

## Placental Weight To Birth Weight Ratio and Its Outcome Among Neonates

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### ABSTRACT

**Objective:** To calculate Placental Weight to Birth Weight Ratio and its effect among neonates delivered at tertiary care center.

**Study Design:** Cross-sectional study.

**Place and Duration of Study:** Obstetrics and Gynecology Department of a tertiary care center, Karachi Pakistan, from Dec 2019 to Feb 2020.

**Methodology:** Booked cases with singleton pregnancies and gestational ages more than 37 weeks at birth were considered. On a manual scale, the placenta was weighed to the nearest gram. Immediately following delivery, the birth weight of babies was recorded to the nearest gram on the same manual weighing equipment. At 01 minute and 05 minutes, the APGAR scores were noted as well.

**Results:** The mean age of our respondents was 29.05±5.27 years old. Placental Weight to Birth Weight Ratio ratios were substantially greater in newborns with low APGAR scores than those with high APGAR scores at 1 minute ( $p=0.001$ ), and the median Placental Weight / Birth Weight was also significantly higher in those infants at 5 minutes ( $p=0.001$ ).

**Conclusion:** Poor perinatal outcomes, such as low APGAR scores at 1 and 5 minutes after birth, are associated with high Placental Weight/Birth Weight ratio.

**Keywords:** APGAR score, Birth weight, Perinatology, Placenta

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### INTRODUCTION

Placenta is a vital organ in mothers for providing the fetus with nutrients and oxygen. If placenta does not function properly, it may cause lack of oxygen supply in the fetus.<sup>1</sup> An examination of the placenta can reveal important details about the fetus's environment while still within the mother before delivery. In several studies, placenta examination on ultrasound for placental volume, thickness, length, blood doppler parameters, placenta weight and placental MRI evaluation are used for the prediction of perinatal outcomes.<sup>1-3</sup>

Studies have shown that placental weight has a significant influence on foetal growth in terms of cord length, body length, and birth weight; however, it has a minor link with the presence of meconium-stained fluid.<sup>1-5</sup> Whereas, other studies showed weak association between placenta weights and above mentioned factors.<sup>6</sup> According to literature, a higher placental weight was related to a low APGAR score, respiratory distress, and perinatal mortality, whereas a lower placental weight was related to health issues in the mother.<sup>7</sup>

Clinical significance of Placental Weight to Birth Weight Ratio (PW/BW) ratio is also well documented. Such as in small size placentas there is a risk of trisomies, while in large size placentas there is a risk of maternal diabetes.<sup>7-9</sup> Low PW/BW ratio indicates acute placental injury resulting in villous edema or malnutrition or maternal anemia. High PW/BW ratio resulted in low APGAR score, fetal distress or maternal hypertension.<sup>6-7</sup>

In the present study, the aim is to determine PW/BW ratio and its effect among neonates delivered at tertiary care hospital, since there is a paucity of similar studies in our region.

### METHODOLOGY

The cross-sectional study was carried out at the Obstetrics and Gynecology Department at a public sector tertiary care hospital, Karachi, Pakistan, from Dec 2019 to Feb 2020, after taking approval from Ethical Review Committee (ERC#1092-2019). The sample size was calculated using WHO sample size calculator on the basis of mean PW/BW ratio as 18.2±2.4.<sup>7</sup>

**Inclusion Criteria:** Booked women of age 18 to 45 years having singleton pregnancy and gestational age >37 years were included.

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## Placental Weight To Birth Weight Ratio

**Exclusion Criteria:** Pregnancy complicated with diabetes, hypertension, hemolytic condition, cardiovascular diseases, anemia, females with history of diabetes, hypertension or cardiovascular disease in previous pregnancy, females with BMI less than 18 or more than 24.9 kg/m<sup>2</sup>, multiple gestation, and fetal abnormalities were excluded.

Using non-probability consecutive sampling technique, patients meeting our inclusion criteria were recruited after taking verbal informed consent. The placentae were made using the placental preparation technique i.e. trimming off all membranes and cutting the umbilical cord at the insertion location on the placenta surface allowed for a precise weight measurement of the placentas. The whole contents of a superficial foetal artery were emptied. Blood clots that had adhered to the maternal surface were removed. On a manual scale, the placenta was weighed to the closest gram. Weights were noted down. After delivery, the weighing was completed in under one hour. Immediately following delivery, the birth weight of babies was recorded to the closest gram on the same manual weighing equipment. The PW/BW ratio was estimated by dividing the placental weight with birth weight of neonate and multiplying by 100. APGAR scores were recorded at 1 and 5 minutes. APGAR score <7 at 1 and 5 minutes after birth was considered as low APGAR score. A proforma was filled by researcher.

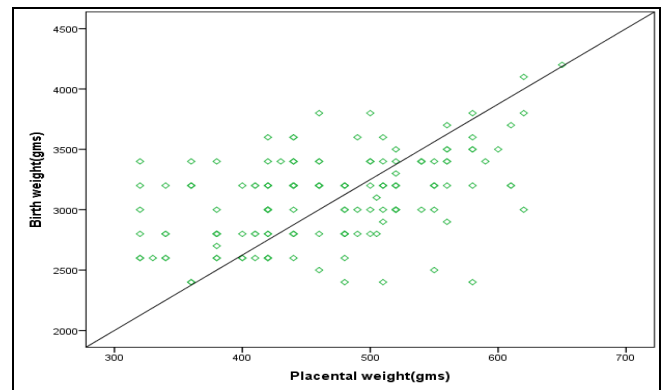
Data analysis was done using Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were presented using mean and standard deviation, while qualitative variables using frequency and percentage. Shapiro-test Wilk's was used to determine if numerical variables were normal. Maternal age, gestational age, weight of mothers, birth weight, placental weight, PW/BW ratio, and APGAR score were all given with mean and standard deviation/median and IQR. For parity and low APGAR scores at 1 and 5 minutes, frequency and percentage were computed. The relationship between the placenta weight, birth weight, PW/BW ratio, and APGAR score was examined using Spearman's correlation. PW/BW ratios between low and high APGAR scores at 1 minute and 5 minutes were compared using the Mann-Whitney U test. The *p*-value of 0.05 or below was regarded as significant.

## RESULTS

One hundred and fifty women with singleton pregnancy, the mean age and gestational age were

29.05±5.27 years and 38.72±0.89 years. Furthermore, the estimated mean weight of women was 64.42±10.35 years. Most of the women were multiparous (88%) while 22% were primiparous. The median PW/BW ratio was 15.06 with IQR as 13.57 to 16.48.

The median birth weight of neonates was 3200 grams (IQR=2800 to 3400 grams), whereas the median placental weight was 470 grams (IQR=420 to 520). The moderate correlation was observed between placenta weight and birth weight ( $r=0.466$ ,  $p=0.001$ ). (Figure)



**Figure: Correlation Analysis of Birth and Placental Weight (n=150)**

The median APGAR score at 1 was 7 and at 5 mins was 7.5. The significant negative correlation was between PW/BW ratio and APGAR score at 1 min ( $r=-0.493$ ,  $p=0.001$ ) and 5 mins ( $r=-0.705$ ,  $p=0.001$ ). The PW/BW ratio was significantly higher in neonates with low APGAR as compared to high APGAR score at 1 min ( $p=0.001$ ), similarly the median PW/BW was significantly higher in neonates with low APGAR score as compared to high APGAR score at 5 mins ( $p=0.001$ ). (Table)

**Table: Comparative Analysis of Low Apgar Score and PW/BW Ratio (n=150)**

Low APGAR at One Minute	PW/BW Ratio	<i>p</i> -value
Yes	16.15(15-17.18)	0.001*
No	14.16(12.94-15.47)	
Low APGAR at 5 mins		
Yes	17.07(16-17.58)	0.001*
No	13.87(12.75-15)	

Data presented as Median and IQR

\*Significant at 0.05 level of significance

At 1 and 5 minutes, the median APGAR score was 7, respectively. PW/BW ratio and APGAR score at 1 min ( $r=-0.493$ ,  $p=0.001$ ) and 5 minutes ( $r=-0.705$ ,

$p=0.001$ ) showed a strong negative correlation. PW/BW ratios were substantially greater in newborns with low APGAR scores than those with high APGAR scores at 1 minute ( $p=0.001$ ) and at 5 minutes ( $p=0.001$ ).

## DISCUSSION

Placenta is a vital organ for providing nutrients and oxygen to fetus from mothers and it has significant effect on birth weight.<sup>1-10</sup> In our study the median placental weight was 470 grams, which is lower than the studies conducted at Nigeria and Turkey.<sup>1-7</sup> While in the study conducted at Pakistan, the mean placental weight was reported as 505.84 grams.<sup>11</sup> The differences in placental weight might be due to variations in the measuring methods. Research also revealed that ethnicity and some other unknown determinants also affect the placental weight.<sup>1-12</sup> Moreover, in our study the median birth was 3200 grams, which is also less than the mean birth weight reported by Nigerian and Turkey studies.<sup>1-7</sup> While in the Pakistani study, the mean birth weight was reported as 3056.53 grams.<sup>11</sup> The variations in birth weight might be due to environmental factors, mother's disease and nutritional status.

From more than a century, the placental weight showed direct association with size of neonate at birth.<sup>13-15</sup> Sanin *et al.* found a positive link between birth weight and placental weight and came to the conclusion that newborns' birth weight rose by 1.98 grams for every 1 gram increase in placental weight ( $p=0.001$ ).<sup>13</sup> Additionally, Panti *et al.* found a significant positive relationship between placental weight and neonatal birth weight ( $p=0.001$ ).<sup>7</sup> We also found positive correlation between placenta weight and birth weight ( $r=0.466$ ,  $p=0.001$ ).

The ratio of these two parameters (birth and placental weights) are useful marker for utero-placental function and fetal nutrition.<sup>1-17</sup> The PW/BW ratio has been widely studied and its association with pregnancy and fetal outcomes.<sup>18</sup> An unusually high PW/BW ratio indicates a placenta with decreased function, such as in cases of HIV, maternal anaemia, and obesity.<sup>19-21</sup> Additionally, a higher PW/BW ratio is linked to a higher risk of coronary heart disease, adult-onset hypertension, decreased glucose tolerance, and cardiovascular mortality.<sup>18-22</sup> Abnormal PW/BW ratio also increases the risk of perinatal death.<sup>18</sup> On the contrary, an abnormally less PW/BW ratio predicts fetuses with presumed decreased placental reserves, like fetus show asymmetric growth restriction,

highlighting that small size of placenta can be a barrier for optimal fetal growth.<sup>18-24</sup> We found a strong inverse relationship between APGAR score and PW/BW ratio. At 1 and 5 minutes, newborns with low APGAR scores had significantly higher PW/BW ratios than those with high APGAR scores. Furthermore, the poor APGAR scores at 1 ( $p=0.001$ ) and 5 minutes ( $p=0.001$ ) continued to significantly correlate with PW/BW ratio even after controlling for confounders. In the study by Shehata *et al.*, the high PW/BW ratio showed significant association with high NICU admissions, respiratory distress, and low APGAR, while low PW/BW ratio was significantly associated with less admissions in NICU and good perinatal outcomes.<sup>25</sup> A study from India and also found that high PW/BW ratio was significantly associated with short-term adverse perinatal outcomes like low APGAR score and increased NICU admissions.<sup>11</sup>

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## CONCLUSION

Poor perinatal outcomes, such as low APGAR scores at 1 and 5 minutes after birth, are associated to high PW/BW ratio.

**Conflict of Interest:** None.

## Authors' Contribution:

Following authors have made substantial contributions to the manuscript as under:

PG & ZJ : Conception, study design, drafting the manuscript, approval of the final version to be published.

K & SI: Data acquisition, data analysis, drafting the manuscript,

SS & F: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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