Original Article

Placental thickness and its relationship to gestational age and fetal growth parameters in normal singleton pregnancies in the central region of Togo

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Abstract

Introduction: Accurate determination of gestational age (GA) is necessary for qualitative obstetric care, and ultrasound fetal biometry parameters are used when the last menstrual period is not known. The aim of this study was to measure by ultrasound the placental thickness (PT) and correlate it with GA and fetal growth parameters.

Population and Methods: This was a descriptive cross-sectional study conducted in the Radiology and Medical Imaging Department of Sokode Regional Hospital. All low-risk pregnancies from the 11th week were included. Excel and R 4.2.2 software were used. A significance level of 5% was established for the statistical tests.

Results: A total of 256 pregnancies were recorded. The mean of PT was 29.89 ± 7.42 mm. The mean of PT in the first, second, and third trimesters was 13.50 ± 3.67 mm, 24.61 ± 4.12 mm, and 34.65 ± 4.17 mm, respectively. There was a strong positive linear correlation between PT and GA ($r = 0.87$, $P < 0.00001$) and between PT and estimated fetal weight (EFW) ($r = 0.80$, $P < 0.00001$). The linear relationship between PT and GA could be expressed by the equation: GA = 0.894*PT-0.103. Similarly, the linear relationship between PT and EFW could be expressed by the equation EFW = 127.314*PT-2563.561. There was a strong linear correlation between PT and parameters such as biparietal diameter ($r = 0.88$, $P < 0.00001$), head circumference ($r = 0.89$, $P < 0.00001$), and femur length ($r = 0.89$, $P < 0.00001$).

Conclusions: This study demonstrated a correlation between PT and fetal growth parameters, suggesting that PT can be utilized to monitor fetal growth.

Keywords: Fetal growth, gestational age, placental thickness, ultrasound

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INTRODUCTION

Accurate determination of gestational age (GA) and monitoring of fetal growth are important parameters in pregnancy surveillance. Abnormalities in fetal growth will affect management in terms of timing and manner of

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delivery.[1] Determining GA is necessary to help reduce the incidence of prolonged pregnancy and improve obstetric care.[2] Crown–rump length (CRL) in the first trimester is the best parameter used to determine GA.[3] When ultrasound is performed in the second or third trimester, a combination of multiple biometric parameters, namely, biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), is used.[3] The accuracy of these measurements depends on the quality of the images obtained. Obtaining optimal imaging may be difficult in some clinical situations, such as abnormal presentation or an obese mother.[4] BPD is less reliable for determining GA in the presence of variations in skull shape, such as dolichocephaly or brachycephaly. Fetal AC is more difficult to measure than the other parameters.[5] Femur length varies somewhat with ethnicity.[6] Frequently, clinicians use the unweighted average of the four biometric parameters (BPD, HC, AC, and FL). However, it is clear that these four parameters are not all equally correlative.[7]

The placenta is a unique organ that physically and biologically connects the developing embryo to the uterine wall. Throughout pregnancy, the placenta provides the embryo and then the fetus with the water, nutrients, and oxygen it needs. It also removes carbon dioxide and metabolic waste products excreted by the embryo and is expelled after delivery. Ultrasound evaluation of the placenta during pregnancy includes the morphology, anatomy, location, implantation, anomaly, size, color/power, and pulsed Doppler sonographic assessment.[8] The size and growth pattern of the placenta have an impact on pregnancy outcome.[9,10] Placental growth can be estimated by measuring its thickness or volume, but it is the placental thickness (PT) that is the most easily measured parameter.

Several authors have reported that placental weight and fetal weight are closely correlated in most cases.[11-14] However, it is known that fetal growth can be influenced by genetic and environmental factors.[15,16] Furthermore, to date, there is no study that has assessed placental growth in our settings, and the measurement of PT is not systematic in our practices. The aim of this study was to measure PT by ultrasound and correlate it with GA and fetal growth parameters.

POPULATION AND METHODS

Conduct of the study and selection criteria

This was a descriptive study with prospective data collection conducted in the Department of Radiology and Medical Imaging of the Sokode Regional Hospital Center in Togo for 6 months (from June 1, 2022, to November 30, 2022). The Sokode Regional Hospital Center is the Reference Hospital of the Central Health Region of Togo.

The study was approved by the Ethics Committee of the Faculty of Health Sciences of the University of Lomé (under number: 0036/UL/CE-FSS/2022). Oral informed consent was obtained from each pregnant woman. The study population included pregnant women who were referred to the radiology department for an obstetric scan. All low-risk pregnancies from the 11th week were included in this study. Pregnancies were dated from the date of the last menstrual period. Pregnancies were classified into trimesters. The first trimester corresponded to GA between 11 and 13 weeks, the second trimester between 14 and 26 weeks, and the third trimester between 27 and 40 weeks.

Pregnancies with multiple fetuses and pregnant women with a history that could affect the normal course of the pregnancy such as hypertension, diabetes mellitus, and renal disease were not included. In addition, pregnant women who had developed complications during the current pregnancy were excluded from the study. Other exclusion criteria were quantitative amniotic fluid abnormalities, low-lying placentas, poor visualization of the placenta and umbilical cord insertion site, and fetal anomalies.

Ultrasound examination technique and study parameters

We used a General Electric Healthcare Logiq E ultrasound machine with Doppler function (Jiangsu, China) put into operation in March 2021. The 3.5 MHz convex probe (4C) was used for the examinations. The pregnant woman lies in the supine position, and the examiner is positioned laterally. After morphological analysis and fetal biometry, including parameters such as CRL or BPD, HC, AC, and FL, the placenta was located and its thickness was measured at the umbilical cord insertion site. The probe was oriented perpendicular to the chorionic and basal plates. The insertion of the cord was seen as an area in the form of linear echoes emanating from the placental surface. Sometimes, color Doppler was able to help locate this insertion [Figure 1]. The estimated fetal weight (EFW) was calculated automatically by the ultrasound machine using the method of Hadlock.[17]

The examinations were carried out by a single radiologist with more than 10 years of experience in fetal ultrasound.

The parameters analyzed were: parity, placental location and thickness, GA, and fetal biometric parameters such as CRL, BPD, HC, AC, FL, and EFW.

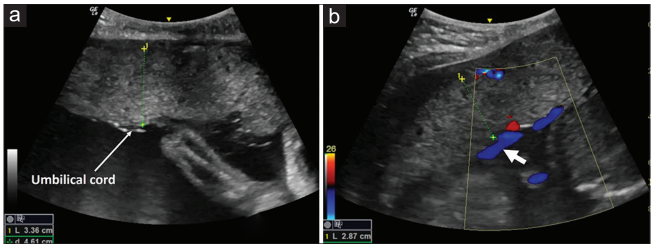

Figure 1: Technique for measuring placental thickness at the umbilical cord insertion site. The insertion of the cord was seen as an area in the form of linear echoes emanating from the placental surface (a); color Doppler showing the insertion of the umbilical cord shown by the thick short arrow (b)

Statistical analysis

The data were analyzed and interpreted using Excel 2016 and R 4.2.2 software (R Foundation for Statistical Computing, released in 2023, Vienna, Austria). Categorical variables were expressed as percentages, while quantitative variables were expressed as mean ± standard deviation. The ANOVA and Student's *t*-test were used to compare data of the groups of quantitative variables groups, and Pearson's coefficient was used to show the correlation between these quantitative variables. A significance level of 5% was established for the statistical tests.

RESULTS

A total of 256 pregnant women were registered in this study. The mean age of the pregnant women was 27.62 ± 6.54 years (ranging from 16 to 45 years). The mean parity was 1.52 ± 1.54. Nulliparous women were the most represented, with 88 (34.38%) cases. Pregnant women in the third trimester were the most represented, comprising 150 (58.59%). Table 1 summarizes the demographic characteristics of the pregnant women.

The placenta was located anteriorly in 116 (45.31%) cases, posteriorly in 92 (35.94%) cases, fundally in 44 (17.19%) cases, and laterally in 4 (1.56%) cases. Overall, the mean PT was 29.89 ± 7.42 mm with a minimum of 10 mm at 11 weeks and a maximum of 52 mm at 39 weeks. The PT was >40 mm in 9 (3.52%) cases. PT increased with GA and EFW [Table 2]. The mean of PT in the first, second, and third trimesters was 13.50 ± 3.67 mm, 24.61 ± 4.12 mm, and 34.65 ± 4.17 mm, respectively. Maximum PT was 33 mm in the second trimester. In the third trimester, the mean PT was 33.34 ± 3.43 mm (95% confidence interval [CI]: 32.72–33.97 mm) for an EFW below 2500 g and 39.11 ± 3.36 mm (95% CI: 37.98–40.24 mm) for an EFW exceeding 2500 g. The PT norms according to fetal biometry parameters and EFW are highlighted in Table 2.

There was a strong positive linear correlation between PT and GA ($r = 0.87$, $P < 0.00001$) and between PT and EFW ($r = 0.80$, $P < 0.00001$). Figures 2 and 3 show the correlation between PT and GA and between PT and EFW. The linear relationship between PT and GA could be expressed by the equation: GA = 0.894*PT-0.103. Similarly, the linear relationship between PT and EFW could be expressed by the equation EFW = 127.314*PT-2563.561 (where PT is expressed in mm, GA in weeks, and EFW in g). There was no relationship between PT and parity ($P = 0.599$).

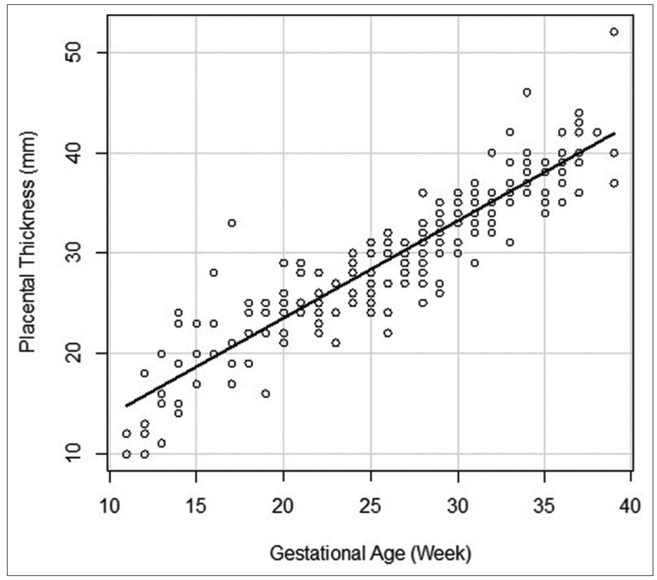

Figure 2: Scatter plot showing the relationship between placental thickness and gestational age. GA – Gestational age

Table 1: Pregnant women demographics

	n (%)
Age group	
<18	21 (8.20)
18–25	83 (32.42)
25–35	118 (46.09)
>35	34 (13.28)
Parity	
0	88 (34.38)
1	48 (18.75)
2	67 (26.17)
3	26 (10.16)
4	10 (3.91)
5	12 (4.69)
6	4 (1.56)
7	1 (0.39)
Trimester	
Trimester 1	14 (5.47)
Trimester 2	92 (35.94)
Trimester 3	150 (58.59)

There was a strong linear correlation between PT and parameters such as BPD ($r = 0.88$, $P < 0.00001$), HC ($r = 0.89$, $P < 0.00001$), FL ($r = 0.89$, $P < 0.00001$), and CRL ($r = 0.67$, $P < 0.00001$). On the other hand, there was a weak correlation between PT and AC ($r = 0.45$, $P < 0.00001$). In addition, BPD, HC, and FL were strongly correlated with each other ($P < 0.00001$). Table 3

Table 2: Placental thickness normogram by gestational age, fetal biometry parameters, and estimated fetal weight

GA	PT	BPD	HC	FL	AC	CRL	EFW
11 (*n*=5)	10.80±1.09	-	-	-	-	46.20±4.43	-
12 (*n*=4)	13.25±3.40	-	-	-	-	54.50±4.12	-
13 (*n*=5)	16.40±7.78	-	-	-	-	68.80±2.59	-
14 (*n*=6)	19.00±4.05	27.33±4.72	93.66±5.78	12.16±1.17	72.16±7.70	-	86.50±5.61
15 (*n*=4)	20.75±2.87	29.00±2.16	107.50±9.57	16.00±2.58	86.25±8.26	-	108.00±18.88
16 (*n*=5)	22.20±3.49	35.00±2.34	126.40±5.68	20.00±2.00	104.80±4.81	-	148.80±13.44
17 (*n*=6)	22.00±5.62	36.66±2.33	135.33±8.38	24.00±2.61	114.00±6.29	-	179.83±18.69
18 (*n*=8)	22.25±1.75	40.62±1.76	148.12±4.61	25.87±1.81	127.62±4.20	-	222.12±21.52
19 (*n*=7)	21.85±2.85	43.85±1.57	163.00±2.58	30.28±1.38	142.71±10.79	-	287.14±30.09
20 (*n*=10)	24.50±1.98	45.75±4.84	173.58±6.08	32.66±2.10	151.41±7.99	-	340.25±35.51
21 (*n*=5)	26.80±2.16	49.60±2.88	187.20±8.64	35.60±2.19	163.60±1.67	-	421.20±31.36
22 (*n*=8)	24.75±1.83	53.62±1.76	198.00±10.15	38.12±1.55	170.25±9.26	-	487.25±36.10
23 (*n*=3)	24.00±3.00	55.33±1.54	204.66±0.58	39.66±0.58	183.00±2.64	-	565.33±15.27
24 (*n*=7)	27.57±1.90	58.85±3.18	219.57±8.79	44.00±2.16	191.71±10.71	-	681.71±61.13
25 (*n*=9)	28.00±2.64	62.00±2.06	228.11±3.95	45.55±1.51	405.88±6.38	-	795.33±58.64
26 (*n*=12)	29.25±3.25	63.83±1.90	237.83±6.61	48.16±3.46	212.66±5.41	-	898.91±82.13
27 (*n*=11)	29.54±1.36	65.00±3.43	244.45±8.88	51.72±2.83	221.54±4.88	-	1020.18±76.08
28 (*n*=21	30.66±2.51	70.09±2.86	259.47±6.13	53.66±1.93	235.66±7.29	-	1253.14±149.73
29 (*n*=18)	31.44±2.23	73.00±2.99	268.33±8.23	55.44±2.52	250.38±7.71	-	1393.11±72.35
30 (*n*=13)	33.76±1.74	74.38±2.18	279.46±6.05	57.38±2.53	252.84±17.29	-	1478.69±167.09
31 (*n*=14	33.85±1.95	77.21±3.70	285.35±7.49	60.21±1.19	266.71±13.27	-	1716.00±143.56
32 (*n*=12)	34.75±2.00	80.25±2.83	293.58±7.53	62.41±2.64	276.08±13.44	-	1872.50±230.34
33 (*n*=13)	36.23±2.52	81.30±2.42	300.76±5.45	64.76±3.44	286.69±8.99	-	2131.23±139.95
34 (*n*=14)	38.35±2.46	83.71±1.77	308.28±5.64	66.92±2.92	299.14±11.91	-	2387.71±129.66
35 (*n*=11)	36.81±2.04	86.90±4.13	318.54±11.85	69.27±1.68	309.90±11.45	-	2682.09±174.58
36 (*n*=11)	38.36±2.11	87.33±6.31	321.00±5.76	70.81±1.66	318.09±9.10	-	2850.63±108.65
37 (*n*=8)	40.87±2.64	90.62±0.91	325.37±4.24	72.00±1.41	333.25±4.80	-	3135.75±157.71
38 (*n*=1)	42.00±0	92.00±0	328.00±0	72.00±0	342.00±0	-	3335.00±0
39 (*n*=3)	43.00±7.93	91.66±4.16	331.33±9.07	74.33±4.72	322.00±9.54	-	3319.33±400.32

PT – Placental thickness, GA – Gestational age, EFW – Estimated fetal weight, BPD – Biparietal diameter, HC – Head circumference, FL – Femur length, AC – Abdominal circumference, CRL – Crown–rump length

Table 3: Correlation coefficient between placental thickness and fetal biometry parameters

	BPD	HC	AC	FL	PT	CRL
BPD	1	0.98	0.48	0.97	0.88	-
HC	0.98	1	0.48	0.97	0.89	-
AC	0.48	0.48	1	0.48	0.45	-
LF	0.97	0.97	0.48	1	0.89	-
PT	0.88	0.89	0.45	0.89	1	0.67
CRL	-	-	-	-	0.67	1

$P<0.00001$ for all correlations. BPD – Biparietal diameter, HC – Head circumference, FL – Femur length, AC – Abdominal circumference, CRL – Crown–rump length, PT – Placental thickness

summarizes the correlations between PT and fetal growth parameters.

DISCUSSION

Measurement of PT depends on the skill of the sonographer as well as the understanding of the placenta-myometer interface. The PT measurement technique described in this study is relatively easy as the cord insertion site is usually central, but a slightly eccentric position may be normal. Measurement of PT may be difficult in some situations like in low-insertion placentas.[18] Measurement of PT correlated with GA and can be involved in the diagnosis and prevention of adverse perinatal outcomes.[19,20]

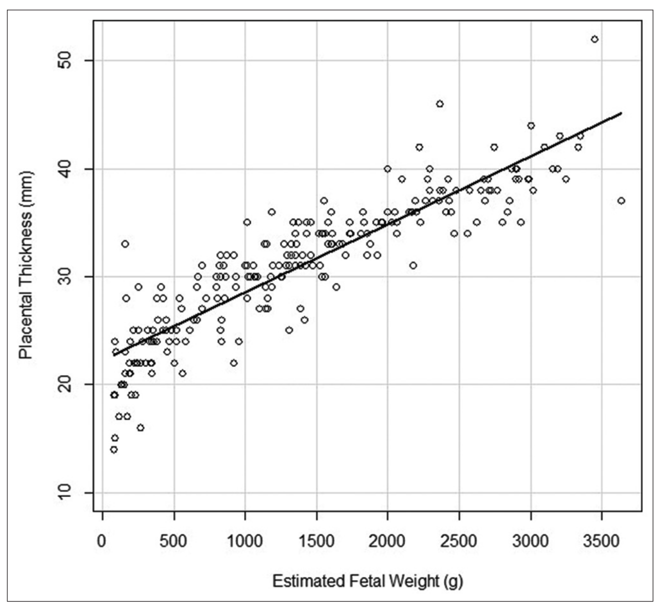

Figure 3: Scatter plot showing the relationship between placental thickness and estimated fetal weight. EFW – Estimated fetal weight

In the present study, the placenta was anterior in 45.31% of cases and posterior in 35.94% of cases. In Nigeria, Azagidi *et al*.[11] had reported a similar result, where in 47.75% of cases, the placenta was anterior and in 38% of the cases posterior. In a study by Fidan *et al*.[21] in Turkey, the placenta was located in the anterior, posterior, and fundal walls in 52.7%, 37.7%, and 9.6% of cases, respectively. Granfors *et al*.[22] in Sweden also reported a predominance of posterior location.

It is important to know the normal PT values to detect possible growth anomalies. Abnormally thick placentas are part of the spectrum of placentomegaly. The cutoff value for defining a thick placenta varies according to GA, measurement methods, and maternal and fetal conditions.[23] It has been predicted that placentas thicker than 40 mm on ultrasound can be considered thick.[24] In the present study of low-risk pregnancies, PT was >40 mm in 3.52% of cases revealing the upper limit of normal spacing. The mean PT in the first, second, and third trimesters was 13.50 ± 3.67 mm, 24.61 ± 4.12 mm, and 34.65 ± 4.17 mm, respectively. The overall mean was 29.89 ± 7.42 mm, and the maximum value was recorded at 39 weeks and was 52 mm. Azagidi *et al*.[11] reported a mean of 29.6 ± 7.1 mm with a lower maximum value of 40.9 mm recorded at 38 weeks. In Ireland, Cooley *et al*.[25] found a mean of 31 ± 9 mm at 22 weeks and 43 ± 14 mm at 36 weeks. Agwuna *et al*.,[26] in Nigeria, found a mean of 23.2 ± 2.8 mm in the second trimester and 36.1 ± 3.6 mm in the third trimester. Karthikeyan *et al*.,[14] in India, found a slightly larger mean in the first trimester of 16.5 mm, but the averages in the second and third trimesters were comparable to those of the present study, 23.78 mm, and 35.81 mm. Olaleye *et al*.,[27] in Nigeria, reported the mean PTs in the second and third trimesters, 23.2 ± 3.1 and 34.1 ± 3.7 mm, respectively. Placentomegaly is seen in a number of conditions and is associated with an increased risk of placental insufficiency. Causes may include upper limit of normal variation, fetal macrosomia, fetal hydrops, TORCH infections, maternal anemia, and maternal diabetes.[23,24] Abnormally reduced PT can be observed in preeclampsia and intrauterine growth restriction.[23,28]

In this study, there was also a strong positive linear correlation between PT and EFW. In general, neonates weighing <2500 g are considered low weight.[29] In the third trimester, the mean PT in this study was 33.34 ± 3.43 mm (95% CI: 32.72–33.97 mm) for an EFW below 2500 g and 39.11 ± 3.36 mm (95% CI: 37.98–40.24 mm) for an EFW exceeding 2500 g. The measurement of PT could serve as a predictor for low birth weights in our settings where the incidence of low birth weight is higher, between 10% and 20%.[29,30] Habib *et al*.,[31] in a study of Saudi women, reported that PT was 22 mm at 36 weeks in fetuses weighing <2500 g and 34.8 mm at 36 weeks in fetuses weighing more than 2500 g. They concluded that PT is a predictor of acceptable birth weight in Saudi women.

Limitations

The main limitation of this study is its single-center nature. The sample size was small and there was only one observer. The sample sizes in the different groups are not the same, and we did not take into account the body mass index of the pregnant women.

CONCLUSIONS

This study demonstrates a correlation between PT and fetal growth parameters suggesting that PT can be used to estimate GA and assess fetal growth. It could help predict low birth weight. However, popularization of this practice could only be achieved after multicenter longitudinal studies with larger samples.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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