. demonstrated that lighter placentas were associated with intrauterine growth restriction and preterm birth [21,22]. Our findings are further supported by Barker's hypothesis, which posits that fetal growth and adult disease risk are influenced by placental efficiency and weight [23]. The relationship between low placental weight and adverse neonatal outcomes, including LBW, asphyxia, and stillbirths, has been consistently documented in previous literature [24]. The biological plausibility lies in the role of the placenta as a vital organ for maternal–fetal nutrient exchange. A suboptimally grown placenta may impair this function, limiting fetal growth and leading to LBW [25]. In contrast, the correlation between umbilical cord length and birth weight was not statistically significant ($p = 0.192$) in this study. Most normal birth weight neonates had cord lengths of 31–40 cm (42.39%) and 41–50 cm (44.57%), while the majority of LBW neonates (87.5%) also had cord lengths between 31–40 cm. These outcomes suggest that although cord length may vary among neonates, its relationship with fetal growth may not be linear or strong. Previous studies have shown mixed results. A study

by Yamamoto et al. found that short cords (<35 cm) were significantly associated with LBW, fetal distress, and adverse outcomes [26], while another study by Ogunlaja et al. did not find a significant correlation between cord length and birth weight, consistent with our findings [27]. The variability in umbilical cord length may be influenced by factors such as fetal mobility, amniotic fluid volume, and genetic predisposition rather than fetal weight alone [28]. Moreover, extremely short (<30 cm) or long cords (>70 cm) are more likely to be associated with obstetric complications such as cord prolapse, true knots, or restricted movement, rather than subtle changes in birth weight [29]. In our study, only 2.17% of neonates had cords longer than 60 cm, and none of the LBW neonates had cord lengths beyond 50 cm, further limiting the range available for robust correlation. Regarding fetal outcomes, 65.33% of neonates were born alive without complications, while 31.33% were asphyxiated and 3.33% were stillbirths. These figures suggest that although most neonates had favorable outcomes, the relatively high asphyxia rate warrants closer monitoring and assessment of intrapartum care quality. A study by Lawn et al. found that perinatal asphyxia accounted for nearly 23% of neonatal deaths worldwide, emphasizing the need for effective obstetric and neonatal resuscitation strategies [30]. While this study did not assess Apgar scores or neonatal intensive care admissions, the association between LBW and poor outcomes is well documented. For instance, Ray et al. reported that LBW neonates had a significantly higher incidence of hypoxia, respiratory distress, and longer hospital stays [31]. From a clinical standpoint, our findings underscore the importance of routine antenatal monitoring of placental parameters, especially in pregnancies with suspected fetal growth restriction. Ultrasonographic estimation of placental size and Doppler studies could provide indirect assessments of placental health and help predict fetal outcomes [32]. Furthermore, antenatal counseling and nutritional interventions may be beneficial in optimizing placental development and fetal growth. This study demonstrated a strong positive correlation between placental weight and neonatal birth weight, suggesting that placental mass plays a pivotal role in fetal growth. However, no statistically significant relationship was observed between umbilical cord length and birth weight. These findings emphasize the importance of placental assessment as a routine component of prenatal evaluation. Improved obstetric care focusing on placental function could contribute to reducing LBW and improving neonatal outcomes.

Limitations of the Study: Like most hospital-based investigations, this study is subject to certain limitations. The findings may not be generalizable to broader national or global populations due to the limited sample size and single-center design. The relatively small number of enrolled patients, compared to similar research, may affect the statistical power and the strength of conclusions drawn. The short study duration also posed challenges in assessing long-term complications and mortality outcomes. Furthermore, incomplete documentation in some patient records particularly regarding lifestyle factors such as smoking and alcohol use could have introduced bias into the data analysis. The six-month timeframe restricted the evaluation of the sustained impact of medications and the effectiveness of interventions to reduce drug-related problems (DRPs). Additionally, the exclusion of pregnant individuals and patients with incomplete data may have led to the omission of significant subpopulations, potentially limiting the overall scope and representativeness of the results.

CONCLUSION

This study demonstrates a statistically significant positive correlation between placental weight and neonatal birth weight, reinforcing the role of the placenta as a key determinant of fetal growth. Although umbilical cord length showed descriptive trends, its association with birth weight was not statistically significant. Clinically, the findings highlight the utility of placental weight as a reliable proxy for fetal development and underscore the need for enhanced monitoring of placental parameters during routine obstetric care. Future research incorporating larger cohorts, placental histology, and maternal nutritional profiles is warranted to further elucidate these associations and improve perinatal outcomes.

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