Original Article

# Association of Placental Thickness with Birth Weight and Other Neonatal Anthropometries: A Prospective Cohort Study

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ABSTRACT

**Background:** Placental growth is concordant with fetal growth and any impairment would negatively impact fetal development and subsequent birthweight that is vital for newborn survival. **Aim:** The aim of the study was to determine the relationship between placenta thickness and birth weight. **Patients and Methods:** This prospective cohort study carried out at the University of Nigeria Teaching Hospital Enugu, Nigeria, involved 80 consecutive pregnant women with thick placenta (>4 cm) and another 80 in the control group with normal placenta thickness (2.5-4 cm) and matched for parity and maternal weight between 38 and 40 weeks of gestation. Both groups were followed up until delivery and the neonatal parameters were measured. Data analysis was descriptive and inferential at 95% confidence levels using Statistical Package for the Social Sciences software version 20. **Results:** The mean placental thickness at recruitment were 5.3 ± 0.7 cm and 3.7 ± 0.2 cm among the study and control groups, respectively. The study group had significantly higher birthweight, head circumference, and crown-heel length compared to the control group ($P < .05$). There was a positive linear correlation between placental thickness and birth weight, head circumference, and crown-heel length. **Conclusion:** This study demonstrated that sonographic measurement of placental thickness antenatally is a reliable predictor of birth weight and other neonatal anthropometric parameters.

**Keywords:** *Birthweight, crown-heel length, head circumference, placental thickness*

## Introduction

Perinatal morbidity and mortality (PNMM) rates remain unacceptably high in developing countries, including Nigeria.[1] A large proportion of PNMM is related to birth weight. Thus, birth weight is a very important parameter that determines neonatal survival.[2]

The placenta is the fetal organ responsible for the transfer of gases, nutrients, and hormones between the maternal and fetal circulation.[3] Thus, an impairment in its development has profound impact on fetal development. The size of the placenta increases during fetal growth period to allow it to carry out its vital functions. Any abnormality is hence reflected by an abnormal placental size.[4-6] Obstetric ultrasound offers the tool to estimate fetal weight and also placental size. The size of the placenta is estimated by either measuring the thickness or its volume.[7] The placental thickness is easier to measure yet little is known of the normal placental thickness by ultrasound.[2] Placental thickness of greater than 4 cm is regarded as thick placenta while that less than 2.5 cm is regarded as thin placenta.[4,7] Thick placenta when it occurs in isolation was reported to be associated with increased risk of PNMM.[8] Thin placentas are also reported to be associated with increased risk of perinatal morbidity and mortality but not to the same extent as thick placenta.[9] Thick placenta has been observed in neonatal infections, congenital anomaly, maternal

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diabetes mellitus, and anemia,[5,7] while thin placenta is observed in intrauterine growth restriction (IUGR), placental infarction and pre-eclampsia.[4]

The role of placenta thickness in determining neonatal outcome remains unclear. Limited studies on placental thickness, including those in the developing countries, only determined its relationship with estimated fetal weight and estimated gestational age, but did not assess its relationship to birth weight.[2-4,6] However, a retrospective study[10] demonstrated a positive correlation between placental thickness and birth weight.

The usefulness of antenatal ultrasound imaging of the placental thickness in predicting birth weight and other neonatal parameters as a key marker of neonatal outcome has not been fully exploited. Hence, this prospective study aimed to determine the relationship between placenta thickness and birth weight with other neonatal anthropometric parameters in Enugu, Nigeria.

## Materials and Methods

This was a prospective cohort study of eligible pregnant women attending the antenatal clinic of the University of Nigeria Teaching Hospital (UNTH) and who intended to deliver at the study center. The study was commenced after approval by the Institutional Review Board of the hospital (NHREC/05/01/2008B -F-WA00002458-1RB00002323). A written informed consent was obtained from each participant before recruitment into the study, and the study was performed in accordance with the ethical principles of Helsinki Declaration. The study consisted of a group of women with thick placenta (study group) and a control, consisting of women with normal placenta. Eligibility for the study was pregnant women who knew their last normal menstrual period (LNMP) or had first trimester ultrasound examinations and who were between 38 and 40 weeks gestational age. Excluded from the study were participants who had diabetes mellitus, hypertensive disease in pregnancy, severe anemia (packed cell volume ≤ 21%), multiple pregnancies, morbid obesity at enrolment (absolute weight > 115 kg),[11] placenta entering the lower segment of the uterus, and women who used illicit drugs including tobacco. The sample size was determined using the formula by Charan and Biswas,[12] $n = 2(SD)^2 (Z_B + Z_{\alpha/2})^2/d^2$, where n = sample size for each group, $Z_B$ = standard normal variate for power; 80% =0.84, $Z_{\alpha/2}$ = standard normal variate for level of significance; 95% =1.96, SD = standard deviation of mean birth weight of neonate with normal placental was 0.411 kg,[13] and d = expected mean difference between infants of mothers with thick and normal placenta was 0.367 kg.[13] Assuming a 15% loss to follow-up, 80 participants were eligible for each arm of the study, hence giving a total sample size of 160 for the two groups. Consecutive recruitment of eligible participants between 38 and 40 weeks gestational age, receiving care at the study center was done from February 2019 to September 2019 following informed consent. All eligible participants were scanned and those with thick placenta (>4 cm) selected as the study group. The next consenting woman with normal placenta thickness (2.5-4 cm) matched for parity and maternal weight groups were selected as control. They were encouraged to be compliant with their antenatal hematinics and adhere to follow-up visits. The two groups of women were followed up weekly in the antenatal clinic until they delivered. At enrolment, information on maternal age, parity, marital status, occupation, level of education, husband's occupation, medical history (diabetes mellitus, hypertension), and complication during pregnancy was collected using proforma (case record form). Participants' weights were performed using standard methods.[14] The pregnant women were scanned in supine position with a partially distended bladder after the coupling gel was applied on the anterior abdominal wall with SonoScape E2 Color Doppler Machine using a 3.5 MHz transducer. The fetuses were observed for viability and gross anatomical defects. Placental thickness was measured from the chorionic plate to placental myometrial interface, at the level of umbilical cord insertion to the placenta.[6] The umbilical cord insertion was identified as the hypoechoic areas nearest to the chorionic plate in the thickest portion of the placenta.[4] Umbilical artery color Doppler was used for further reconfirmation of the site of umbilical cord insertion. For this study, a thick placenta was regarded as a placental thickness of greater than 4 cm while normal placental thickness was a thickness ranging from 2.5 to 4 cm.[4]

Data were obtained from the newborns of both groups and included gestational age at birth, Apgar score, birth weight, crown-heel length, head circumference, and neonatal admission. The gestational age at birth was determined from the first day of the mother's last normal menstrual period. Calculations from first-trimester ultrasound scans were used in cases where the LNMP was not recalled with certainty. Macrosomia was regarded as a birth weight greater than 4 kg as defined by WHO (International Statistical Classification of Diseases and Related Health Problems 2010).[15] The normal head circumference at term was 35 ± 2 cm.[16]

The primary outcome measure was the mean birth weight among the study and control groups. The secondary outcome measures included the rate of

newborn macrosomia and mean head circumference and crown-heel length of newborns in each group.

Data collected were keyed into the statistical package for social sciences (SPSS) computer software version 20 for Windows. Continuous variables were analyzed using the mean ± SD and compared between the two groups using the Student T-test. Proportions were compared using Pearson's Chi-square, and correlation was assessed with Pearson correlation. Relationships were expressed using relative risks at a 95% confidence interval. All tests were two-sided, and a *P* value of < 0.05 was considered statistically significant.

## Results

One hundred and sixty eligible pregnant women were recruited from the study center. Eighty of them had thick placenta while 80 had normal placenta thickness. Nine participants (11.3%) from the study group and five participants (6.3%) from those that had normal placenta thickness were lost to follow-up. The total number analyzed was 71 for the study group and 75 for the control group.

The basic characteristics of the participants were similar between the study and the control groups. Details are shown in Table 1. The mean ages of the participants were 31.1 ± 4.7 years and 31.6 ± 4.4 years for the study and control groups, respectively (*P* = .507). Most of the participants in both groups were multiparous (*P* = .572), and the modal parity was 2. The participants in both groups had similar weight at recruitment (*P* = .618).

The mean placental thickness among the entire participants was 4.5 ± 1.0 cm, while the mean thickness at recruitment for the study and control groups were 5.3 ± 0.7 cm and 3.7 ± 0.2 cm, respectively.

The mean birth weights of participants' babies were 3.7 ± 0.4 kg and 3.4 ± 0.3 kg among the study and control groups, respectively. This difference was statistically significant (*P* < .05). The incidence of macrosomia was higher in the study than in the control group (*P* = .043). This is outlined in Table 2.

The mean head circumference of neonates in the study group was 35.5 ± 0.7 cm while that of the control was 34.6 ± 1.6 cm (*P* = <.001). The mean crown-heel length of neonates of the study group was 51.3 ± 2.4 and 50.1 ± 2.7 among the neonates of the control group (*P* = .008). Details are shown in Table 2.

Table 3 shows a positive linear correlation between placental thickness and birth weight, head circumference, and crown-heel length (r = 0.24, *P* = .004; r = 0.22, *P* = .007; r = 0.21, *P* = .012).

**Table 1: Participants' basic characteristics**

| Characteristics group | | Women with thick placenta (study group) (*n*=71) | Women with normal placental thickness (control group) (*n*=75) | *P* |
|---|---|---|---|---|
| Age (years) | Mean±SD | 31.1±4.7 | 31.6±4.4 | 0.507 |
| | 20–24 | 2 (2.8%) | 0 (0.0%) | 0.089 |
| | 25–29 | 10 (14.1%) | 23 (30.7) | |
| | 30–34 | 42 (59.2%) | 36 (48.0%) | |
| | 35–39 | 10 (14.1%) | 11 (14.7%) | |
| | ≥40 | 7 (9.9%) | 5 (6.7%) | |
| Parity | Primiparous | 16 (22.5%) | 20 (26.7%) | 0.572 |
| | Multiparous | 55 (77.5%) | 55 (73.3%) | |
| Ethnic group | Igbo | 48 (67.7%) | 57 (76.0%) | 0.556 |
| | Hausa | 6 (8.5%) | 4 (5.3%) | |
| | Yoruba | 10 (14.1%) | 6 (8.0%) | |
| | Others | 7 (9.9%) | 8 (10.7%) | |
| Maternal weight (kg) | Mean±SD | 90.6±10.6 | 88.9±11.1 | 0.355 |
| | <90 | 34 (47.9%) | 32 (42.7%) | 0.618 |
| | ≥90 | 37 (52.1%) | 43 (57.3%) | |

**Table 2: Association of placental thickness and newborn anthropometric measurements**

| Characteristics group | | Study group (*n*=71) | Control group (*n*=75) | *P* | RR (95%CI) |
|---|---|---|---|---|---|
| Birth weight (kg) | Mean±SD | 3.7±0.4 | 3.4±0.3 | <0.001 | |
| | <4 | 58 (81.7%) | 70 (93.3%) | 0.043 | 0.32 (0.11–0.95) |
| | ≥4 | 13 (18.3%) | 5 (6.7%) | | |
| Head circumference (cm) | Mean±SD | 35.5±0.7 | 34.6±1.6 | <0.001 | |
| Crown-heal length (cm) | Mean±SD | 51.3±2.3 | 50.1±2.7 | 0.008 | |

**Table 3: Correlation between placental thickness with birth weight, head circumference, and crown-heel length**

| Characteristics | Total number of cases | Mean±SD | Pearson's correlation (*r*) | *P* |
|---|---|---|---|---|
| Placental thickness (cm) | 146 | 4.5±1.0 | | |
| Birth weight (kg) | 146 | 3.5±0.4 | 0.24 | 0.004 |
| Head circumference (cm) | 146 | 35.0±1.3 | 0.22 | 0.007 |
| Crown-heel length (cm) | 146 | 50.7±2.6 | 0.21 | 0.021 |

## Discussion

Placenta thickness measurement is a simple ultrasonic measurement that can be performed in any facility with assess to an ultrasound machine. Unfortunately, most sonologists pay limited attention to placenta thickness during routine ultrasound scan procedures.[17] Placenta thickness is documented to increase with advancing gestational age[3]; hence, it is a useful parameter to detect early danger signs to the fetus/newborn.

In the current study, the mean placental thickness at recruitment for the study and control groups was higher than the mean reported in a previous study in the same center that assessed the relationship between placental thickness and gestational age.[3] This variance in the two studies carried out in the same setting may be difficult to explain. However, this could be due to the high rate of marginal insertion of the umbilical cord to the placenta of 15.4% among those that were included in the previous study[3] and different measurement techniques used. The current study utilized color Doppler in confirmation of the placental cord insertion unlike the previous study[3] that utilized only ultrasound characteristics. The mean placental thickness of the study group in the present study was similar to the maximum thickness reported by Ohagwu *et al*.[18] at 39 weeks. The thickened placenta is not diagnostic of any condition but may occur in chromosomal anomaly, maternal and fetal anemia, fetal heart failure, and maternal diabetes mellitus[5,7] and may contribute greatly to the identification or management of fetuses at risk. This thickening is postulated to occur as a result of inflammation, edema, or compensatory hypertrophy of the placental tissues.[19]

There was a significant positive correlation between placental thickness and birth weight with participants with thickened placenta having higher birth weight This result agrees with a study carried out by Hamidi *et al*.,[10] Ismail *et al*.,[4] Nagpal *et al*.,[5] and Baghel *et al*.[6] This however differed from past studies by Dombrowski *et al*.[8] and Ichiro *et al*.[20] that reported lower birth weights with a thickened placenta. The reason for this could be due to the reduced gestational age of delivery reported among the thick placenta group in the studies.[8,20] Placental thickness may be useful in predicting and managing fetus at risk as the birth weight is reported as a single most important factor that affects neonatal mortality.[21]

The incidence of macrosomia, although higher among the study than the control group in the present study was not statistically significant. This incidence was also high in the study that established a correlation between thick placenta and perinatal morbidity and mortality reported by Elchalal *et al*.[19] This was supported by Ichiro *et al*.[20] where a 1 cm increase in placental thickness resulted in a 0.9 kg increase in birthweight and could have been the reason for the study finding.

The mean head circumference and mean crown-heel length among the study group in the present study were significantly higher than that in the control group. These higher values in the study group were similar to values reported by Demyer[16] and Freeman *et al*.[22] There was also a positive linear correlation between placental thickness, head circumference, and crown-heel length in the present study. This is not surprising as the present study noted a positive linear correlation between placental thickness and birth weight. Therefore, a thickened placenta noted antenatally should guide clinicians to suspect increased birthweight and other neonatal anthropometric measurements. Hence, it may influence decisions on proper birth preparedness, route of delivery, and the need to ensure careful anthropometric measurements at birth as their anomaly may be an early indicator of intracranial pathology and linear growth anomalies in the new born.[23]

Certain confounders like maternal nutritional status, ethnicity, and weight gain in pregnancy are associated with improved or impaired placental growth which could affect fetal growth and subsequent birthweight.[24,25] However, in the current study, ethnicity and maternal weight at recruitment were homogeneous between the study and control groups. Hence would not have affected the study findings.

This study was limited by the low number of study participants, possible measurement bias and it being a single-center study. However, the present study was exploratory but it offered necessary insight to the subject as it was strengthened by its prospective observational design.

## Conclusion

This study demonstrated that sonographic measurement of placental thickness antenatally is a useful predictor of birth weight and other neonatal anthropometric parameters. Multicenter studies with larger sample sizes could confirm this study's findings.

### Recommendation

Placental thickness measurement should be a part of routine fetal biometric assessment done antenatally to predict newborn birth weight. It can also be solely used in facilities with limited manpower or skills to carry out detailed fetal biometric assessments.

### Ethical approval

Ethical approval for the study was obtained from the Research Ethics Committees of the University of Nigeria Teaching Hospital (NHREC/05/01/2008B-F-WA000024 58-1RB00002323).

### Informed consent

A written informed consent was obtained from each participant before enrolment into the study.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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