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Morphometric and Morphologic Assessment of the Placenta, Birth Weight and Associated Risk Factors in Full Term Neonates in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Placenta is a temporary and dynamic organ which is unique in its development and function on which survival, healthy growth and development of fetus in the uterus mostly depends. The study was carried out to determine the morphometry and morphology of placenta, birth weight and associated risk factor of full-term neonates. The study involved 50 placentae (27 from males and 23 from females). Descriptive statistical method of data analysis was used to analyze the mean, standard deviation and z-test to correlate the mean. The mean and standard deviation of neonatal weight, fetoplacental coefficient, weight of placenta, maximum weight of placenta, thickness of placenta and the length of umbilical cord observed were; 3.21±0.4, 6.36±1.92, 0.54±0.16 21.30±1.04, 2.17±0.28 and 54.16±2.11 respectively. Also, the most predominant type of umbilical

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cord attachment was eccentric with a frequency of 38. The number of cotyledons was found to be 15 and above for 98% of the placentaes excluding one which had 8 cotyledons. The presence of incomplete artery was observed in the study. The result showed that placental weight correlates significantly with neonatal weight and that abnormal placenta results in poor health of the neonate. The examination of the placenta can be useful for the future postnatal life as it is indicative of neonatal birth weight. and resistance to early adulthood diseases of the neonates. It is, therefore, recommended that physicians pay attention to the placenta.

Keywords: Placenta morphometry; placental morphology; birth weight.

1. INTRODUCTION

"Commonly called afterbirth, the placenta is a dynamic and temporary organ that is unique in its development and function. It is an organ formed in the uterus during pregnancy that connects the fetus and mother. Survival, healthy growth and development of fetus in the uterus are mainly dependent on the placenta. The placenta maintains fetal homeostasis by performing a wide range of physiological functions which after birth are carried out by the lungs, gastrointestinal tract, kidney and endocrine glands of the neonate" [1,2].

"The placenta undergoes various changes in its weight, surface area, structure, shape and function continuously throughout the gestation to support the growth of fetus in utero. Abnormalities in the placenta eventually result in low birth weight (LBW) and Intra Uterine Growth Restriction (IUGR) which leads to increased rate of prenatal morbidity and mortality" [3].

"Birth weight is an important determinant of child survival, healthy growth and development. Low birth weight is a wel1-established risk factor for adverse long-term health, particularly cardiovascular disease and metabolic syndrome" [4].

"A child's health is tomorrow's wealth. However, children's health is to a great extent determined by factors that operate in utero itself, way before they are born. Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500g" [5].

"In humans, the placenta averages 22 cm (9inch) in length and 2-2.5cm (0.8-l inch) in thickness, with the center being the thickest, and the edges being the thinnest. It weighs approximately 500grams. It has a dark reddish blue or crimson color. It connects to the fetus by an umbilical cord of approximately 55-60cm (22-24inch) in length which contains two umbilical arteries and one umbilical vein" [1-3]. "Cord inserts into the chorionic plate which has an eccentric attachment. Vessels branch out over the surface of the placenta and further divide to form a network covered by a thin layer of cells. This results in the formation of villous tree structures. On the maternal side, these villous tree structures are grouped into lobules called cotyledons" [6].

"The shape of the placenta is determined by the persistent area of the chorionic villi. Usually, this is a circular area, giving the placenta a discoid shape. As the chorionic villi invade the decidual basalis, decidua tissue is eroded to enlarge the intervillous. This erosion produces several wedge-shaped areas of decidua, placental septa that project toward the chorionic plate, the part of the chorionic wall related the placenta. The placental septa divide the fetal part of the placenta into irregular convex areas called cotyledons. Each cotyledon consists of two or more stem villi and there are many branch villi. By the fourth month, the decidual basalis is almost entirely replaced by the cotyledons" [1,7].

Over the years, several children have been born with abnormalities, but so far case report or research publications showing their correlation is scarcely seen in Nigeria.

Pradeep and Abbey [7] did "a study to determine placental morphometry in relation to birth weight of full term new born babies". The cross-sectional descriptive study included 374 subjects. The morphometric parameters of placenta such as; weight, volume, surface area, fetoplacental weight ratio and birth weight of the baby were observed which were 321.2 ± 63.7, 460.4±106.1, 219.7±41.6, 1.3±0.94 and 2833±234 respectively. It was seen that the placental weight increased according to the birth weight and that the placental parameters and its ratio to birth weight were significantly associated with some adverse pregnancy outcomes.

Abubakar et al. [8] conducted "a study on the relationship between the weight of the placenta and birth weight of the neonates in a Nigerian

hospital. Their cross-sectional descriptive study included 1451 total deliveries but 1009 mothers met the inclusion criteria and established birth weight within the range of 2030-5020 of 3275±469g, placental weight of 590±82g with a range of 300-390g and placental birth weight ratio was 18.2±2.4 with a range of 10.1- 28.8. It was seen that an increase in birth weight of the neonate was associated with corresponding increase in placental weight".

Bolisetty et al. [9] did "a study to correlate umbilical cord weight with birth weight on 96 consecutive healthy term infants soon after birth. The morphometric parameters of the placenta were taken soon after birth. they reported the mean values of morphometric parameters of the placenta like umbilical cord weight, placenta weight and weight of infants as 41.4±1.7, 590.1±12.4 and 344.5±42.9 respectively. Besides, they stated that there was a significant positive correlation between umbilical cord weight and length and placental weight and birth weight".

In the study carried out by Kowsalya et al. [10] "on morphometric examination of placenta and birth weight of full-term newborns in Puducherry, India using 200 subjects reported that the birth weight, placental weight, number of cotyledons, maternal and fetal surface area and insertion of umbilical cord at the center were 2806±207 and 2058±321, 1101±58, 146±41, 152±37 and 4.5% respectively".

Balihallimath et al. [6] conducted "a study on clinical determinants of the placental morphometry and birth weight on 164 consecutives singleton deliveries. The morphometric parameters of placenta like weight, volume, surface area and thickness were observed which were 414.7±110.5gm, 363.1±113.2ml, 223.7±54.7Sqcm and 2.1±0.5 respectively with birth weight mean ±SD 2536.1±675.5gm. Positive and significant relationship between placental weight and thickness ($p<0.01$) volume and birth weight ($p<0.05$) was seen in their study".

According to Susumita et al. [11] who carried out "a research on morphometric study of placenta of full term newborn and its relation to fetal weight in tertiary hospital of Odisha on 103 placenta of mothers aging between 23-39 years; mean values of age of mother, weight of placenta, fetal surface area, maternal surface area, number of cotyledons and weight of fetus in low and normal birth weight were 27.42±3.64, 404.79±19.37, 163±12.01, 152.50±13.16, 11.32±2.3 and 2287.87±156.58 for low birth weight and 29.23±3.89, 547.83±29.09, 245.78±17.34, 251.60±19.74, 14.63±2.66 and 2672.38±271.94 for normal weight respectively. They posited that increase in placental size is significantly associated with maternal weight and it is an independent predictor of birth weight".

Gunapriya et al. [12] carried out "a study on the morphology and morphometry of the human placenta and its clinical relevance in a population in Tamilnadu. Morphological and morphometric parameter studies and their respective mean values in their work includes weight (528.55gm), shape (94 circular shape and 7 oval), fetoplacental ratio (5.35:1), placenta coefficient (0.19), number of cotyledons (18), colour of placental membranes (translucent) and presence of subchorionic fibrosis (a case of subchorionic placental cyst with clear serous fluid observed)". They stated that birth weight and placental weight were positively significant. This finding has been reported by several researchers [4,13-15].

"The size, morphology and nutrient transfer capacity of the placenta determine the prenatal growth trajectory of the fetus to influence birth weight" [14-17].

Therefore, examination of the placenta will give valuable information about the state of the fetal wellbeing and also helpful in the management of complications in mother and new born [18]. This information is, however, scanty in literature of Nigerian populations, hence the significance of the study.

2. MATERIALS AND METHODS

The study was conducted in Rivers State College of Health and Technology, Rumueme, Port Harcourt. The duration within which this research was conducted was two months and two weeks. The sample size for the study was 50 placentae of which 27 were from males and 23 from females. Purposive sampling technique, a type of non-probability sampling was used to sample out the subjects.

The study included; mothers within ages 20-35 and only full-term neonates.

While diabetic mothers, multiple pregnancy, hypertensive mothers, anemic mothers, and mothers with vascular disease were excluded.

The instruments used for this study are as follows;

Weighing scale: Was used to measure the weight both the baby and placenta and is calibrated in kilograms.

Measuring tape: Was used to measure the length and width of placenta.

Forceps and scissor: Were used to hold and dissect through the placenta respectively.

Data sheet: This was used to record information obtained from the subjects; such as information on height, length, width, number of Cotyledons, Arteries, Veins, etc.

Hand gloves: gloves were worn to avoid direct contact with blood.

Cotton wool, methylated and jik: Were used to clean up the instrument after each study before washing

2.1 Method of Data Collection

- **Collection of Placenta**

The placentae were washed in running tap water immediately after expulsion and separation from the neonate.

After the collection of the placenta, the following metric and non-metric parameter were measured or ascertained respectively.

- **Metric parameters**

Weight of Neonate: This was weighed using a calibrated weight scale.
Weight of placenta: The weight of the placenta was taken immediately after that of the neonate using a calibrated weight scale.

Length: The length of the placenta, being a tube-like structure was measured using a measuring tape.

Thickness: The thickness was measured using a calibrated knitting pin.

- **Non-metric parameters**

With the aid of the forceps and scissor, umbilical cords were cut through to view the number of arteries and vein present. The cotyledons, color, attachment, appearance, coiling, knots, surfaces, and types were ascertained macroscopically and all the data were recorded for proper analysis.

3. RESULTS

3.1 Data Analysis

Table 1. Statistical description of placental morphometry and birth weight of fullterm neonate

Parameters	Both sex (n=50)	Female (n=23)	Male (n=27)
	Mean±SD	Mean±SD	Mean±SD
W_n (Kg)	3.21±0.40	3.13±0.36	3.27±0.42
FETOPLACENTAL COEFFICIENT	6.36±1.92	6.32±1.18	6.39±2.40
W_p (Kg)	0.54±0.16	0.52±0.13	0.56±0.18
$MaxL_p$ (cm)	21.30±1.04	21.04±0.88	21.52±1.12
T_p (cm)	2.17±0.04	2.13±0.09	2.21±0.37
L_{uc} (cm)	54.16±2.11	54.13±1.91	54.19±2.30

W_n = weight of neonate, W_p = weight of placenta, $MaxL_p$ = maximum length of placenta, T_p = thickness of placenta, L_{uc} = length of umbilical cord

Table 2. Inferential statistical on placental morphometry and birth weight of fullterm neonates

Parameters	sex	mean	p-value	z-calculated	Inference @ p<0.05
W_n (Kg)	Female	3.13±0.036	0.21	1.24	Not significant
	Male	3.27±0.42			
Fetoplacental coefficient	Female	6.32±1.18	0.89	0.13	Not significant
	Male	6.39±2.40			
W_p (kg)	Female	0.52±0.13	0.31	1.02	Not significant
	Male	0.56±0.18			
$MaxL_p$ (cm)	Female	21.04±2.40	0.09	1.67	Not significant
	Male	21.52±0.13			
T_p (cm)	Female	2.13±0.09	0.28	1.08	Not significant
	Male	2.21±0.37			
L_{uc} (cm)	Female	54.13±1.91	0.92	0.09	Not significant
	Male	54.19±2.30			

W_n = weight of neonate, W_p = weight of placenta, $MaxL_p$ = maximum length of placenta, T_p = thickness of placenta, L_{uc} = length of umbilical cord

Table 3. Correlation of placenta morphometry and birth weigth of fullterm neonates

Parameters		Fetoplacental coefficient	Wp	Lp	Tp	Luc
W_n	Pearson Correlation	-0.219	0.586**	0.398**	-0.093	0.331*
	Sig. (2-tailed)	0.127	0.000	0.004	0.52	0.019
Fetoplacental coefficient	Pearson Correlation	1	-0.809**	-0.479**	-0.333*	-0.071
	Sig. (2-tailed)		0.000	0.000	0.018	0.624
W_p	Pearson Correlation		1	.720**	0.460**	0.071
	Sig. (2-tailed)			0.000	0.001	0.623
L_p	Pearson Correlation			1	0.519**	-0.013
	Sig. (2-tailed)				0.000	0.928
T_p	Pearson Correlation				1	-0.443**
	Sig. (2-tailed)					0.001

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed)

W_n = weight of neonate, W_p = weight of placenta, MaxL_p = maximum length of placenta, T_p = thickness of placenta, L_{uc} = length of placenta

Table 4. Frequencies and percentage of the type of umbilical cord attachment, number of cotyledons, types of placental membrane and placental weight

Categories	Frequency	Percentage (%)
Attachment of Umbilical Cord		
Central	8	16
Eccentric	38	76
Marginal	4	8
Number of Cotyledon		
Below 15	1	2
15 & Above	49	98
Type of placental membrane		
Circumvallate	2	4
Normal	48	96
Placental weight		
Low placental weight	14	28
Normal placental weight	36	72

4. DISCUSSION AND CONCLUSION

This study confirms and expands previous observations on neonatal birth weight and placental morphology and morphometry.

Nutritional availability alters placenta, thus leading to variation in placental weight, altered vascular development and reduced glucose, amino acid, and lipid transport. Therefore, the variation in placenta morphometry influences the fetal growth.

Balihallimath et al. [6] in their study mentioned that the birth weight in normal group ranges from 2500-4000gm (2.5-4.0kg). In another study by Sitti et al. [4], they observed that it ranges from 235-586gm while in the present study placental weight ranges from 2500-4200gm (2.5-4.2kg), it corresponds with the work of Balihallimath et al. [6] and with the normal range given by WHO. Many studies have reported that placental weight had positive significant correlation with the birth weight, same observations were noted in the present study. The mean thickness of full-term placenta was reported by Gunapriyal et al. [12] and Sitti et al. [4] as 2.1cm, and 2.2cm. In this present study, mean thickness is found to be 2.17cm which correlated significantly with placenta weight and length. The present study corresponds to the findings of Gunapriyal et al. [12] and Sitti et al. [4] Comparing the findings reported above, it is inferred that racial and ethnic difference does not affect morphometry of the placenta.

Nuchal cords are situations where the umbilical cord rounds the neck of the neonate. The presence of this complication results in poor respiratory rate. In the present study same complication was observed. Incomplete placental vessels also result in poor respiratory rate, same observation was noted in the present study. Edematous placenta which resulted in poor respiration of the neonate was observed in this study. Out of the 50 placentae studied, 48 had normal membrane and 2 circumvallate membrane. The most predominant type of umbilical cord attachment was eccentric with a frequency of 38. Of the 50 placentae, 49 had a complete number of cotyledons which ranges from 15 and above and 1 had below normal (less than 15) cotyledons.

In conclusion, placental morphometry can be used as a tool to ascertain birth weight and common risk factors associated with neonate. Hence, physicians should pay more attention to the placenta.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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