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Original Research Article

Correlation between placental weight and birth weight of the newborn and its effect on perinatal outcome: a hospital based cross-sectional study

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ABSTRACT

Background: The placental weight and its correlation with birth weight have been studied extensively for their potential associations with fetal growth and perinatal outcomes. This study aimed to investigate the correlation between placental weight and birth weight of newborns and evaluate the effects of this correlation on perinatal outcomes.

Methods: This hospital-based cross-sectional study included 50 pregnant women with singleton pregnancies without comorbidities. Placental weight was measured immediately after delivery, and birth weight was recorded within the first hour. Perinatal outcomes such as Apgar scores, neonatal intensive care unit (NICU) admission, and respiratory distress were documented. Statistical analysis included descriptive statistics, Pearson's correlation coefficient, and appropriate tests to analyze the effects of placental weight and birth weight on perinatal outcomes.

Results: A positive correlation was observed between placental weight and birth weight of newborns. No significant differences were found in mean birth weight and placental weight across gestational age groups. Lower birth weights and placental weights were associated with adverse perinatal outcomes, including lower Apgar scores, increased NICU admissions, and higher incidence of respiratory distress.

Conclusions: The positive correlation between placental weight and birth weight reinforces the crucial role of the placenta in supporting fetal growth and development. Deviations from normal placental weight may signal underlying placental insufficiency or pathological conditions, increasing the risk of adverse perinatal events. Monitoring placental weight and fetal growth during pregnancy may help identify high-risk pregnancies and optimize perinatal outcomes.

Keywords: Placental weight, Birth weight, perinatal outcomes, Apgar scores, NICU admission, Respiratory distress, Fetal growth, Placental function

INTRODUCTION

The placenta plays a crucial role in the intrauterine growth and development of the fetus, facilitating the exchange of nutrients, gases, and waste products between the maternal and fetal circulations.¹ As a highly specialized organ, the placenta undergoes significant morphological and functional changes throughout pregnancy to meet the

increasing demands of the growing fetus.² The weight of the placenta at delivery is considered a reflection of its functional capacity and has been extensively studied for its potential association with fetal growth and perinatal outcomes.³

Birth weight is a widely recognized indicator of fetal growth and is closely linked to the overall health and

survival of the newborn.⁴ Low birth weight (LBW), defined as a birth weight of less than 2,500 grams, is a significant public health concern, as it is associated with an increased risk of perinatal morbidity and mortality, as well as long-term adverse consequences, such as impaired growth and neurodevelopmental delays.⁵

Several studies have explored the relationship between placental weight and birth weight, with the general consensus being that placental weight is positively correlated with birth weight.⁶ However, the strength of this correlation and its potential implications for perinatal outcomes remain subjects of ongoing research and debate.

Placental weight is influenced by various factors, including maternal characteristics (age, parity, nutritional status, and pre-existing medical conditions), fetal factors (gestational age, genetic factors, and fetal growth patterns), and environmental exposures (altitude, pollutants, and toxins).⁷ Similarly, birth weight is influenced by a multitude of factors, such as maternal health, gestational age, fetal genetics, and placental function.⁸

Understanding the correlation between placental weight and birth weight, as well as their respective associations with perinatal outcomes, can provide valuable insights into fetal growth patterns, placental adaptations, and potential risk factors for adverse perinatal events.⁹ This knowledge may inform clinical decision-making, risk stratification, and the development of interventions aimed at optimizing placental function and fetal growth.

This hospital-based cross-sectional study aims to investigate the correlation between placental weight and birth weight of newborns and to evaluate the effects of this correlation on perinatal outcomes. By examining a diverse population of pregnant women and their newborns, this study seeks to contribute to the existing body of knowledge and provide a better understanding of the complex interplay between placental weight, fetal growth, and perinatal outcomes.

METHODS

This was a hospital-based cross-sectional study conducted at a S. Nijalingappa Medical College and H. S. K. Hospital and Research Centre Bagalkot over a period of six months, from April 2023 to September 2023. The study protocol was approved by the Institutional Review Board, and written informed consent was obtained from all participants.

Inclusion criteria

Pregnant women with singleton pregnancies, without any co-morbidities, who came to deliver at the tertiary care hospital during study period, were included in the study.

Exclusion criteria

Patients with multiple pregnancies, pregnancies complicated with hypertension, diabetes, and anemia and pregnancies associated with intrauterine fetal demise were excluded from the study.

The sample size was estimated using MedCalc software. At a 95% confidence level and 80% power of the study, with a two-tailed α of 0.050 and β of 0.200, the standard normal deviates for α (Z_α) and β (Z_β) were 1.960 and 0.842, respectively. Based on a previous study by Rao et al, which reported a correlation coefficient of 0.46 between placental weight and birth weight, the sample size was calculated using the formula given.¹⁰

$$N = ([Z_\alpha + Z_\beta]/C)^2 + 3, \text{ where } C = 0.5 \times \ln([1 + r]/[1 - r])$$

The estimated sample size was 42, which was rounded up to 50 participants for the study.

Informed written consent was obtained from all eligible participants who agreed to participate in the study. Relevant demographic and obstetric data were collected from the participants using a structured questionnaire. After delivery, the placental weight was measured immediately using a calibrated weighing scale in the labor room. The birth weight of the newborn was recorded within the first hour of delivery using a calibrated weighing scale. Perinatal outcomes, such as Apgar scores, admission to the neonatal intensive care unit (NICU), and any complications, were documented.

The data were analyzed using appropriate statistical software. Descriptive statistics were used to summarize the demographic and obstetric characteristics of the participants. The correlation between placental weight and birth weight was assessed using Pearson's correlation coefficient. The strength of the correlation was interpreted based on the correlation coefficient values. The effects of placental weight and birth weight on perinatal outcomes were analyzed using appropriate statistical tests, such as student's t-test, analysis of variance (ANOVA), or regression analysis, as applicable. A p value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 provides an overview of the key demographic and obstetric characteristics of the 50 participants included in the study. It shows the mean maternal age was 27.4 years with a standard deviation of 4.2 years. Around 48% were primigravida (first pregnancy) and 52% were multigravida (more than one pregnancy). The mean gestational age at delivery was 38.6 weeks with a standard deviation of 1.3 weeks. 70% of deliveries were vaginal, and 30% were caesarean sections. The table also provides data on Apgar scores at 1 and 5 minutes, NICU admissions, and respiratory distress in the newborns.

Figure 1 shows a strong positive correlation between placental weight and birth weight. This correlation was statistically significant ($p < 0.001$).

Table 1: Demographic and obstetric characteristics of the study participants (n=50).

Characteristics	Mean±SD or N (%)
Maternal age (years)	27.4±4.2
Gravidity	
Primigravida	24 (48)
Multigravida	26 (52)
Gestational age at delivery (weeks)	38.6±1.3
Mode of delivery	
Vaginal delivery	35 (70)
Caesarean section	15 (30)
Apgar score at 1 min	
<7	40 (80)
>7	10 (20)
Apgar score at 5 min	
<7	36 (72)
>7	14 (28)
NICU admission	
Yes	37 (74)
No	13 (26)
Respiratory distress	
Yes	15 (30)
No	35 (70)

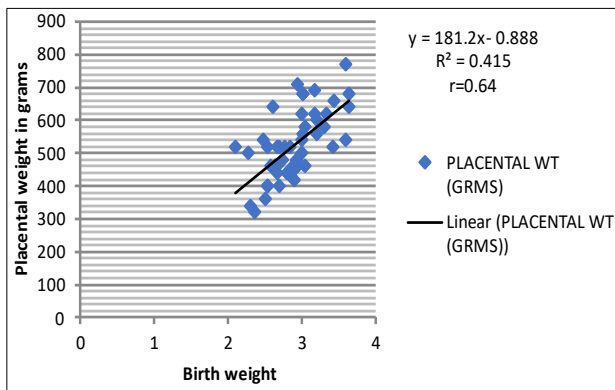


Figure 1: Correlation between placental weight and birth weight.

Table 2: Mean birth weight and placental weight by gestational age.

Gestational age	Birth weight	Placental weight
37-37+6	2.78±0.58	512±131
38-38+6	2.73±0.26	520.9±104.9
39-39+6	2.94±0.38	516.7±87.5
40-40+6	2.93±0.32	496.9±90.2
41-41+6	2.94±0.12	595±98.4
P value	0.519	0.529

Table 2 shows the mean birth weights and mean placental weights stratified by gestational age categories, there was no statistically significant difference in birth weight and placental weight according to gestational age ($p > 0.05$).

Table 3 compares various perinatal outcomes (Apgar scores at 1 and 5 minutes, NICU admission, respiratory distress) with birth weight and placental weight. It shows the mean birth weight and mean placental weight was statistically more in good outcomes compared to poor perinatal outcomes ($p < 0.05$).

Table 3: Comparison of perinatal outcomes by birth weight categories.

Perinatal outcome	Mean birth weight	Mean placental weight
Apgar score at 1 min		
<7	2.4±0.3	381.3±63.6
>7	3.1±0.2	453.4±71.4
P value	<0.001	0.003
Apgar score at 5 min		
<7	2.5±0.25	401.5±55.1
>7	3±0.18	485.6±65.7
P value	<0.001	<0.001
NICU admission		
Yes	2.6±0.32	421.4±76.5
No	3.2±0.22	503.8±80.1
P value	<0.001	0.002
Respiratory distress		
Yes	2.45±0.28	390.5±65.9
No	3.05±0.21	470.1±75.7
P value	<0.001	0.001

DISCUSSION

The fetoplacental weight ratio, the ratio of birth weight to placental weight, is considered to reflect the physiologic balance between these two interdependent but potentially competing growth trajectories. The placenta is the single greatest oxygen consumer in utero; in times of deprivation, the placenta can metabolize fetally derived glucose, potentially to fetal detriment. If the fetal growth outstrips the placenta, the fetus may face the stresses of parturition with reduced functional reserves. If the different dimensions of placental growth (e.g., the lateral expansion within the uterine lining measured as larger and smaller placental diameters and disk thickness) have similar effects on birth weight and placental weight across variable ranges, the fetoplacental weight ratio will not change. A greater effect on birth weight than placental weight will increase the fetoplacental weight ratio. Conversely, if placental weight increases with a steeper slope than birth weight (placental growth enhanced to a greater extent than fetal growth), the fetoplacental weight ratio will fall. If any placental gross growth dimensions, or even distinct ranges of any variables, showed such relationships, they would be potential markers of fetuses with distinctive intrauterine environments (fetal-growth

promoting>placental growth promoting, “balanced”, and placental-growth promoting>fetal growth promoting). Either of the “unbalanced” relationships could be hypothesized to mark stressful fetal-placental physiologic states. It is hard to think of a biologically plausible “healthy” reason why a placenta should be getting larger while the fetus it is supplying does not. In general, maximal fetal growth would be considered a biologically “good outcome”, the baby with a fetoplacental weight ratio of 10:1 would be expected to have a different intrauterine cardiovascular and endocrine “experience” (to name two examples) than a baby with a normal fetoplacental weight ratio of 7.5 ± 1.1 , or a baby with a fetoplacental weight ratio of 5:1.

The weight of the placenta is used in the determination of the foeto-placental ratio. The weight of the placenta gives an idea of the amount of substance that is exchanged between the mother and the foetus.

The results of this study demonstrated a positive correlation between placental weight and birth weight of newborns. This finding is consistent with several previous studies that have reported a positive association between these two variables.^{4,6,7}

In contrast, Lurie et al mean placental weight was found to be higher than the one obtained here.¹¹ Since Borton gave a range for the term placental weight, the mean placental weight obtained fell within this range even though the range here was 289-815 gm. This indicates that the mean placenta weight differs from place to place and may be due to so many factors such as nutrition, genetics, gestational age, maternal size, etc. It was found that the placental weight correlates significantly with the weight of the baby and for every 1g increase in the placental weight, the foetal weight increases by 2g and this corresponds to Luz et al who found that for every 1g increase in placental weight, the foetal weight increases by 1.98 g.¹² Since the weight of the placenta correlated positively with the fetal weight, it then implies that, factors which directly affect the weight of the baby will indirectly affect the weight of the placenta. Such factors could include nutrition, maternal size, maternal haemoglobin gain, altitude, paternal factors, maternal and paternal genetics, gestational age, and maternal diabetes mellitus.

We found no significant difference in mean birth weight and placental weight across different gestational age groups. This contrasts with some earlier studies that suggested placental weight increases with advancing gestational age, likely as an adaptive mechanism to meet the growing nutritional demands of the fetus.⁷

The most significant findings were presented in Table 3, which compared perinatal outcomes based on birth weight and placental weight categories. Newborns with lower birth weights and lower placental weights were more likely to have poor Apgar scores at 1 and 5 minutes, require

NICU admission, and experience respiratory distress. These associations between lower birth weight, lower placental weight, and adverse perinatal outcomes align with the findings of several previous studies.^{3,9}

For instance, a large cohort study by Hutcheon et al reported that both low and high placental weights for gestational age were associated with an increased risk of adverse perinatal outcomes, including low Apgar scores, NICU admission, and respiratory distress.³ Similarly, Naeye found that placental weight was positively correlated with birth weight and that deviations from the normal placental weight-birth weight ratio were associated with an increased risk of perinatal complications.⁹

The positive correlation between placental weight and birth weight observed in this study is likely due to the crucial role played by the placenta in facilitating the transfer of nutrients and gases to the fetus, thereby supporting fetal growth and development.^{1,2} A well-functioning placenta with adequate weight and vascular development can better meet the metabolic demands of the growing fetus, leading to higher birth weights and better perinatal outcomes.

It is important to note that while this study establishes associations between placental weight, birth weight, and perinatal outcomes, causality cannot be inferred from these cross-sectional data. Further prospective studies are needed to elucidate the underlying mechanisms and potential confounding factors that may influence these relationships.

Strengths

Overall, the findings of this study contribute to the growing body of evidence highlighting the importance of placental weight and its relationship with fetal growth and perinatal outcomes. These results may have implications for clinical practice, such as identifying high-risk pregnancies based on placental weight deviations and implementing appropriate interventions to optimize perinatal outcomes.

Limitations

The lack of difference observed in this study could be attributed to the relatively small sample size or the narrow gestational age range included.

This study only establishes associations between placental weight, birth weight, and perinatal outcomes, causality cannot be inferred from these cross-sectional data.

Future perspectives

Further prospective studies are needed to elucidate the underlying mechanisms and potential confounding factors that may influence these relationships.

CONCLUSION

This study found a positive correlation between placental weight and birth weight of newborns, consistent with previous research. Lower birth weights and placental weights were associated with adverse perinatal outcomes like low Apgar scores, increased NICU admissions, and respiratory distress. No significant differences were observed in birth weight and placental weight across gestational age groups. The positive correlation highlights the crucial role of the placenta in supporting fetal growth and development. These findings emphasize the importance of monitoring placental weight and fetal growth during pregnancy to identify high-risk cases and optimize perinatal outcomes.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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