RESEARCH ARTICLE

Anterior-Posterior Thigh Diameter in Healthy Pregnancies and its Correlation With Several Parameters of Fetal Biometry

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ABSTRACT

Background: The measurement of anterior-posterior thigh diameter (APTD) in healthy pregnancies offers valuable insights into fetal growth and development. By examining the correlation between APTD and other parameters of fetal biometry, healthcare providers can assess fetal well-being and identify potential growth abnormalities. This study aimed to investigate the anterior-posterior thigh diameter in healthy pregnancies and examine its correlation with several parameters of fetal biometry. **Methods:** This cross-sectional study was conducted at the Department of Radiology and Imaging, Mymensingh Medical College & Hospital, Mymensingh, Bangladesh from January 2010 to January 2012. A total of 250 healthy women between the 24th and 38th weeks of normal pregnancy were purposively enrolled as the study subjects. Data analysis was conducted using SPSS version 23.0. Results: In this study, positive significant correlations were found between fetal anterior-posterior thigh diameter with gestational age (wk) ($r=1.0$; $p<0.001$); Bi-parietal diameter ($r=0.856$; $p<0.001$); Head circumference ($r=0.962$; $p<0.001$); Abdominal circumference ($r=0.972$; $p<0.001$) and Femur length ($r=0.948$; $p<0.001$). Conclusion: There are significant positive correlations between fetal anterior-posterior thigh diameter and various parameters, including gestational age, biparietal diameter, head circumference, abdominal circumference, and femur length.

Keywords: Anterior-posterior thigh diameter, Pregnant women, correlation, Fetal biometry, Femur length, Abdominal circumference.

INTRODUCTION

Uncertain gestational age is linked to higher perinatal mortality and a greater incidence of low birth weight and preterm delivery [1]. Accurate calculation of gestational age is a critical component of prenatal ultrasound examinations. The process of birth is considered the most perilous journey an individual undertakes [2]. Ultrasound is currently employed to determine gestational age by measuring various parameters such as gestational sac diameter, fetal crown-rump length (CRL), fetal biparietal diameter (BPD), femur length (FL), abdominal circumference (AC), lengths of other fetal long bones like the arm, fetal transverse cerebellar diameter (TCD), and fetal foot length [3]. Precise estimation of gestational age depends on the accurate measurement of these parameters [4]. Furthermore, variation in fetal measurements by different individuals tends to increase with gestational age, making earlier measurements more reliable for determining gestational age [5]. Numerous studies have been conducted in various countries, leading to the development of different measurements and tables to determine fetal age based on various diameters [6]. Textbooks highlight that fetal growth is influenced by genetic factors, which are further affected by ethnic and geographic differences, with these variations becoming more significant in the third trimester [7,8]. In the first trimester, the mean gestational sac diameter and CRL

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are commonly used to determine gestational age, while in the second and third trimesters, measurements such as BPD, FL, AC, TCD, and head circumference (HC) are utilized. However, measuring these parameters has its challenges and limitations [9]. In the third trimester, the accuracy of determining gestational age using BPD and FL decreases, and specific fetal conditions, such as improper positioning or certain anomalies, can complicate the determination of gestational age using these parameters [10]. Although there is a relationship between femur length (FL) and fetal age, measuring femur length has a potential technical error due to the non-visible epiphyses, which are often overlooked [11]. Anterior posterior thigh diameter (APTD) is considered a reliable and valid method for assessing fetal age in normal pregnancy and may be especially useful when other parameters fail to accurately predict fetal age. Accurate linear measurements of multiple fetal parameters provide a more comprehensive profile of fetal growth and the estimated delivery date. Additionally, APTD may help identify fetal growth issues [12].

METHODOLOGY

This cross-sectional study took place at the Department of Radiology and Imaging, Mymensingh Medical College & Hospital in Mymensingh, Bangladesh, from January 2010 to January 2012. A total of 250 healthy women, in their 24th to 38th weeks of normal pregnancy, were enrolled using purposive sampling. The study received approval from the hospital's ethical committee, and all participants provided written informed consent before data collection began. Inclusion criteria required that participants' gestational ages were confirmed by their last menstrual period and that they underwent ultrasonographic evaluations between the 24th and 38th weeks of pregnancy. The exclusion criteria included fetuses with congenital anomalies, cases of intrauterine growth retardation (IUGR), and multiple gestations. The study utilized fetal anthropometric parameters such as BPD, FL, AC, and HC to determine gestational age. Anterior-posterior thigh diameter (APTD) was measured using two-dimensional sonography across gestational ages ranging from 24 to 38 weeks and correlated with these parameters. Ultrasonographic evaluations were performed for all participants. In the study, anterior-posterior thigh diameter (APTD) was measured using several techniques: adjusting the transducer position, excluding distal femoral epiphyses, and utilizing real-time sonographic equipment with 3.5 MHz transducers. Accuracy was ensured by using electronic calipers and Dr. Hadlock's femur length tables. All demographic and clinical data were recorded. Data analysis was performed using SPSS version 23.0, with a P value <0.05 considered indicative of statistical significance.

RESULT

In our study, more than one-third (34.0%) of the participants were in the age range of 21-25 years (n=85). This was followed by 28.8% in the age range of <20 years (n=72), 25.2% in the age range of 26-30 years (n=63), and 12.0% in the age range of >30 years (n=30). The mean age of the participants was 24.79 ± 4.71 years. The distribution of gestational age among the observed cases shows that the frequencies are relatively evenly spread across the weeks from 24 to 38, with slight variations. The highest percentages are seen at 26 and 34 weeks, each accounting for 7.6% of the cases. Weeks 24 and 31 follow closely, each with 7.2%. In this study, the scatter diagram illustrated a perfect positive correlation (r=1.000) between gestational age (weeks) and fetal anterior-posterior thigh diameter (cm). Another scatter diagram showed a strong positive correlation (r=0.856) between fetal anterior-posterior thigh diameter and biparietal diameter (cm). Moreover, a separate scatter diagram demonstrated a strong positive correlation (r=0.962) between fetal anterior-posterior thigh diameter and head circumference (cm). Additionally, we found a strong positive correlation (r=0.972) between fetal anterior-posterior thigh diameter and abdominal circumference (cm). There was also a strong positive correlation (r=0.948) between fetal anterior-posterior thigh diameter and femur length (cm).

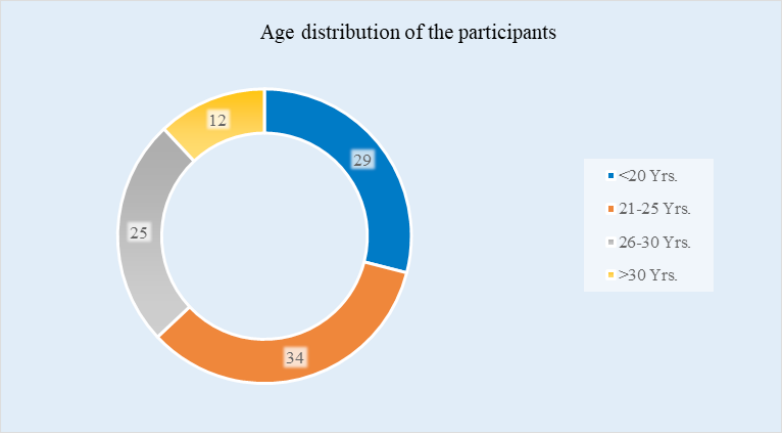

Figure I: Column chart showed age wise participants distribution (N=250)

Table 1: Gestational age distribution (N=250)

Weeks	n	%
24 Wks.	18	7.2
25 Wks.	15	6
26 Wks.	19	7.6
27 Wks.	17	6.8
28 Wks.	16	6.4
29 Wks.	15	6
30 Wks.	17	6.8
31 Wks.	18	7.2
32 Wks.	15	6
33 Wks.	17	6.8
34 Wks.	19	7.6
35 Wks.	16	6.4
36 Wks.	16	6.4
37 Wks.	17	6.8
38 Wks.	15	6

Table 2: Distribution of biparietal diameter according to gestational age at different weeks of gestation (N=250)

G. age (Week)	n	Biparietal diameter	
		Mean	±SD
		(mm)	
24	18	60.7	0.98
25	15	63.7	1.73
26	19	69.1	6.83
27	17	72.2	7.95
28	16	73.8	6.22
29	15	74.2	1.83
30	17	76.9	2.31
31	18	78.6	1.16
32	15	79.4	1.69
33	17	77	6.96
34	19	82.8	2.48
35	16	83.7	3.84
36	16	84.2	3.33
37	17	86.4	1.46
38	15	86.5	0.93

Table 3: Distribution of head circumference according to gestational age at different weeks of gestation (N=250)

G. age (Week)	n	HC	
		Mean	±SD
		(mm)	
24	18	220.3	1.03
25	15	231.3	7.04
26	19	243.9	8.35
27	17	250.6	5.46
28	16	256.8	5.32
29	15	266.7	4.68
30	17	276.7	5.64
31	18	280.6	4.57
32	15	285.5	3.15
33	17	286.2	3.05
34	19	291	4.33
35	16	296.5	7.66
36	16	301.4	4.99
37	17	309.6	3.05
38	15	311.5	4.55

Table 4: Distribution of abdominal circumference according to gestational age at different weeks of gestation (N=250)

G. age (Week)	n	AC	
		Mean	±SD
		(mm)	
24	18	191.9	2.45
25	15	202.6	8.02
26	19	214.4	5.58
27	17	222.9	9.53
28	16	232.7	5.95
29	15	244.8	9.69
30	17	257.9	4.68
31	18	262.5	5.29
32	15	267.8	8.13
33	17	271.8	5.93
34	19	280.4	7.78
35	16	283.7	7.93
36	16	293.3	5.2
37	17	301.9	2.5
38	15	303.6	11.06

Table 5: Distribution of femur length according to gestational age at different weeks of gestation (N=250)

G. age (Week)	n	FL	
		Mean	±SD
		(mm)	
24	18	41.8	1.13
25	15	43.9	1.88
26	19	45.3	1.38
27	17	49.1	2.6
28	16	50.4	2.61
29	15	52.5	1.64
30	17	54.2	1.55

31	18	55.9	1.77
32	15	56.6	2.03
33	17	56.6	1.05
34	19	57.7	1.95
35	16	60	4.46
36	16	60.6	1.83
37	17	62.4	0.83
38	15	63.6	0.89

Table 6: Distribution of fetal anterior-posterior thigh diameter (APTD) according to gestational age at different weeks of gestation. (N=250)

G. age (Week)	n	APTD Mean (cm)	APTD ±SD (cm)
24	18	2.42	0.01
25	15	2.53	0.02
26	19	2.65	0.02
27	17	2.75	0.02
28	16	2.85	0.02
29	15	2.94	0.02
30	17	3.04	0.02
31	18	3.13	0.03
32	15	3.23	0.03
33	17	3.34	0.03
34	19	3.44	0.02
35	16	3.54	0.02
36	16	3.64	0.02
37	17	3.74	0.03
38	15	3.84	0.03

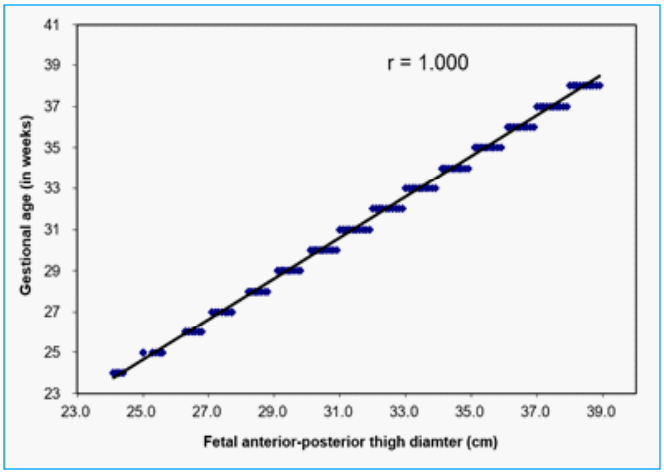

Figure 2: Positive correlation between gestation age with fetal APTD

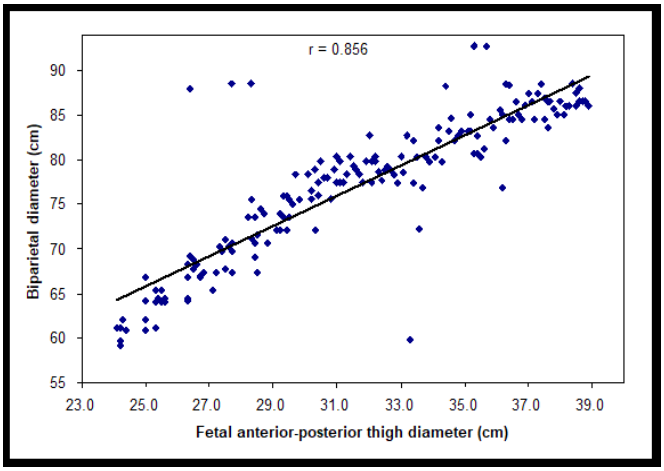

Figure 3: Positive correlation between fetal APTD diameter with biparietal diameter.

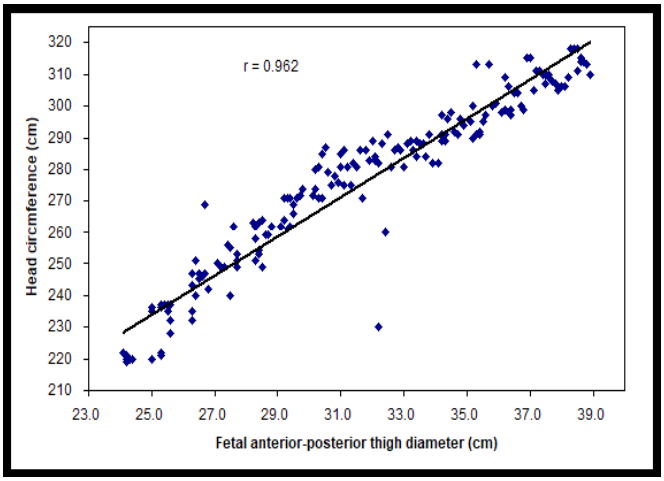

Figure 4: Positive correlation between fetal APTD diameter with head circumference.

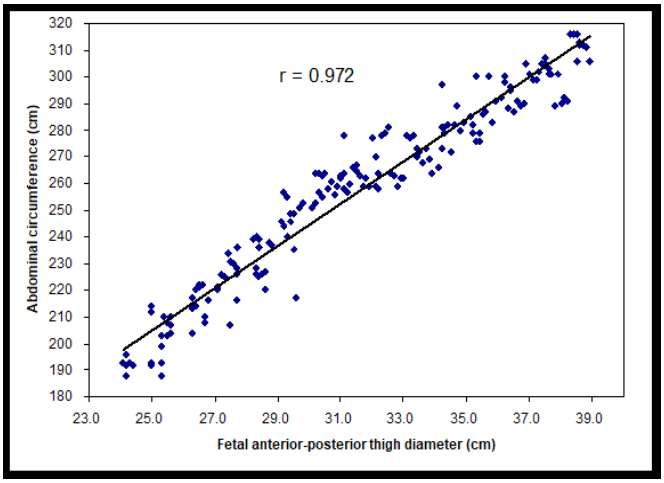

Figure 5: Positive correlation between fetal APTD diameter with abdominal circumference.

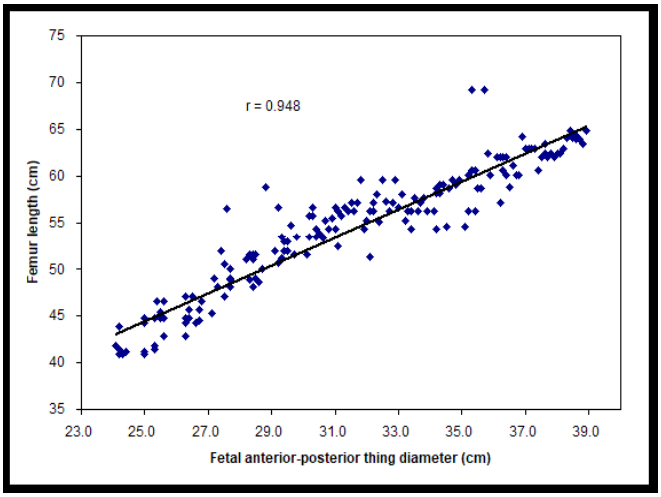

Figure 6: Positive correlation between fetal APTD diameter with femur length.

DISCUSSION

In this current study, the mean age of the participants was 24.79 ± 4.71 years, with a range from 18 to 35 years, which closely resembled the findings of Saad and Kubaise (2006) [13]. It was observed that the mean gestational age of the participants was 30.93 ± 4.32 weeks, ranging from 24 to 38 weeks, which was consistent with the observations of Ismail et al. (2007) [12], where the gestational age ranged from 18 to 28 weeks. However, since fetal weight depends not only on head and body dimensions but also on extremity size, it seems reasonable to investigate the role of other body measurements in improving fetal weight estimates. Hoffbauer and co-workers were among the first to include fetal thigh diameter in a weight formula. Hadlock et al. (1984) [14] concluded that circumference measurements of the fetal thigh could be made reliably and used to detect changes in the soft tissue mass, potentially improving fetal weight estimation. The accuracy of determining fetal age, weight, and estimated delivery date (EDD) is improved when multiple predictors are used, particularly when it is difficult to obtain fetal head biometry due to factors like the head being too low in the pelvis or conditions such as hydrocephalus, anencephaly, or fetal renal disease. Consequently, reliable methods for estimating fetal body weight and age without head measurements are necessary [15]. The results obtained in this present study indicate that anterior-posterior thigh diameter (APTD) demonstrates high validity and reliability. The simple correlation established in this study—1 mm APTD per week of fetal age—is a novel and useful finding. Previous research has shown that measuring the thigh parameter can be a convenient method for determining fetal growth in the second trimester [16]. APTD may play a role in the quality control of ultrasound examinations and assist in diagnosing fetal growth abnormalities. The accuracy of fetal biometry is extremely important, particularly when using fetal long-bone measurements [17]. There are relationships between intrauterine growth restriction (IUGR), smaller fetal biometry, and smaller thigh circumference. APTD may be used as an indicator of fetal biometric disturbances, allowing the physician to manage the pregnancy better [18]. In this current study, it was shown that fetal APTD provides an accurate linear measurement of the fetus, thereby generating a more complete profile. Significant correlations ($r=1.000$; $p<0.001$) of APTD with fetal age indicate that this is a reliable method, particularly useful when other fetal parameters may not accurately predict fetal age or are difficult to obtain. A significant positive correlation was found in this study between fetal anterior-posterior thigh diameter and various parameters: gestational age (weeks) ($r=1.0$; $p<0.001$), biparietal diameter ($r=0.856$; $p<0.001$), head circumference ($r=0.962$; $p<0.001$), abdominal circumference ($r=0.972$; $p<0.001$), and femur length ($r=0.948$; $p<0.001$). Similarly, Saad and Kubaisi et al. (2006) [13] reported Rsq >0.9993 and p-value <0.001, showing a positive correlation between anterior-posterior thigh diameter and fetal age, which is consistent with the findings of the current study.

LIMITATION OF THE STUDY

This study was single-centered with a small sample size and conducted over a short period. Consequently, the findings may not accurately reflect the situation across the entire country.

CONCLUSION

The significant positive correlations between fetal anterior-posterior thigh diameter and parameters such as gestational age, biparietal diameter, head circumference, abdominal circumference, and femur length underscore the importance of these measurements in prenatal assessments. These correlations suggest that monitoring the anterior-posterior thigh diameter can provide valuable insights into fetal development and overall health. Consequently, incorporating this metric into routine prenatal checkups could enhance the accuracy of fetal growth evaluations, aiding in the timely identification of potential concerns and enabling more effective, personalized care for expectant mothers and their babies.

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