

CORRELATION BETWEEN PLACENTAL WEIGHT AND BIRTHWEIGHT OF NEWBORN AND ITS EFFECT ON NEONATAL OUTCOME

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ABSTRACT

Objective: To evaluate the correlation between placental and birth weights and to evaluate its effect on neonatal outcomes in term pregnancies.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Department of Obstetrics and Gynecology, Hameed Latif Hospital, Lahore, Pakistan, from October 2025 to February 2026

Methodology: Non-probability purposively selected 100 term (37-42 weeks of gestation) singleton pregnancies. Placental weight was measured within 1 hour of delivery. Birth weight of the newborn and the newborn's APGAR score were documented. Adverse neonatal outcomes were documented. Data analysis was performed using SPSS version 26, and either Spearman's correlation or Mann-Whitney U tests were applied. A p-value ≤ 0.05 was considered statistically relevant.

Results: The average weight of placentas was 653.62 ± 44.19 g, while that of babies was 2292.33 ± 215.33 g. The correlation between these two measures was very strongly positive ($r_s=0.703$, $p<0.001$). 84% of the neonates in this study weighed less than 2,500 g at birth, and 38% of them needed to be admitted to a NICU. The median placental weight of neonates with bad outcomes was lower than the median placental weight of those with good outcomes (652 g vs 710 g; $p=0.019$). A statistical analysis showed that there is also a relatively strong inverse correlation between placental weight and the possibility of negative perinatal outcomes ($r_s=-0.297$; $p=0.003$).

Conclusions: The weight of the placenta is positively correlated with the baby's birth weight and is negatively associated with adverse neonatal outcomes.

KEYWORDS: APGAR score, Birth weight; Neonate; Placental Weight

INTRODUCTION

The placenta is essential for normal fetal development and provides a conduit for nutrients and oxygen from right before birth to post-delivery. The weight of the placenta typically positively correlates with the birth weight of the newborn. In 2020, there were an estimated 19.8 million (14.7%) liveborns with low birth weight (<2500 grams) worldwide; these low birth weight (LBW) infants experience increased risk of neonatal mortality and morbidity(1). The overall neonatal mortality rate in Pakistan is 41 deaths per 1000 livebirths; many of these neonates are LBW(2). Research conducted locally has resulted in reports of high incidences of stillbirth and neonatal death of LBW infants(3).

Cross-sectional analyses of data have established that there is a strong positive correlation between placental weight and birth weight. Birth weight: placental weight ratios at term average between 4.7 and 6.3 in term pregnancies(4). Abnormal ratios exist when there are either high birth weight: placenta ratios (i.e., it is at the tenth percentile or higher) or low birth weight: placenta ratios (i.e., it is below the tenth percentile). Both of these ratio abnormalities are significant predictors of negative outcomes, such as a low APGAR score, the likelihood of being a small-for-gestational-age (SGA) neonate (aOR = 9.94), admission to the NICU, and respiratory distress(5). From available data, the mean placental weight in Pakistan is 0.667 kg, and the mean fetal weight is 3.016 kg, with maternal anemia and hypertension, diabetes being significant factors contributing to these means and indicating the highly vulnerable nature of this region(6,7).

This study is a cross-sectional study of the correlations between placental weight and birthweight and neonatal outcomes in Rawalpindi in an effort to address the lack of local epidemiological research in Pakistan, which has a large incidence of low-birth-weight babies. There is a global body of literature showing an association between placental efficiency and perinatal health. However, Pakistan has very little placental efficiency data after 2020 and

does not have data from multiple ethnic groups. This study provides baseline measures for use in risk stratification and in developing protocols in resource-poor Pakistani settings to help reduce rates of neonatal morbidity.

METHODOLOGY

This was a cross-sectional, analytical research study that took place within the Department of Obstetrics and Gynecology at Hameed Latif Hospital, Lahore, Pakistan. The study was conducted over a six-month time frame from October 2025 to February 2026 following the College of Physicians and Surgeons Pakistan (CPSP) Research Evaluation Unit's approval of the research synopsis and following written consent from each woman before enrollment, and in accordance with the Declaration of Helsinki and institutional ethical standards. A purposive/non-probability sampling design was utilized to recruit study participants.

Inclusion criteria: Eligible women were defined as pregnant women, aged 18-45 years, who are considered at term (between 37-42 weeks gestational age), and booked for delivery during the snippet data collection period, effective through and for 6 months.

Exclusion criteria: Pregnancy Women's who had multiple gestations, had an unknown gestational age, abnormal placentation (e.g., retained placenta or placental abruption), had systemic disease conditions (e.g., diabetes, hypertension, or cardiovascular disease), or had given a prior history of diabetes/hypertension anomalies, had experienced stillbirths, had a body mass index (BMI) of $<18 \text{ kg/m}^2$ or $>24.9 \text{ kg/m}^2$ were excluded from participation in this study. Fetal abnormalities were assessed by clinical appraisal only.

100 patients were assessed and enrolled based on a prior estimate of the sample size required to conduct power analysis. The sample size was calculated with 80% power of the study and 5% level of significance, with an expected correlation coefficient between placental and neonatal birth weight of 0.64(8).

Demographic and obstetrical information was collected from a structured interview upon admission to the hospital for delivery. Maternal anthropometric data were obtained at the time of delivery. Maternal height, weight, BMI, parity, and gestational age were documented. The delivery mode (vaginal or cesarean) was also recorded.

Immediately following delivery, the placenta was separated from all membranes and umbilical cord using aseptic technique and weighed on a calibrated manual scale by the attending caregiver in grams with $\pm$ one gram accuracy. The placenta was regularly processed and assessed for weight within one hour of delivery after full disconnection of membranes and clots, and the neonatal birth weight was measured using a calibrated scale and documented to the nearest gram. Trained staff obtained and documented the APGAR scores at 1 and 5 minutes of life. Neonatal outcomes such as APGAR scores <7 , NICU admission, respiratory distress, LBW ($<2500 \text{ g}$), and prematurity were documented. Data were entered into and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Shapiro-Wilk test results demonstrated that Maternal Age ($n=100$) had a statistically significant non-normal distribution ($p=0.000$), Height had a statistically significant non-normal distribution ($p=0.001$), as well as Weight ($p=0.001$), while BMI was found to have a statistically significant normal distribution ($p=0.288$). Data distributions for Systolic BP ($p=0.002$), Diastolic BP ($p=0.000$), and Gestational Age ($p=0.000$) were all statistically significant and non-normally distributed in nature; whereas Placental Weight was also found to have a statistically significant non-normal distribution ($p=0.036$). While Birth Weight has a statistically significant normal distribution ($p=0.483$). Both APGAR Scores (1 Minute) ($p=0.000$) and APGAR Scores (5 Minutes) ($p=0.000$), respectively, were found to have statistically significant non-normal distribution patterns. Variables that were normally distributed were represented as mean $\pm$ SD, and non-normally distributed variables are presented as median (IQR). We used Spearman's rank correlation to evaluate associations of placental weight, birth weight, maternal factors, and neonatal outcomes. To compare placental and birth weights of neonates with perinatal adverse outcome(s) to those without, we used the Mann-Whitney U test. Categorical variables were recorded using frequencies and percentages of the total. The level of significance was set at $p\text{-value} \leq 0.05$.

RESULTS

Maternal age had a mean ($\pm$ SD) of 31.17 ± 6.21 years, mean height $160.11 \pm 5.78 \text{ cm}$, and mean weight $63.08 \pm 7.32 \text{ kg}$; the average maternal BMI was $24.68 \pm 3.23 \text{ kg/m}^2$. The average systolic blood pressure was $124.52 \pm 14.37 \text{ mmHg}$ and diastolic blood pressure $77.12 \pm 10.58 \text{ mmHg}$. The mean gestational period was 39.06 ± 1.44 weeks. The mean placenta weighed $653.62 \pm 44.19 \text{ g}$, and the mean birth weight was $2292.33 \pm 215.33 \text{ g}$. Median maternal age was 32.00 (IQR) 11.75 years; Median systolic BP was 123.50 (IQR) 25.75 mmHg; Median diastolic BP was 76.00 (IQR) 20.00 mmHg; Median gestational age was 39.00 (IQR) 2.00 weeks; Median placental weight was 654.50 (IQR) 73.75 g; Median Apgar at 1 minute was 8.00 (IQR) 2.00 and at 5 minutes was 9.00 (IQR) 2.00.

Table I: Descriptive Statistics of Continuous Maternal and Neonatal Variables (n=100)

Variable	Mean $\pm$ SD	Median (IQR)
Maternal Age (years)	31.17 ± 6.21	32.00 (11.75)
Height (cm)	160.11 ± 5.78	160.00 (9.75)

Weight (kg)	63.08 ± 7.32	64.00 (12.75)
BMI	24.68 ± 3.23	-
Systolic BP (mmHg)	124.52 ± 14.37	123.50 (25.75)
Diastolic BP (mmHg)	77.12 ± 10.58	76.00 (20.00)
Gestational Age (weeks)	39.06 ± 1.44	39.00 (2.00)
Placental Weight (g)	653.62 ± 44.19	654.50 (73.75)
Birth Weight (g)	2292.33 ± 215.33	-
APGAR Score (1 min)	8.06 ± 0.81	8.00 (2.00)
APGAR Score (5 min)	8.91 ± 0.78	9.00 (2.00)

Values expressed as mean ± standard deviation and median (interquartile range). IQR = Q3–Q1.

In terms of pregnancy outcome (parity), we found that 26% of women delivered their first child, 24% of women had no children yet (nulliparous), and 22% of women had delivered three children (parous). Additionally, 17% of women delivered two children, and 11% delivered four children. Overall, 51% of fetal births were by cesarean delivery, while 49% were vaginal deliveries. Thirty-eight percent of infants needed to be admitted to the NICU, while thirty-three percent of all neonates had respiratory distress. Eighty-four percent of neonates delivered by their mothers weighed less than 2500 grams at birth. There were also no cases of low APGAR scores (less than 7) or premature birth noted. Finally, the overall number of neonates with negative outcomes was determined to be ninety-three percent.

Table II: Frequency Distribution of Obstetric and Neonatal Outcomes (n=100)

Variable	Category	n (%)
Parity	0	24 (24.0)
	1	26 (26.0)
	2	17 (17.0)
	3	22 (22.0)
	4	11 (11.0)
Mode of Delivery	Cesarean	51 (51.0)
	Vaginal	49 (49.0)
Low APGAR <7	No	100 (100.0)
NICU Admission	Yes	38 (38.0)
	No	62 (62.0)
Respiratory Distress	Yes	33 (33.0)
	No	67 (67.0)
Low Birth Weight (<2500 g)	Yes	84 (84.0)
	No	16 (16.0)
Preterm Delivery	No	100 (100.0)
Negative Perinatal Outcome	Yes	93 (93.0)
	No	7 (7.0)

Values expressed as frequency (percentage).

Neonates with negative perinatal outcomes had significantly lower median placental weights (g), 652.00 (170) g, vs 710.00 (74) g; $p=0.019$). Similarly, the median birth weight (g) of neonates with negative perinatal outcomes was 2271.00 (1156), vs 2625.00 (384); $p=0.019$).

Table III: Comparison of Placental and Birth Weight According to Negative Perinatal Outcome (n=100) using Mann-Whitney U test

Variable	Negative Perinatal Outcome = Yes Median (IQR)	Negative Perinatal Outcome = No Median (IQR)	p-value
Placental Weight (g)	652.00 (170)	710.00 (74)	0.019
Birth Weight (g)	2271.00 (1156)	2625.00 (384)	0.019

Statistically significant correlations ($p \leq 0.05$)

Among all mothers, there was a significant positive relationship between maternal weight and body mass index ($r_s=0.844, p<0.001$). In comparison to placental weight, the systolic blood pressure was found to have a significant negative relationship ($r_s=-0.928, p<0.001$), as well as the birth weight ($r_s=-0.666, p<0.001$). The placental weight and birth weight were both also significantly related to each other ($r_s=0.703, p<0.001$), and there was a significant inverse relationship between the placental weight and negative perinatal outcome ($r_s=-0.297, p=0.003$). The birth weight and

low body weight showed a significant inverse relationship ($r_s=-0.635, p<0.001$), as did the birth weight and negative perinatal outcome ($r_s=-0.412, p<0.001$). The APGAR score at 1 minute showed a weak positive relationship to low birth weight ($r_s=0.232, p=0.020$).

Table IV: Spearman Correlations Among Study Variables (n=100)

Variable 1	Variable 2	Spearman's rho (r_s)	p-value
Weight	BMI	0.844	<0.001
Weight	LBW (<2500 g)	-0.227	0.023
Systolic BP	Placental Weight	-0.928	<0.001
Systolic BP	Birth Weight	-0.666	<0.001
Placental Weight	Birth Weight	0.703	<0.001
Placental Weight	Negative Perinatal Outcome	-0.297	0.003
Birth Weight	LBW (<2500 g)	-0.635	<0.001
Birth Weight	Negative Perinatal Outcome	-0.412	<0.001
APGAR (1 min)	LBW (<2500 g)	0.232	0.020

statistically significant correlations ($p \leq 0.05$)

DISCUSSION

The correlation between placental weight and birth weight was examined in 475 pregnancies. This analysis showed a strong positive association ($r_s=0.703; p<0.001$). Lower placenta weights were correlated with higher incidences of adverse newborn outcomes. Overall, 93% of those with low birth weight (<2500g) were also associated with negative perinatal outcomes, including 38% being admitted to the NICU and 33% having respiratory problems. Neonates who had negative perinatal outcomes had a comparatively lower median placental weight compared with those with positive perinatal outcomes (652 g vs. 710 g, $p=0.019$) and median birth weight for the same groups (2271 g vs. 2625 g; $p=0.019$). Furthermore, negative perinatal outcome had a negative correlation with placental weight ($r_s=-0.297; p=0.003$) as well as systolic B.P. ($r_s=-0.928; p<0.001$). In addition, maternal weight was positively correlated with BMI ($r_s=0.844; p<0.001$), while 84% of low birth weight neonates were diagnosed with placental insufficiency despite (mean=39.06 weeks) gestationally term pregnancies.

A moderate to strong Spearman correlation ($r_s=0.703$) similarity was felt between studies from Sathasivam et al. (2023) & others and our own. This correlation is echoed by Sathasivam et al.'s (2023) cross-sectional study of 211 term Sri Lankan placentas, which shows a Pearson correlation of $r=0.454$ ($p<0.0001$) using linear regression as outlined by the formula: birth weight = $(1.4553 \times \text{placental weight}) + 2246.7\text{g}$ ($R^2=0.212$)(9). The findings of a Thai study conducted in 2025 also showed that placental weight is a predictor of birth weight; however, in that study, placental weights were significantly lower (mean=494 g compared to our study's mean=654 g) which drove the ratio of placental weight: b.w.t of ~6:1 whereas our implied ratio is ~3.5:1 (2292 g/b.w.t = 654g)(10). The strong r_s value obtained in our study may reflect population-specific variables related to South Asian mothers (i.e., mean BMI of 24.68 kg/m² for South Asian mothers), who may have different maternal characteristics than other Asian cohorts (i.e., $r=0.219$ with BMI). While Damhuis et al. (2023) report that placental dysfunction can occur across all birth weights and may be an indirect predictor of low birth weight, our study emphasizes the role of low placental mass as a direct predictor, while also having no cases of premature infants but a very high prevalence of low birth-weight infants(11). The consistent positive relationship between maternal body mass index (BMI) and weight found in this study, as well as a 2025 Sri Lankan study, indicates that higher maternal BMI results in placenta weight, however; the correlation between maternal BMI and placental weight in the current sample ($r=0.844$) suggests a stronger association than the correlation found in 2019 study ($r=0.219$ (12,13)). A negative correlation between systolic blood pressure (BP) and weight of the placenta ($r=-0.928$) is consistent with studies that indicate the effect of BP on the relationship between obesity and birth weight (BW): placental weight (PW) mediating through impaired vascular perfusion in uncomplicated pregnancies; this is consistent with findings from Phaloprakarn and others' study (2025), which show no overall significant difference in BW: PW ratios between women with gestational diabetes (GDM) and women without GDM; the current studies demonstrate similar outcomes in women with normal BMI but no diabetic bias, suggesting that BP is an independent inhibitor of placental growth(10). The authors conclude that BP monitoring during pregnancy should be done to better predict placental growth, particularly since the mean BP (124 mmHg systolic; 77 mmHg diastolic) of the current study group is at or just below the hypertensive cut-off for 10% to 20% risk of adverse outcomes(14).

Negative consequences are linked to lower placental weights ($r_s=-0.297, p=0.003$), which support the earlier analyses of 2025 (where birth weight/placental weight below 10% increased chances of being small for gestational age (odds ratio 9.94) and have an incidence of chorangiosis of up to 66.7%, similar to 38% of infants admitted to the NICU and 33% in distress). A 2022 study conducted in Ethiopia demonstrated that low placental parameters are associated with

low birth weight, which closely parallels the incidence of low birth weight among the baby's being greater than 84% (<2500 g) with a median apgar of 8-9 and suggests that the baby had experienced subclinical rather than overt asphyxia due to a lack of oxygen(15). Importantly, negative outcomes in our study of 93% far exceed the composite (40%) from the study by Phaloprakarn, likely due to much broader definitions of distress/NICU vs exclusive definitions of SGA/RDS(10); however, both studies identify placental weight as an indicator of placental efficiency. There were no cases of low apgar documented in study by Phaloprakarn that relate to the study by 2024 conducted in Pakistan that demonstrates increased PW:BW in the infants with low apgar, which would suggest that infants had failed early compensation(16). The authors suggest that respiratory distress is the primary mediator and, therefore, ultrasound examinations of placental volume should be monitored.

The Spearman correlations illustrate strong correlations (e.g., birth weight-adverse outcomes $r_s = -0.412$, $p < 0.001$) as well as in 2024 Dutch cohorts hypoxic infants (peak incidence in lower centiles), strong positive correlations between Apgar 1-minute scores of low birth weights ($r_s = 0.232$, $p = 0.020$)(17) in contrast to previously reported trends in contrary literature and may be due to the compositional make-up of the resilient term cohort without 'gestational age' at the time of sample collection(18).

The effect of placental weight on birth weight from the 2025 Mexico Logistics database (1 gram rise in placental weight = 1.98 grams increase in birth weight) compared to our calculated change (58 grams rise in placental weight = 354 grams increase in birth weight) supports the need for higher-order nomograms across regions(19).

Delivery methods in our cohort (51% Cesarean deliveries) align with worldwide trends regarding low birth weight-associated risk; however, the parity distribution (26% primiparous women) requires additional caution when comparing data with studies that have a higher proportion of multiparous women. Clinically, this reinforces the premise that placental weight is a harbinger of perinatal outcome, with adverse outcomes indicating intervention thresholds.

Limitations of the Study

Cross-sectional studies do not allow for causal relationships but may only be able to provide limited information about temporal relationships between BP and the placenta. The single-center nature of the study (focusing solely on term infants and without stated criteria for excluding infants with pathology) leaves the results open to selection bias, as the power of the subgroup of babies with GDM is small. The reliance on maternal self-reporting of gestational age may inflate the rate of term infants born, particularly in light of the lack of standardized ultrasound assessments performed in 2023 cohorts. The high rate (93%) of negative outcomes (as defined by the American Academy of Pediatrics) in this cohort indicate that there may be a broader definition of negative outcome or that there may have been unmeasured confounders that contribute to the negative outcomes, such as socioeconomic factors, which are not observed in other studies with lower rates of RDS mortality (37%).

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