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Correlation between Placenta Weight and Birth Weight at Full Term Pregnancy

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ABSTRACT

Placental pathology is a recognized factor contributing to perinatal adverse health outcomes, and it might be linked to the growth of the placenta, potentially being evaluated through indirect physical measurements. **Objective:** To examine the average weight of the placental tissue and its association with newborn weight. **Methods:** The study, conducted at Civil Hospital, Karachi, from October 2017 to February 2018, was a descriptive cross-sectional study. It enrolled 36 primigravida females with singleton pregnancies who delivered in the labor room.Placental weight and newborn weight were recorded at the time of delivery, and a structured questionnaire was completed for each participant. **Results:** The average age of participants was 25.5 years, with a typical pregnancy period of 38.8 weeks. Mean placental weight was 604 grams (range 500-670 grams), and mean fetal weight was 2958 grams (range 2500-3400 grams). A statistically significant positive correlation was found between placental weight and neonatal weight (Pearson's correlation at the 0.01 level), as well as between maternal age and placental weight (significant at the 0.05 level). **Conclusions:** This study establishes a reference range for placental and fetal weight in the Pakistani population and highlights the significant correlation between the two. Placental weight serves as a reliable indicator of fetal health, underlining the importance of monitoring placental development and assessing the placenta post-delivery to evaluate neonatal health.

INTRODUCTION

Placental pathology is a recognized factor contributing to perinatal adverse health outcomes, and it might be linked to the growth of the placenta, potentially being evaluated through indirect physical measurements. The current study, based on a cross-sectional study design aimed to examine the average weight of the placental tissue and its association with newborn weight [1]. The placenta has a crucial responsibility in supporting a healthy pregnancy through promoting the transfer of oxygen, macronutrients and micronutrients between the mother and the growing fetus thus maintaining a healthy pregnancy [2]. Although the placenta plays a critical role in eutherian pregnancy, it has not received the level of attention it truly warrants. Recent research highlights that the placenta is not only the primary organ for supplying essential substances to the growing fetus but also plays a critical role in modulating the endometrial intracellular environment, ensuring a successful pregnancy. Contrary to the traditional focus on maternal factors, growing evidence suggests that placental tissue cells and their secretory factors are pivotal to modulating the mother's immune response and promoting immunological system adaptation during

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pregnancy [3].The placenta performs a key function in regulating nutrient transfer to the developing embryo throughout gestation.Proper placental function is therefore crucial for ensuring normal fetal growth.One of the most prevalent pregnancy complications is fetal growth restriction, or Intrauterine Growth Restriction (IUGR), commonly associated with compromised placental function[4].Placental weight reflects the balance between fetal nutrient demand and placental nutrient supply, influencing birth weight outcomes[5].The development of the placenta is essential for fetal well-being. Placental weight is a marker of proper metabolism and healthy pregnancy.Thus, the placental weight reflects fetal growth and perinatal well-being [6-8].The typical weight of a trimmed term placenta is 510 g, with a diameter of 185mm, a thickness of 23 mm, and an average volume of 500ml. Additionally, weight of the placenta varies between 300g and 890g depending on birth weight, with a mean of 590± 82g [1].A low placental weight may indicate inadequate placentation, while a higher placental weight could result from diabetes in the mother or excessive weight gain during pregnancy. Both of these conditions are recognized as predisposing factors for unfavorable results for the mother and fetus, as well as potential long-term effects on the newborn [9].Increased weight of the placenta, or a higher placental weight relative to birth weight, has been associated with various negative consequences, including low Apgar scores, respiratory distress in newborns, perinatal loss, and cardiovascular fatalities in later life[10]. Placental weight shows a positive correlation with neonatal birth weight.However, the proportion of placental weight to neonatal birth weight decreases as the pregnancy duration increases.Therefore, extending pregnancy beyond term may negatively impact fetal health [11].Abnormalities in placental weight can indicate potential placental insufficiency or underlying pathological conditions, raising the risk of negative perinatal outcomes.Regular monitoring of placental weight and fetal growth throughout pregnancy can help identify high-risk cases and improve perinatal outcomes[12]. In a study conducted by Zhang K *et al.*, it was observed that gestational weight gain showed a significant correlation with both the weight and the volume of the placenta, with the connection being particularly noticeable in women who were classified as underweight or had normal weight before pregnancy[13]. Salavati *et al.*, (2019) found that greater placental weight at term is positively associated with higher bone mass and improved body composition in childhood [14]. Mayhew *et al.*, (2020) used stereology to reveal distinct placental morphological changes in pre-eclamptic pregnancies, especially when accompanied by fetal growth restriction [15].A research study by Janthanaphan M *et al.*, revealed that the mean placental to birth ratio was 17.08%, showing a slight decline with increasing gestational age [16]. It also identified a strong link between decreases in placental weight falling beneath the 10th percentile and associated fetal compromise [16]. In their Ukrainian research, Little RE *et al.*, determined that the placenta was readily accessible, provided consistent measurements, and by revealing a distinct aspect of fetal growth served as a valuable research tool [17].Disorders of the placenta are a well-recognized driver of perinatal and neonatal death and illness, often precipitating harmful outcomes for both mother and infant.Conducting a comprehensive placental evaluation, including gross inspection, microscopic analysis, immunohistochemical staining and, when indicated, genetic testing, is essential for detecting these pathologies. Fetal growth and thriving in utero rely critically on placental function[1].The placental weight serves as an indicator of placental efficiency. However, it is worth emphasizing that morphometric measurements of the placenta vary significantly across different regions, countries, and even within regions of the same country. The ethnic and ancestral backgrounds of both mother and fetus also contribute to these variations.This study aimed to assess the mean placental weight of term newborns and its association with birth weight at a tertiary care hospital in Karachi, Pakistan.This study was conducted at Civil Hospital Karachi, a setting where no previous research has focused on placental weight within the local population. By concentrating on this hospital, it was aimed to address the unique characteristics and health outcomes of the population living in Karachi.

The findings from this study provide meaningful understanding of the role of placental weight within the framework of neonatal health in this specific region, which has not been previously explored in detail.

METHODS

This study, designed as a prospective cross-sectional analysis, took place in the Department of Obstetrics and Gynecology, Unit-1 of Civil Hospital Karachi, between October 2017 and February 2018 following formal approval from the College of Physicians and Surgeons of Pakistan (Letter reference number: CPSP/REU/OBG-2016-183-7218). A sample size of 36 was determined using the WHO software [16]. Non-probability consecutive sampling techniques were employed. Females aged 18-30 years, booked, primigravida, having singleton pregnancies (confirmed by ultrasound scan at booking) with no comorbidities and a normal BMI (between 20-15 kg/m2) were included in this study. The decision to include only primigravida women with normal BMI was made to reduce potential confounding factors that could affect placental weight and neonatal outcomes. Primigravida women were chosen because first-time pregnancies may have different placental and fetal growth patterns compared to subsequent pregnancies, which could influence the

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results. Additionally, women with abnormal BMI (either underweight or overweight) were excluded, as abnormal BMI has been associated with increased risks of delivering small for Gestational Age (SGA) or Large for Gestational Age (LGA) babies, which could introduce variability into the analysis of placental weight and its association with birth outcomes. While this selective inclusion helps to control for known variables that may affect the outcomes of the study, it does restrict the applicability of the findings to the wider population. The results may be more applicable to primigravida women with a normal BMI, and further research including a more diverse sample of women, with varying BMI and parity, is necessary to explore how these factors influence placental weight in relation to perinatal outcomes in different populations. To ensure an accurate link between placental weight and neonatal outcomes, certain groups were excluded women from the study. Women who were unbooked, indicating possible socioeconomic disadvantage and limited access to prenatal care, as well as those with pre-existing conditions such as diabetes mellitus and hypertension or other chronic medical issues, were not included as these conditions can significantly affect placental function and fetal growth. Additionally, pregnancies classified as preterm or post term were excluded from the study to eliminate the potential impact of gestational age on placental weight and neonatal outcomes. This selection criteria helped control for confounding factors related to maternal health, nutritional and socioeconomic status, allowing for a more focused analysis of the interplay between placental weight and neonatal outcomes in the studied population. By excluding these factors, it was aimed to ensure that the study focused on a more homogenous group, minimizing the potential impact of these confounders on the relationship between placental weight and neonatal outcomes. This study primarily aimed to assess the correlation between placental mass and neonatal birth weight in full-term deliveries. Following approval from the CPSP, and the ethical review committee, data were collected. Consecutive booked patients presenting to the labour room and undergoing normal vaginal delivery or delivered by surgical assistance (vacuum vaginal delivery, forceps vaginal delivery or cesarean section) meeting the inclusion criteria were enrolled after taking an informed consent. Weight of newborn was taken immediately after birth on a standard set weight scale (with no zero error). Following delivery of the placenta, it was rinsed with water to eliminate blood clots and then weighed using the same scale. Data collection was conducted using a proforma to gather necessary information, including demographic variables such as maternal age, gestational age, weight, height, Body Mass Index (BMI), and outcomes such as neonatal weight and placental weight. All data were collected and entered by the primary investigator. SPSS software, version 21.0, was utilized for data entry and analysis. The mean ± SD was calculated for continuous variables such as maternal age, weight, height, BMI, gestational age, and the weight of the newborn and placenta. Frequency and percentage were computed for categorical variables, including newborn gender. To evaluate the association between placental weight and neonatal weight, Pearson's correlation coefficient was employed. Two-tailed testing was used to account for both positive and negative associations, as no specific direction of the relationship was hypothesized. Statistical significance was defined as a p-value of less than 0.05. Influencing factors, including maternal age, gender, gestational age, weight, height, BMI, and pregnancy duration, were adjusted using stratification. Post-stratification, the correlation coefficient was recalculated.

RESULTS

A sum of 36 primigravida females who met the requirements for inclusion were involved in the research. Table 1 summarized the mean values of the key variables in the study. The data includes 36 participants with no missing values. This table presents the mean, median, mode, standard deviation, and range for variables such as age, gravida (number of pregnancies), weight, height, BMI, gestational duration, placental weight, and fetal weight. Key observations include a mean age of 25.58 years, a mean BMI of 22.57, an average gestational duration of 38.86 weeks, and average placental and fetal weights of 604 grams and 2958.33 grams, respectively. The table highlighted the central tendency and spread of these variables, providing insight into the sample characteristics.

Table 1: Demographics of the Study Participants

Variable	N (Valid)	Missing	Mean ± SD	Median	Mode	Range
Age	36	0	25.58 ± 2.98	26.00	26.00	12.00
Gravida	36	0	1.00 ± 0.00	1.00	1.00	0.00
Weight (kg)	36	0	2.42 ± 0.55	2.00	2.00	2.00
Height (cm)	36	0	164.03 ± 5.52	165.00	165.00	29.00
BMI	36	0	22.57 ± 1.19	22.00	22.00	4.47
Duration (weeks)	36	0	38.86 ± 0.95	39.00	39.00	4.00

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Placenta Weight (g)	36	0	604.00 ± 39.17	605.00	600.00	170.00
Fetal Weight (g)	36	0	2958.33 ± 223.45	2950.00	2900.00	900.00

N=Number

A marked association was observed between placental weight and fetal size or weight, as determined by the Pearson correlation coefficient (at the 0.01 significance level) as demonstrated in Table 2.

Table 2: Association between placental, fetal weights and Age using Pearson Correlations

Variables	Placental Weight	Fetal Weight
Placenta Weight	Pearson Correlation	1
	Sig. (2-tailed)	-
	N	36
Fetal Weight	Pearson Correlation	0.602**
	Sig. (2-tailed)	0.000
	N	36
Age	Pearson Correlation	0.309*
	Sig. (2-tailed)	0.003
	N	36

* Correlation is significant at the 0.05 level (2-tailed)

Among the singleton pregnancies, 19 infants and 17 infants were males and females respectively. The average BMI of the patients was 22.56 kg/m2, with a strong positive link observed between the weight of the fetus, the weight of the placental and the BMI of the patient.

Figure 1 and 2 demonstrated the chorionic and the basal plate of the placenta and the photographs were taken during data collection.

Figure 1: Fetal Surface of a Term Placenta with Central Cord Insertion

DISCUSSION

The perinatal mortality rate, ranging from 63 to 92 per 1,000 births in two provinces of Pakistan, is notably high. A large proportion of births and neonatal deaths take place in household settings and go unrecorded. Despite the implementation of several effective child survival programs, their impact on perinatal health remains limited [18]. Placental weight is increasingly recognized as a key determinant of fetal development, neonatal outcomes, and long-term health. Hasegawa *et al.*, demonstrated that estimating placental weight using ultrasonography in the second trimester can serve as a valuable predictor of fetal growth, underscoring the clinical utility of prenatal imaging in early risk assessment [19]. Faupel-Badger *et al.*, found a significant association between increased placental weight and the risk of childhood obesity, suggesting that placental development may influence postnatal metabolic programming [20]. Similarly, Burton *et al.*, emphasized that disruptions in placental structure and function contribute to the developmental origins of chronic diseases, reinforcing the long-term implications of placental health [21]. In pregnancies affected by maternal obesity, O'Tierney-Ginn *et al.*, observed an increase in placental weight and alterations in fetal body composition, highlighting the placenta's role as a mediator between maternal metabolic status and fetal growth [22]. Heazell *et al.*, provided mechanistic insight by linking intrauterine growth restriction to increased placental apoptosis and altered angiogenic signaling, suggesting pathological remodeling of the placenta in response to suboptimal intrauterine conditions [23]. Moreover, Karayiannis *et al.*, reported that heavier placentas are associated with better neonatal anthropometric outcomes, while Jensen *et al.*, noted that an imbalanced placental-to-birth weight ratio may elevate the risk of neonatal complications [24, 25]. Finally, Abduljalil *et al.*, emphasized the importance of placental weight in predicting fetal drug and nutrient exposure, which has implications for both clinical pharmacology and personalized prenatal care [26]. A thorough examination of the placenta can uncover important pathological characteristics, such as hypoplasia, infarction, and retroplacental hemorrhage, which indicate maternal vascular mal-perfusion therefore, placental weight serves as a reliable indicator of placental function [27]. The primary role of the placenta is to supply oxygen and nutrients to the fetus, and its proper function is crucial for fetal health. It has been proposed that placental weight indicates the placenta's capacity to effectively deliver nutrients to the fetus. Although considerable attention has been given to understanding the placenta's role in fetal development, the significance of placental weight remains relatively unexplored [27]. While this study measures placental weight after delivery, the findings still have significant implications for clinical practice in predicting perinatal outcomes. The weight of the placenta after delivery can act as an effective indicator of its function during pregnancy, potentially identifying cases of placental insufficiency or abnormal fetal growth. By comparing placental weight to neonatal outcomes,

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clinicians can gain insights into possible complications related to fetal development, such as intrauterine growth restriction or other birth-related issues.This information may be useful for future pregnancies, allowing healthcare providers to monitor at-risk individuals more closely and take preventive measures when necessary.Additionally, the findings from this study may offer valuable contributions to the development of post-delivery guidelines for evaluating placental health, aiding in the management of long-term maternal and neonatal health. Although the study included a relatively small sample size of 36 participants, it is important to highlight that it was designed to detect key relationships between placental weight and neonatal outcomes, based on existing data and the WHO software for sample size calculation.However, a larger sample size would certainly increase the statistical power and reliability of the findings, making the results more generalizable to broader populations. Future research with a larger cohort is recommended to further strengthen the conclusions and better understand the relationships between placental weight and neonatal health outcomes.

CONCLUSIONS

This study established a reference range for placental and fetal weight in the Pakistani population and highlights the significant correlation between the two. Placental weight serves as a reliable indicator of fetal health, underlining the importance of monitoring placental development and assessing the placenta post-delivery to evaluate neonatal health.

Authors Contribution

Conceptualization: FNB
Methodology: SK
Formal analysis: ZAP
Writing, review and editing: ZM, FNB, RB, AI
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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