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Original Research Article

Relationship between birth weight of the neonate with weight of placenta and cord length in a tertiary care hospital

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ABSTRACT

Background: The study of birth-related parameters, such as umbilical cord length, placental weight, and neonatal birth weight, is crucial for assessing neonatal health. The placenta, known as the "lifeline of the fetus," plays a vital role in nutrient and gas exchange, with an average placental weight of around 508 grams. This study aimed to investigate the relationship between neonatal birth weight, placental weight, and umbilical cord length in term pregnancies.
Methods: This cross-sectional comparative study was conducted at the Department of Obstetrics and Gynecology in Bangladesh to examine the relationship between neonate birth weight, placenta weight, and umbilical cord length. A total of 100 singleton pregnancies delivered between 37 and 42 weeks of gestation were included from January to December 2021.
Results: Most mothers were aged 21-25 (40%), with a mean age of 24.84 years. Over half were primiparous (52%). Neonatal data indicated an average gestational age of 38.89 weeks and a mean weight of 2990 grams. Caesarean deliveries accounted for 60%, and the gender ratio was nearly equal (54% male, 46% female). The correlation analysis revealed that while umbilical cord length had no significant relationship with birth weight ($p=0.192$), placental weight showed a significant association ($p<0.001$).
Conclusions: The study demonstrates a strong correlation between placental weight and neonatal birth weight, suggesting that placental health is crucial for fetal development. However, umbilical cord length showed no significant relationship with birth weight. These findings highlight the importance of placental function in neonatal health and the need for further research.

Keywords: Birth weight, Placental weight, Umbilical cord length, Neonatal health, Term pregnancy

INTRODUCTION

The investigation of birth-related parameters, including length of the umbilical cord, placental weight, and neonatal birth weight, has been an area of substantial interest within the medical and scientific community for several years.[1] These parameters are frequently evaluated as critical indicators of neonatal health, serving as predictors for a variety of outcomes both in the immediate neonatal period and later stages of development.[2] Among these, the placenta holds a particularly pivotal role, often referred to as "the lifeline of the fetus in utero," due to its crucial function in mediating the physiological exchange between the mother and the developing fetus.[3] The placenta is a unique and dynamic organ, not only in terms of its development but also in its specialized function. Unlike any other organ in the body, it is derived from two individuals, the mother and the fetus, highlighting its dual origin and complex nature.[4] Placental weight refers to the mass of this essential organ, which connects the developing fetus to the uterine wall, facilitating the transport of nutrients, the removal of waste products, and the exchange of gases through the mother's blood supply.[5]

The average placental weight in a typical pregnancy is around 508 grams.[6] The growth and development of the fetus during pregnancy are inextricably linked to the proper functioning and structure of both the placenta and the umbilical cord, which serve as the primary means of nutrient and oxygen exchange.[3] Although fetal well-being is influenced by a multitude of factors, a healthy and well-functioning placenta remains the single most critical determinant in ensuring the delivery of a healthy newborn.[4] However, placental characteristics such as its weight, size, thickness, shape, and consistency can vary significantly, and altered placental growth has been recognized as a potential early indicator of underlying maternal medical conditions.[7,8] Research has shown that factors such as maternal race, socioeconomic status, and health conditions can significantly impact placental weight.[9] For instance, deviations in placental weight, whether excessive or insufficient, are correlated with poor perinatal outcomes. Low placental weight is often associated with neonatal complications such as low Apgar scores, respiratory distress syndrome, and, in some cases, perinatal death.[7] In contrast, placental weights that are significantly higher than average are commonly observed in pregnancies affected by maternal conditions such as syphilis, diabetes, hydrops fetalis, rhesus isoimmunization, and severe anemia.[10] Conversely, smaller-than-normal placental sizes are often noted in cases involving genetic abnormalities such as trisomy conditions and maternal hypertension.[11] The umbilical cord, often described as the "fetus's essential lifeline," plays an equally critical role in the fetus's survival during intrauterine life.[12] Its vital importance was aptly captured by Ian Donald's (1955) famous remark: "The baby's life hangs by a cord." In species that give birth to live young, such as placental mammals, the umbilical cord forms an essential part of the fetoplacental unit, which supports the embryo's growth and development within the maternal body.[13] One of the key parameters of interest regarding the umbilical cord is its diameter, as the umbilical cord diameter (UCD) significantly influences both fetal blood flow and overall weight gain.[14] Typically, the umbilical cord measures approximately 60 centimeters in length at full term and is characterized by a distinctive helical shape, with about one to three coils per 10 centimeters of length.[15,16] Various abnormalities of the umbilical cord can arise from factors such as length, thickness, coiling pattern, insertion site on the placenta, number of vessels, in-utero distortions, or the presence of primary tumors. Each of these factors has the potential to impact fetal growth and development, influencing both birth weight and neonatal health outcomes. For example, deviations in umbilical cord length or abnormalities in placental weight can be early indicators of issues such as preterm birth or low birth weight, both of which are associated with increased risks of neonatal morbidity and mortality.[1] Birth weight is one of the most critical determinants of a newborn's survival, healthy growth, and development.[17] It is defined as the weight of the infant immediately after birth and serves as an important indicator of neonatal health status.[18] Low birth weight is a well-established risk factor for a variety of long-term health issues, including cardiovascular disease and metabolic syndrome later in life. On the other hand, excessively high birth weight, a condition known as macrosomia, can lead to complications during delivery, increasing the likelihood of requiring a caesarean section and raising the risk of postpartum hemorrhage.[13] Notably, the weight ratio between the placenta and the newborn is approximately 1:6, further emphasizing the proportional relationship between placental health and birth outcomes.[18] Several studies have explored how variations in umbilical cord and placental parameters, influenced by factors such as maternal health, gestational age, and environmental conditions, affect neonatal outcomes.[19] For instance, research has shown that thicker, heavier placentas with larger surface areas and non-twisted umbilical cords are often associated with higher birth weights. Moreover, multiple studies have demonstrated a positive correlation between fetal weight and placental weight, with larger placental sizes generally corresponding to heavier birth weights.[20] This relationship between the birth weight of neonates, placental weight, and umbilical cord length is intricate and involves numerous interrelated factors. A comprehensive understanding of these relationships can help clinicians and researchers develop strategies for improving fetal health and identifying potential areas for early intervention.[21] Given this complex backdrop, the present study aims to investigate the relationships among neonatal birth weight, placental weight, and umbilical cord length. By delving into the intricate interactions between these parameters, researchers hope to uncover valuable insights into the mechanisms that govern fetal growth and development. These findings could contribute to the development of more effective strategies for monitoring fetal health, thereby improving neonatal outcomes and reducing the risks associated with abnormal fetal growth.

METHODS

This cross-sectional comparative study was conducted at Department of Department of Obstetrics and Gynecology, Community Based Medical College Hospital Bangladesh (CBMCB), Mymensingh, Bangladesh. The aim was to investigate the relationship between the birth weight of neonates, the weight of the placenta, and the length of the umbilical cord. In this study we included 100 pregnant women and neonates during the study period (one year), from 01 January 2021 to 31 December 2021. The study was approved by the Institutional Ethics Committee.

Inclusion criteria

Cases with singleton pregnancies, delivery between 37 and 42 weeks of gestation, and alive newborns were included in the study.

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 IUGR, cases of placental insufficiency, placental abruption, or placenta previa, and conditions such as a short or excessively long cord, cord prolapse, or true knots in the cord were excluded.

All procedures involving human participants in this study were conducted following the approval of the institution's research ethics committee. Informed consent was obtained from mothers for the collection of data related to their babies for research purposes. Data were gathered in real-time for all deliveries included in the study using a predesigned proforma. The variables collected included the mother's age, parity, baby's sex, birth weight, umbilical cord length, birth length, and placenta weight. After each delivery, the umbilical cord was promptly double-clamped and cut between the clamps.

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.

Birth weight

It was measured using an electronic baby scale with accuracy to the nearest gram.

Placental weight

It was recorded after cleaning and trimming, using an electronic balance accurate to the nearest gram.

Umbilical cord length

It was measured from the point of insertion on the placenta to the point of attachment on the neonate, using a tape measure, and recorded in centimetres.

All data were meticulously collected and entered into a standardized form by trained medical staff to ensure consistency and accuracy.

Statistical analysis

Data analysis was performed using statistical package for the social sciences (SPSS) (version 26.0). Descriptive statistics including mean, standard deviation, and range were calculated for all variables. The relationship between birth weight, placental weight, and umbilical cord length was evaluated using Pearson's correlation coefficient. Multiple linear regression analysis was conducted to assess the independent effects of placental weight and cord length on birth weight while adjusting for potential confounders such as maternal age and gestational age. P values of less than 0.05 were considered statistically significant. The results are presented as mean±standard deviation for continuous variables and frequencies for categorical variables.

RESULTS

The study offers a comprehensive examination of maternal and neonatal demographic characteristics, as well as critical correlations between birth weight and certain physiological parameters like umbilical cord length and placental weight. Table 1 presents the maternal demographic data, showing that the majority of the mothers (40%) were between 21-25 years old, with another significant portion (25%) aged 16-20 years. A smaller percentage (23%) fell within the 26-30 years age group, while those aged 31-35 made up 11%, and only 1% were above 40 years of age. The mean maternal age was 24.84 years, with a standard deviation of 4.85 years. Parity data reveals that over half of the mothers (52%) were primiparous, meaning it was their first childbirth experience, while 47% were multiparous, having previously given birth. Only 1% of the mothers were nulliparous, indicating no prior childbirth. Table 2 outlines the neonatal demographic characteristics. The average gestational age at birth was 38.89 weeks with a standard deviation of 1.75 weeks, and the mean neonatal weight was 2990±450 grams. The placental weight averaged 617.51±161.02 grams, while the umbilical cord length had a mean value of 42.58 cm, with a standard deviation of 6.54 cm. A significant proportion of the deliveries (60%) were caesarean sections, while the remaining 40% were spontaneous vaginal deliveries. The gender distribution of the neonates was nearly equal, with 54% being male and 46% female. Neonatal outcomes were overwhelmingly positive, with 98% of the neonates being born alive, and only 2% experiencing mortality. Table 3 delves into the correlation between birth weight and umbilical cord length. The majority of neonates with normal birth weight (44.57%) had umbilical cord lengths between 41-50 cm, while the majority of low birth weight (LBW) neonates (87.50%) had cord lengths between 31-40 cm. Umbilical cord lengths shorter than 30 cm and longer than 60 cm were uncommon in both normal and LBW categories. However, the p value of 0.192 indicates that this correlation is not statistically significant, suggesting that umbilical cord length does not have a strong predictive value for birth weight. Table 4 explores the correlation between birth weight and placental weight, revealing a significant relationship. Most neonates with normal birth weight (46.74%) had placental weights between 500-699 grams, while the majority of LBW neonates (62.50%) also had placental weights in the same range. Notably, a small

percentage of neonates with normal birth weight (1.09%) had placental weights in the 100-299 grams range, while none of the LBW neonates had placental weights in this category. The p value of <0.001 suggests a highly significant statistical association between birth weight and placental weight, highlighting placental weight as a strong predictor of neonatal birth weight.

Table 1: Maternal demographical characteristics of the study.

Variables	Frequency (N)	Percentage
Age range (in years)		
16-20	25	25.00
21-25	40	40.00
26-30	23	23.00
31-35	11	11.00
Above 40	1	1.00
Mean±SD	24.84±4.85	
Parity		
Nulliparous	1	1.00
Primiparous	52	52.00
Multiparous	47	47.00

Table 2: Neonatal demographical characteristics of the study.

Variables	Frequency (N)	Percentage
	Mean±SD	
Gestational age at birth (weeks)	38.89±1.75	
Neonatal weight (gram)	2990±450	
Placental weight (gram)	617.51±161.02	
Umbilical cord length (cm)	42.58±6.54	
Mode of delivery		
Spontaneous vaginal delivery	40	40.00
Cesarean section	60	60.00
Neonatal gender		
Male	54	54.00
Female	46	46.00
Foetal outcome		
Alive	98	98.00
Dead	2	2.00

Table 3: Correlation of birth weight with cord length.

Length of cord (cm)	Birth weight				P value
	Normal (n=92)		LBW (n=8)		
	n	%	n	%	
25-30	5	5.43	0	0.00	0.192
31-40	39	42.39	7	87.50	
41-50	41	44.57	1	12.50	
51-60	5	5.43	0	0.00	
>60	2	2.17	0	0.00	

Table 4: Correlation of birth weight with placental weight.

Placental weight (g)	Birth weight				P value
	Normal (n=92)		LBW (n=8)		
	n	%	n	%	
100-299	1	1.09	0	0.00	<0.001
300-499	7	7.61	2	25.00	
500-699	43	46.74	5	62.50	
700-899	35	38.04	1	12.50	
900-1000	5	5.43	0	0.00	
>1000	1	1.09	0	0.00	

DISCUSSION

The present study provides a detailed analysis of the demographic characteristics of 100 mothers and their newborns, with an emphasis on understanding the relationship between birth weight, umbilical cord length, and placental weight. The study's findings are instrumental in shedding light on the intricate interplay of these factors and contribute to the growing body of knowledge in neonatal and maternal health. Maternal age distribution revealed a distinct trend, with the majority of mothers falling within the 21-25 age group, accounting for 40.00% of the sample. This was followed by the 16-20 age group, which constituted 25.00%, and the 26-30 age group, representing 23.00% of the participants. These findings are consistent with those reported by Bhattarai et al. (2022), who observed similar patterns of maternal age distribution in their study.[22] The concentration of maternal age within these groups may reflect various social, cultural, and biological factors influencing childbearing age in this population. Parity distribution showed that primiparous women, or first-time mothers, comprised 52.00% of the sample, while multiparous women made up 47.00%. These results are comparable to previous findings by Makinde et al who reported a slightly higher prevalence of multiparous women at 50.00% in their study.[23] The distribution of primiparous and multiparous women is significant as it often correlates with different maternal and neonatal outcomes, particularly in terms of birth weight and delivery methods. The study also analyzed the gestational age of the newborns, finding an average gestational age of 38.89 weeks, with a standard deviation of 1.75 weeks. This aligns closely with the typical full-term gestational period, and similar results have been documented by researchers such as Panti et al, Wen et al, and Alim et al.[7,24,25] The consistency of these findings with established gestational norms underscores the reliability of the study's data in reflecting common birth characteristics. In terms of neonatal characteristics, the average birth weight recorded in this study was 2990±450 grams, the mean placental weight was 617.51±161.02 grams, and the average umbilical cord length was 42.58±6.54 cm. These results are in agreement with those observed by Alim et al, indicating that the study's neonatal parameters are in line with standard measurements reported in similar populations.[25] The mode of delivery in this study was

nearly evenly split between vaginal births (40.00%) and caesarean sections (60.00%). This distribution reflects broader global trends, where caesarean section rates have been rising in many regions, a pattern documented in previous research.[26] Gender distribution among the newborns was also fairly balanced, with 54% male and 46% female neonates, which is consistent with global sex ratio trends. These results align with other studies, such as those by Wen et al, which have reported similar gender distributions at birth. This balance suggests that there is no significant gender bias in birth outcomes within the studied population. A closer look at the relationship between umbilical cord length and birth weight revealed that the majority of newborns with normal birth weights (44.57%) had umbilical cords measuring between 41-50 cm, while a significant proportion of LBW neonates (87.50%) had umbilical cords measuring between 31-40 cm. However, the p value of 0.192 indicates that this correlation is not statistically significant. This suggests that umbilical cord length may not be a strong predictor of birth weight. Interestingly, this finding contrasts with the results of Ogunlaja et al, who reported a significant positive correlation between umbilical cord length and birth weight (p=0.011).[27] Such discrepancies highlight the complexity of predicting neonatal outcomes based on umbilical cord length alone. On the other hand, the correlation between birth weight and placental weight was found to be highly significant in this study. Most newborns with normal birth weight (46.74%) had placental weights in the range of 500-699 grams, while 62.50% of LBW neonates also fell within this weight range. Interestingly, a very small percentage of normal birth weight neonates (1.09%) had placental weights between 100-299 grams, while none of the LBW neonates were found in this category. The highly significant p value of <0.001 underscores the strong association between placental weight and neonatal birth weight, confirming placental weight as a robust predictor of birth weight. Similar findings have been reported by Alim et al, Njoku et al, and Jakó et al, all of whom identified significant correlations between these two parameters.[25,28,29] Despite the strong statistical association, it is important to note that the correlation, while significant, is not extraordinarily high, suggesting that other factors also contribute to determining birth weight. This aligns with existing research, which emphasizes the multifactorial nature of birth outcomes, including the influence of maternal health, nutrition, genetic factors, and environmental conditions.[30] Therefore, while placental weight serves as an important predictor, it should be considered within the broader context of multiple interacting variables affecting neonatal health.

Limitations

This study has a limited sample size which may affect the generalizability of the findings. Conducting the study in a single tertiary care hospital limits the external validity, as differences in care practices across institutions may influence outcomes. Potential confounding variables, such as maternal nutrition, socioeconomic status, and genetic factors, were not considered, which may have affected the observed relationships. The cross-sectional design limits the ability to establish causality between the variables studied.

CONCLUSION

The present study highlights a significant relationship between neonatal birth weight and placental weight, underscoring the critical role of placental health in fetal development. A strong correlation was found between higher placental weights and normal neonatal birth weights, suggesting placental weight as a reliable predictor of neonatal outcomes. However, no statistically significant relationship was observed between umbilical cord length and birth weight, indicating that cord length may have limited predictive value for neonatal weight. The findings reaffirm the placenta's essential role in neonatal health, emphasizing the need for continued research into the factors influencing placental growth and function. By understanding these intricate relationships, healthcare providers can improve fetal monitoring and potentially intervene earlier in pregnancies with abnormal growth patterns, thus enhancing neonatal outcomes.

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