ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 18, Issue 8, 2025

Online - 2455-3891
Print - 0974-2441

Research Article

ANATOMICAL STUDY OF THE RELATIONSHIP BETWEEN PLACENTAL WEIGHT, UMBILICAL CORD LENGTH, AND NEONATAL BIRTH WEIGHT

GOPAL BAGAL[1], GAJANAN BHANUDAS PADMAWAR[1], MANJIRI VAIBHAV GANJEWAR[1], PRANITA RAMRAO GABALE[2]

[1]Department of Anatomy, Dr. BAVP's R K Damani Medical College, Shri Ramchandra Institute of Medical Sciences, Chhatrapati Sambhajinagar, Maharashtra, India. [2]Department of Obstetrics and Gynecology, ASPL's CSMSS Medical College and Hospital, Chhatrapati Sambhajinagar, Maharashtra, India.

***Corresponding author: Pranita Ramrao Gabale; Email: itspranitagp@gmail.com**

Received: 15 May 2025, Revised and Accepted: 26 June 2025

ABSTRACT

Objective: To analyze the relationship between placental weight and umbilical cord length with neonatal birth weight in term singleton pregnancies and to identify whether placental and cord parameters can serve as a predictor of fetal growth outcomes.

Methods: This hospital-based, cross-sectional study was conducted from January to December 2024 in the Department of Obstetrics and Gynecology of a tertiary care center. A total of 60 term singleton pregnancies (37–42 weeks) were included based on predefined inclusion and exclusion criteria. Immediately post-delivery, neonatal weight was recorded using a digital scale. Umbilical cord length was measured from placental insertion to the neonatal end, and the trimmed placenta was weighed with an electronic balance. Data were statistically analyzed using the Statistical Package for the Social Sciences v23.0. Pearson was applied to determine relationships among placental weight, cord length, and birth weight.

Results: The mean placental weight was 588.8 g. The mean umbilical cord length was 41.12 cm, and the mean neonatal birth weight was 2963.83 g. There was a strong positive relationship between placental weight and birth weight as indicated by a Pearson correlation coefficient (r) of 0.9983. This correlation was statistically highly significant, with a $p<0.001$. The mean umbilical cord length in the studied cases was 41.117 cm, whereas the mean birth weight was 2963.83 g. The association was not statistically significant ($p=0.1305$).

Conclusion: Placental weight demonstrates a significant positive association with neonatal birth weight. However, umbilical cord length lacks statistical significance for the prediction of birth weight. Post-delivery placental evaluation may aid retrospective assessment of fetal well-being and inform perinatal risk stratification.

Keywords: Placental weight, Umbilical cord length, Neonatal birth weight, Fetal growth, Term pregnancy.

 DOI: http://dx.doi.org/10.22159/ajpcr.2025v18i8.55589. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Among the significant determinants of neonatal health are the structural and functional characteristics of the placenta and umbilical cord [1]. These are instrumental in sustaining intrauterine life. Neonatal morbidity and mortality continue to be public health concerns, particularly in low- and middle-income countries. In developing countries, birth outcomes are frequently compromised due to limited prenatal surveillance and maternal health services. Low birth weight contributes substantially to neonatal complications such as respiratory distress, hypoglycemia, and impaired thermoregulation. The placenta and umbilical cord, being the principal anatomical interfaces between the mother and fetus, have thus emerged as focal points of investigation in perinatal health studies aimed at improving neonatal outcomes [2].

The placenta not only facilitates nutrient and gas exchange but also plays a crucial immunological role [3]. Placental weight has long been identified as a surrogate marker of placental efficiency; abnormal placental weight has been known to be associated with adverse pregnancy outcomes. A placenta weighing significantly less than the gestational norm may suggest pathologies such as intrauterine growth restriction (IUGR) and pre-eclampsia. On the other hand, an excessively large placenta may reflect conditions such as maternal diabetes, fetal hydrops, or infections such as syphilis [4]. Anatomical anomalies in the placenta, including abnormal insertion of the umbilical cord as well as excessive villous immaturity, can compromise fetal development. Similarly, the umbilical cord plays a pivotal role in maintaining fetoplacental circulation. At term umbilical cord length typically ranges between 50 and 60 cm. Aberrations in cord length have been linked with complications such as fetal distress, cord prolapse, true knots, and delivery-related injuries [5].

Research has consistently demonstrated a positive correlation between placental weight and neonatal birth weight. The studies suggest that placental growth mirrors fetal growth under physiologic conditions [6]. Several studies have observed that higher placental weights correlate positively with increased birth weights, and placental weight thereby serves as an indicator of optimal intrauterine growth. For example, Sanin *et al.* have reported that an increase in placental weight is often associated with improved neonatal outcomes. This is particularly relevant when the placenta-to-birth weight ratio remains within physiologic norms [7]. However, this correlation is not absolute as multiple factors significantly influence both placental and fetal growth trajectories. Similarly, the umbilical cord's length and morphology have been the subject of interest, with studies suggesting a positive correlation between the cord length and birth weight [8]. Despite these insights, some studies have reported no significant association between umbilical vein diameter and neonatal birth weight [9].

Although multiple studies have examined the associations between individual fetal parameters and birth outcomes, there is a relative paucity of research simultaneously evaluating anatomical relationships among placental weight, umbilical cord length, and neonatal birth weight [10]. Previous studies have often focused on isolated variables, overlooking the potential interactions among these critical structures. In the context of developing countries, including India, where maternal anemia, gestational diabetes, and hypertensive disorders are prevalent, there is an urgent need to analyze these anatomical relationships using locally relevant data.

In light of these considerations, the present study aims to bridge the knowledge gap by conducting a detailed anatomical assessment of placental weight and umbilical cord length to neonatal birth weight.

METHODS

The present study was a prospective observational study conducted in the Department of Obstetrics and Gynecology of a tertiary care medical institute. A total of 60 pregnant women with singleton term pregnancies were included based on predefined inclusion and exclusion criteria. Since it was a purely observational study in which only data such as placental thickness, umbilical cord length, and birth weight were analyzed without any kind of intervention hence ethical clearance was waived. Data were anonymized before analysis to protect the identity of participants. The study duration was 1 year. The sample size was calculated based on pilot studies and previously published data, which assessed the correlation between placental weight, umbilical cord length, and neonatal birth weight. Assuming a power (1-Beta error) of 80% and a confidence interval (1-Alpha error) of 95%, the minimum sample size required was estimated to be 55. Therefore, a total of 60 participants were included in the study.

Systematic data collection was done immediately following delivery. After the neonate was delivered and the umbilical cord clamped and cut, the baby was weighed using a digital neonatal scale with 1 g precision. Subsequently, the umbilical cord was measured in its entirety from the placental insertion to the neonatal end using a flexible, non-stretchable tape measure. The placenta was then washed gently under running water to remove excess blood. Placental membranes and cord were trimmed before being weighed. Gestational age was confirmed based on first-trimester ultrasound or from a reliable last menstrual period. Maternal demographic data, such as age, parity, and mode of delivery were also recorded on a structured pro forma.

Data were entered and managed using Microsoft Excel and subsequently analyzed with the Statistical Package for the Social Sciences software version 23.0. Descriptive statistics were calculated for all variables. For continuous variables, means and standard deviations were used. Frequencies with percentages were given for categorical data. To explore the relationships between variables such as placental weight, umbilical cord length, and neonatal birth weight Pearson correlation coefficient was used. A $p<0.05$ was considered statistically significant.

Inclusion criteria

- Singleton pregnancy
- Gestational age between 37 and 42 weeks
- Live-born neonates
- Consent provided for participation.

Exclusion criteria

- Preterm (<37 weeks) or post-term (>42 weeks) deliveries
- Multiple pregnancies
- Neonates with congenital anomalies
- Cases with placental abnormalities (e.g., abruption, previa)
- Umbilical cord anomalies (e.g., true knots, cord prolapse)
- Maternal conditions known to affect fetal growth (e.g., uncontrolled diabetes, severe pre-eclampsia).

RESULTS

The analysis of the age distribution of the studied cases showed that the majority of participants belonged to the 26–30 years age group, accounting for 26 cases (43.33%). This was followed by the 31–35 years group with 14 cases (23.33%) and the 18–25 years group with 13 cases (21.67%). The least number of cases was observed in the age group above 35 years, comprising 7 cases (11.67%). The mean age of the participants was 27.9 years with a standard deviation of ±4.8 (Table 1).

The analysis of the parity distribution of the studied cases showed that the majority were primigravida, comprising 36 cases (60.00%), whereas the remaining 24 cases (40.00%) were multigravida (Table 2).

The analysis of the relationship between umbilical cord length and fetal birth weight, as depicted in the graph, showed a positive association. The shortest umbilical cord length observed was 32.63 cm, which was linked to a fetal birth weight of approximately 2300 g, whereas the longest cord measured 45.95 cm and corresponded to a birth weight close to 3800 g. Most cases with umbilical cord lengths above 40 cm were associated with birth weights exceeding 3000 g, whereas cords shorter than 38 cm tended to correspond with lower birth weights, generally below 2800 g (Fig. 1).

The analysis of the correlation between umbilical cord length and fetal birth weight revealed a weak positive relationship, with a Pearson correlation coefficient (r) of 0.1974. The mean umbilical cord length in the studied cases was 41.117 cm, whereas the mean fetal birth weight was 2963.83 g. The association was not statistically significant, as indicated by a $p=0.1305$ (Table 3).

The analysis of fetal birth weight to placental weight indicated a positive association, where placental weight was generally accompanied by higher fetal birth weights. The lowest placental weight observed was 452 g, which corresponded to a birth weight just above 2200 g, whereas the highest placental weight was 717 g, associated with a birth weight nearing 3800 g. Most cases with placental weights between 600 and 700 g showed fetal birth weights above 3000 g, suggesting that heavier placentas tend to support greater fetal growth (Fig. 2).

The analysis of the correlation between placental weight and fetal birth weight revealed a strong positive relationship, as indicated by a Pearson correlation coefficient (r) of 0.9983. The mean placental weight among the studied cases was 588.8 g, whereas the mean fetal birth weight was 2963.83 g. This correlation was found to be highly statistically significant, with a $p<0.001$ (Table 4).

DISCUSSION

This study found a significant and positive correlation between placental weight and neonatal birth weight ($p<0.001$). The findings of our study were similar to the findings reported by Salafia *et al*., who reported that increased placental weight had a significant positive correlation greater neonatal birth weight, particularly in term pregnancies. These findings suggest that placental mass can

Table 1: Age groups in studied cases

Age group (years)	Number of cases (%)
18–25	13 (21.67)
26–30	26 (43.33)
31–35	14 (23.33)
>35	7 (11.67)
Total	60 (100.00)
Mean±SD	27.9±4.8

SD: Standard deviation

Table 2: Primigravida vs multigravida among studied cases

Parity	Number of cases	Percentage
Primigravida	36	60.00
Multigravida	24	40.00
Total	60	100.00

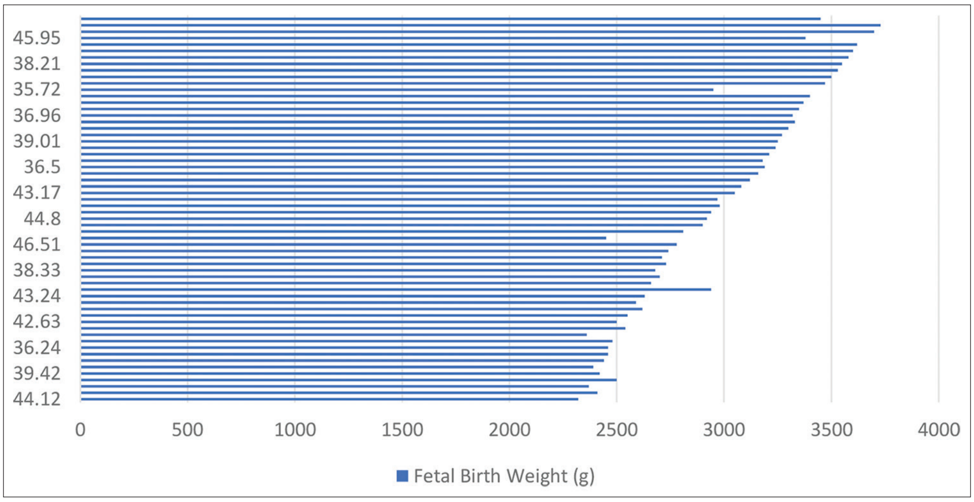

Fig. 1: Correlation between umbilical cord length and birth weight

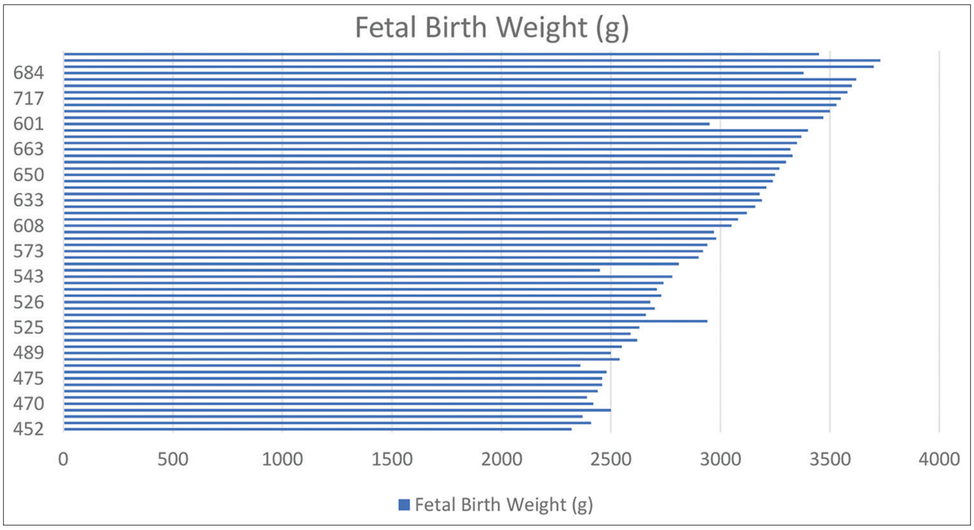

Fig. 2: Correlation between placental weight and birth weight of studied cases

Table 3: Correlation between umbilical cord length and birth weight

Parameter description	Value
Mean umbilical cord length (cm)	41.117±4.08*
Mean fetal birth weight (g)	2963.83±417.92*
Pearson correlation coefficient (r)	0.1974
Statistical significance	Not significant (p≤0.1305)

*Mean±SD. SD: Standard deviation

Table 4: Correlation between placental weight and birth weight

Parameter description	Value
Mean placental weight (g)	588.8±91.57*
Mean fetal birth weight (g)	2963.83±417.92*
Pearson correlation coefficient (r)	0.9983
Statistical significance	Highly significant (p<0.001)

*Mean±SD

be used as a surrogate marker for intrauterine growth capacity [11]. Similarly, the study by Thame *et al.* also confirmed these findings by demonstrating that placental weight was a reliable predictor of birth weight in both low- as well as high-risk pregnancies [12]. These similar findings highlight the importance of placental morphology and size in fetal growth and emphasize that placental weight can be an effective indicator of fetal well-being.

Our study revealed a weak and statistically non-significant positive correlation between umbilical cord length and neonatal birth weight (r=0.1974, p=0.1305). These findings are similar to the research done by Kalluru *et al.*, who also noted an inconsistent association between umbilical cord length and birth weight. This study suggested that although longer cords might reflect better in utero mobility and overall fetal health, the relationship is not always linear or predictive [13]. In a similar study, Pathak *et al.* reported that there exists a significant variability in umbilical cord length with no strong correlation to birth weight. This inconsistent relationship may be a result of maternal, fetal, or genetic factors that might affect this relationship [14].

The strong correlation between placental weight and birth weight also makes it possible to predict the possibility of IUGR and macrosomia by assessing placental weight [15]. In a study, Sathasivam *et al.* found that reduced placental weight was consistently associated with growth-restricted neonates. This makes it important to evaluate placental parameters as part of routine antenatal care [6]. Likewise, Soongsatitanon and Phupong demonstrated that placental volume and weight, assessed via 3D ultrasonography, can predict fetal weight and growth, especially in pregnancies complicated by gestational diabetes or pre-eclampsia [16]. These findings suggest that incorporating placental biometric assessment may enhance the prediction and management of abnormal fetal growth patterns [17].

The interrelationship among placental weight, umbilical cord length, and neonatal birth weight could be a topic that needs to be studied extensively to draw any significant conclusion. While our data show that placental weight is a far more consistent predictor of fetal weight compared to cord length, it remains unclear whether variations in umbilical cord morphology can be used to assess fetal weight. Hasegawa *et al*. suggested that abnormalities in umbilical cord length may reflect underlying fetal hypokinesia or compromised vascular development, both of which could have secondary effects on growth [18]. On the other hand, Holland *et al*. proposed that cord length and coiling may be shaped by fetal movement and overall health status, reinforcing their potential role as markers rather than mediators of fetal well-being [19].

CONCLUSION

There was a significant positive association between placental weight and neonatal birth weight. This highlights the placenta's key role in intrauterine development and suggests that post-delivery placental assessment can provide valuable insights into fetal growth patterns and potential perinatal risks. In contrast, the association between umbilical cord length and birth weight was weak and not statistically significant, indicating that cord length may not serve as a reliable predictor of neonatal size.

AUTHORS CONTRIBUTION

NM- Concept and design of the study, prepared first draft of manuscript, interpreted the results, reviewed the literature, and manuscript preparation; JB- Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript. GB -Conceptualization of intellectual content; literature review; development and implementation of study protocol; data collection and analysis; and preparation of initial manuscript draft. GP - Contributed to study design and protocol development; literature review; drafting, editing, and revision of manuscript; preparation of final article; responsible for submission. MG- Critical review of the manuscript. PG - Overall study concept and design; development of clinical protocol; manuscript editing and critical revision.

CONFLICT OF INTEREST

None.

SOURCE OF FUNDING

None.

REFERENCES

1. Fowden AL, Forhead AJ, Coan PM, Burton GJ. The placenta and intrauterine programming. J Neuroendocrinol. 2008 Apr;20(4):439-50. doi: 10.1111/j.1365-2826.2008.01663.x, PMID 18266944
2. Guo X, Wang Y, Yu H. Relationship between placental pathology and neonatal outcomes. Front Pediatr. 2023 Jun 15;11:1201991. doi: 10.3389/fped.2023.1201991, PMID 37397153, PMCID PMC10309182
3. Gude NM, Roberts CT, Kalionis B, King RG. Growth and function of the normal human placenta. Thromb Res. 2004;114(5-6):397-407. doi: 10.1016/j.thromres.2004.06.038, PMID 15507270
4. Horn LC, Röse I. Placental and fetal pathology in intrauterine viral infections. Intervirology. 1998;41(4-5):219-25. doi: 10.1159/000024940, PMID 10213900
5. Rayburn WF, Beynen A, Brinkman DL. Umbilical cord length and intrapartum complications. Obstet Gynecol. 1981 Apr;57(4):450-2. PMID 7243092
6. Sathasivam R, Selliah P, Sivalingarajah R, Mayorathan U, Munasinghe BM. Placental weight and its relationship with the birth weight of term infants and body mass index of the mothers. J Int Med Res. 2023 May;51(5):1-10.3000605231172895. doi: 10.1177/03000605231172895, PMID 37194202, PMCID PMC10192661
7. Sanin LH, López SR, Olivares ET, Terrazas MC, Silva MA, Carrillo ML. Relation between birth weight and placenta weight. Biol Neonate. 2001;80(2):113-7. doi: 10.1159/000047129, PMID 11509810
8. Sharma S, Soliriya V. Study of length of umbilical cord at term and its correlation with fetal outcome: A study of 500 deliveries. J South Asian Feder Obst Gynae. 2016;8(3):207-11. doi: 10.5005/jp-journals-10006-1419
9. Tutus S, Asal N, Uysal G, Şahin H. Is there a relationship between high birth weight and umbilical vein diameter? J Matern Fetal Neonatal Med. 2021 Nov;34(21):3609-13. doi: 10.1080/14767058.2020.1814247, PMID 33081536
10. Togni FA, Araujo Júnior E, Vasques FA, Moron AF, Torloni MR, Nardozza LM. The cross-sectional area of umbilical cord components in normal pregnancy. Int J Gynaecol Obstet. 2007 Mar;96(3):156-61. doi: 10.1016/j.ijgo.2006.10.003, PMID 17280668
11. Salafia CM, Zhang J, Charles AK, Bresnahan M, Shrout P, Sun W. Placental characteristics and birthweight. Paediatr Perinat Epidemiol. 2008;22(3):229-39. doi: 10.1111/j.1365-3016.2008.00926.x
12. Thame M, Osmond C, Bennett F, Wilks R, Forrester T. Fetal growth is directly related to maternal anthropometry and placental volume. Eur J Clin Nutr. 2004;58(6):894-900. doi: 10.1038/sj.ejcn.1601909, PMID 15164110
13. Kalluru PK, Kalluru HR, Allagadda TR, Talur M, Gonepogu MC, Gupta S. Abnormal umbilical cord coiling and association with pregnancy factors. J Turk Ger Gynecol Assoc. 2024 Mar 6;25(1):44-52. doi: 10.4274/jtgga.galenos.2023.2023-3-3, PMID 38445471, PMCID PMC10921081
14. Pathak S, Hook E, Hackett G, Murdoch E, Sebire NJ, Jessop F, *et al*. Cord coiling, umbilical cord insertion and placental shape in an unselected cohort delivering at term: Relationship with common obstetric outcomes. Placenta. 2010 Nov;31(11):963-8. doi: 10.1016/j.placenta.2010.08.004, PMID 20832856
15. Barwari SS. Histological evaluation of placentas in idiopathic intrauterine growth restriction. Cureus. 2024 Oct 31;16(10):e72789. doi: 10.7759/cureus.72789, PMID 39493149, PMCID PMC11528041
16. Soongsatitanon A, Phupong V. First trimester 3D ultrasound placental volume for predicting preeclampsia and/or intrauterine growth restriction. J Obstet Gynaecol. 2019 May;39(4):474-9. doi: 10.1080/01443615.2018.1529152, PMID 30585097
17. Cox P, Marton T. Pathological assessment of intrauterine growth restriction. Best Pract Res Clin Obstet Gynaecol. 2009 Dec;23(6):751-64. doi: 10.1016/j.bpobgyn.2009.06.006, PMID 19854107
18. Hasegawa J, Arakaki T, Nakamura M, Takita H, Sekizawa A. Placental volume measurement in clinical practice. Donald Sch J Ultrasound Obstet Gynecol. 2015;9(4):408-12. doi: 10.5005/jp-journals-10009-1427
19. Holland OJ, Cuffe JS, Dekker Nitert M, Callaway LK, Ellwood D, Perkins AV. Placental mitochondrial function and structure in gestational diabetes mellitus. Placenta. 2017;54:59-66.