Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Radiology

Correlation of Estimated Gestational Age with the Anterior-Posterior Thigh Diameter and Other Parameters of Fetal Biometry

Dr. Mohammed Abdoullah Al Maruf[1*], Dr. Safia Sultana[2], Dr. Ataul Karim[3], Dr. Maria Sultana[4]

[1]Consultant, Radiologist, Mediscan Specialized Imagine Centre, Kishoreganj, Dhaka, Bangladesh
[2]Associate Professor, Department of Microbiology, Shaheed Syed Nazrul Islam Medical College, Kishoreganj, Dhaka, Bangladesh
[3]Consultant, Sonologist, Mediscan DNA Lab, Kishoreganj, Dhaka, Bangladesh
[4]Consultant Sonologist, Mediscan DNA Lab, Kishoreganj, Dhaka, Bangladesh

DOI: 10.36347/sjams.2024.v12i07.014 | **Received:** 23.05.2024 | **Accepted:** 04.07.2024 | **Published:** 26.07.2024

***Corresponding author:** Dr. Mohammed Abdoullah Al Maruf
Consultant, Radiologist, Mediscan Specialized Imagine Centre, Kishoreganj, Dhaka, Bangladesh
Email: drmaruf75@yahoo.com

Abstract **Original Research Article**

Background: Accurate gestational age estimation is vital for tracking pregnancy, identifying growth issues, and guiding clinical decisions. Including anterior-posterior thigh diameter (APTD) in fetal biometry enhances fetal health assessment. Correlating EGA with APTD and other biometry parameters is crucial for evaluating fetal growth and development. This study aimed to evaluate the correlation of estimated gestational age with the anterior-posterior thigh diameter and other 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 enrolled using a purposive sampling technique. Data analysis was performed using SPSS version 23.0. ***Results:*** More than one-third (34.0%) of participants were aged 21-25 years. The mean gestational age was 30.93 ± 4.32 weeks, and over half (56.4%) were primigravida. Significant positive correlations were found between fetal anterior-posterior thigh diameter and gestational age (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:*** The fetal anterior-posterior thigh diameter shows significant positive correlations with several parameters, including gestational age, biparietal diameter, head circumference, abdominal circumference, and femur length in this study.

Keywords: Correlation, Estimated gestational age, anterior-posterior thigh diameter, Fetal biometry.

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 crucial aspect of prenatal ultrasound examinations. The process of birth is regarded as the most perilous journey an individual undertakes [2]. Precise estimation of gestational age relies on the accurate measurement of these parameters [3]. Ultrasound plays a critical role in assessing gestational age by measuring parameters such as gestational sac diameter, fetal crown-rump length (CRL), biparietal diameter (BPD), femoral length (FL), abdominal circumference (AC), and other fetal dimensions like transverse cerebellar diameter (TCD) and foot length [4]. The accuracy of gestational age estimation relies on the precise measurement of these factors [5]. Variability in fetal measurements increases with advancing gestational age, with earlier measurements generally providing more accurate results [6]. Numerous studies worldwide have investigated this field, leading to the development of various measurement charts for different fetal dimensions [7,8]. Textbooks emphasize that genetic factors significantly influence fetal growth, a process further shaped by ethnic and geographical differences, which are particularly evident in the third trimester [9]. During the first trimester, mean gestational sac diameter and crown-rump length play crucial roles in estimating gestational age, while parameters like biparietal diameter (BPD), femoral length (FL), abdominal circumference (AC), transverse cerebellar diameter (TCD), and head circumference (HC) are utilized in the second and third trimesters. However, each measurement has its specific characteristics and limitations [10]. In the third trimester, the accuracy of BPD and FL for estimating gestational age decreases, especially in cases of fetal malposition or anomalies, which pose considerable challenges [11].

METHODOLOGY

This cross-sectional study was conducted in the Department of Radiology and Imaging at Mymensingh Medical College & Hospital, Mymensingh, Bangladesh, from January 2010 to January 2012. A total of 250 healthy pregnant women between their 24th and 38th weeks of gestation were purposively sampled for the study. The hospital's ethical committee approved the study, and written informed consent was obtained from all participants before data collection. The inclusion criteria encompassed patients with gestational age confirmed by the last menstruation date and who underwent ultrasonographic evaluations between the 24th and 38th weeks of pregnancy. Exclusion criteria included fetuses with congenital anomalies, cases of intrauterine growth retardation (IUGR), and multiple gestations. The study utilized fetal anthropometric parameters such as biparietal diameter (BPD), femoral length (FL), abdominal circumference (AC), and head circumference (HC) to determine gestational age. Additionally, anterior-posterior thigh diameter was measured via two-dimensional sonography across gestational ages ranging from 24 to 38 weeks and correlated with these parameters. Ultrasonographic evaluation was performed for all participants. Anterior-posterior thigh diameter was measured using various techniques, including adjusting the transducer position, excluding distal femoral epiphyses, and employing real-time sonographic equipment with 3.5 MHz transducers. Electronic calipers and Dr. Hadlock's femur length tables were used to ensure accuracy. All demographic and clinical data were recorded. Data analysis was conducted using SPSS version 23.0, with a P value <0.05 considered significant.

RESULT

In our study, 34.0% of participants were aged 21-25 years, 28.8% were under 20, 25.2% were 26-30, and 12.0% were over 30. The mean age was 24.79 ± 4.71 years. The mean gestational age of the participants ranged from 24 to 38 weeks, with an average of 30.93 ± 4.32 weeks. In this study, among the 250 participants, 54.0% were primigravida, 33.2% were in their second pregnancy, 8.4% were in their third pregnancy, and 4.4% were in their fourth or subsequent pregnancies. The distribution of gestational age among the observed cases is relatively even across the weeks from 24 to 38, with slight variations. The highest percentages are observed at 26 and 34 weeks, each accounting for 7.6% of the cases, followed closely by weeks 24 and 31, each with 7.2%. In this study, the scatter diagram showed 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). Additionally, a separate scatter diagram demonstrated a strong positive correlation (r=0.962) between fetal anterior-posterior thigh diameter and head circumference (cm). We also found a strong positive correlation (r=0.972) between fetal anterior-posterior thigh diameter and abdominal circumference (cm). Furthermore, there was a strong positive correlation (r=0.948) between fetal anterior-posterior thigh diameter and femur length (cm).

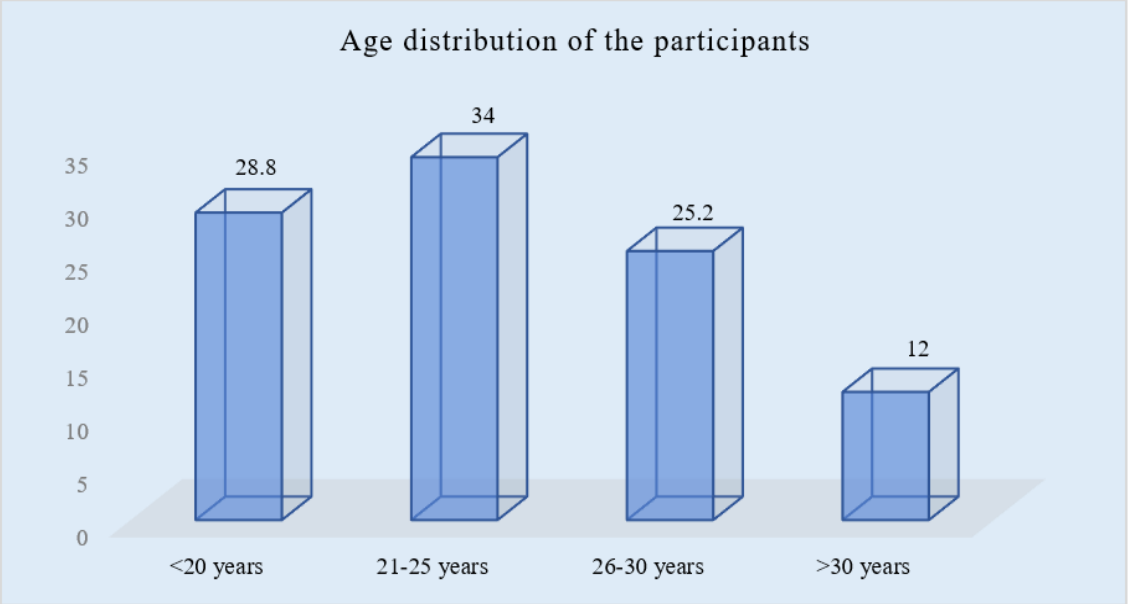

Figure I: Column chart showed age wise participants distribution (N=*250)*

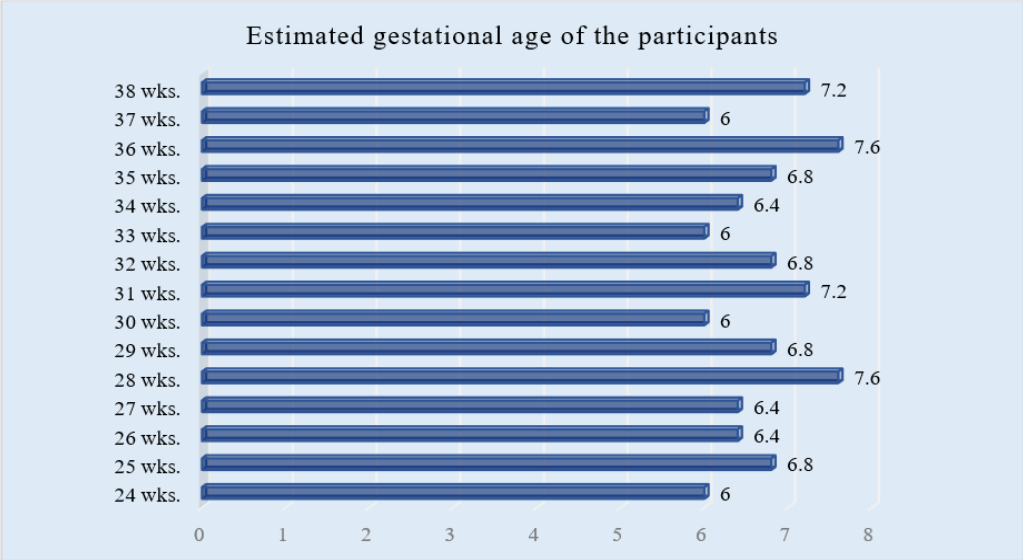

Figure II: Bar chart showed estimated gestational age wise participants (N=*250)*

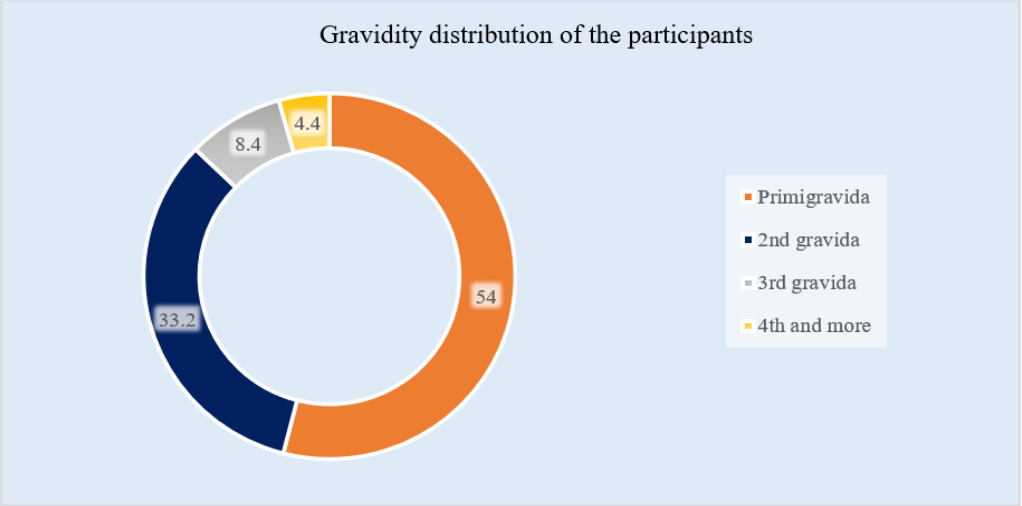

Figure III: Ring chart showed gravidity wise participants (N=*250)*

Table 1: Estimated gestational versus several fetal parameters (N=250)

G. age (Week)	BD		HC		AC		FL		APTD	
	Mean (mm)	±SD	Mean (mm)	±SD	Mean (mm)	±SD	Mean (mm)	±SD	Mean (cm)	±SD
24 Week	60.7	1.0	220.3	1.0	191.9	2.5	41.8	1.1	2.42	0.01
25 Week	63.7	1.7	231.3	7.0	202.6	8.0	43.9	1.9	2.53	0.02
26 Week	69.1	6.8	243.9	8.4	214.4	5.6	45.3	1.4	2.65	0.02
27 Week	72.2	8.0	250.6	5.5	222.9	9.5	49.1	2.6	2.75	0.02
28 Week	73.8	6.2	256.8	5.3	232.7	6.0	50.4	2.6	2.85	0.02
29 Week	74.2	1.8	266.7	4.7	244.8	9.7	52.5	1.6	2.94	0.02
30 Week	76.9	2.3	276.7	5.6	257.9	4.7	54.2	1.6	3.04	0.02
31 Week	78.6	1.2	280.6	4.6	262.5	5.3	55.9	1.8	3.13	0.03
32 Week	79.4	1.7	285.5	3.2	267.8	8.1	56.6	2.0	3.23	0.03
33 Week	77	7.0	286.2	3.1	271.8	5.9	56.6	1.1	3.34	0.03
34 Week	82.8	2.5	291.0	4.3	280.4	7.8	57.7	2.0	3.44	0.02
35 Week	83.7	3.8	296.5	7.7	283.7	7.9	60.0	4.5	3.54	0.02
36 Week	84.2	3.3	301.4	5.0	293.3	5.2	60.6	1.8	3.64	0.02
37 Week	86.4	1.5	309.6	3.1	301.9	2.5	62.4	0.8	3.74	0.03
38 Week	86.5	0.9	311.5	4.6	303.6	11.1	63.6	0.9	3.84	0.03

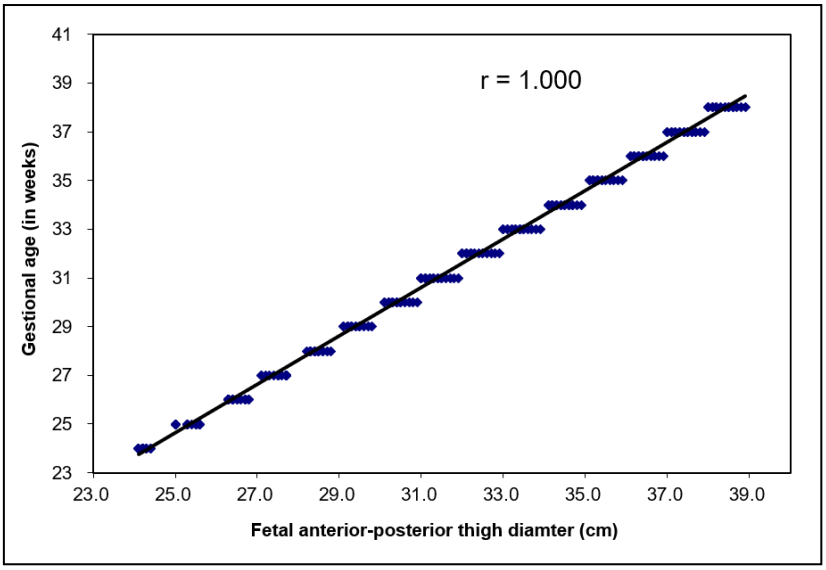

Figure IV: Positive correlation between gestation age with fetal APTD

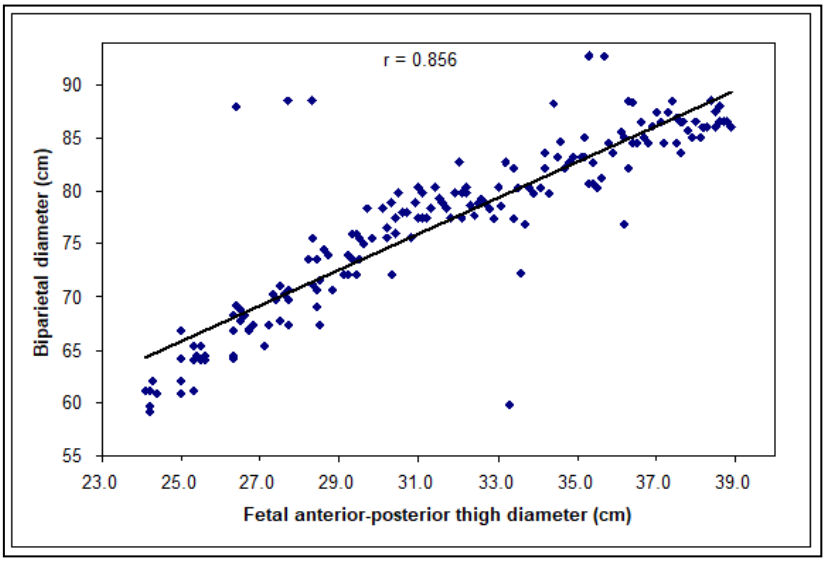

Figure V: Positive correlation between fetal APTD diameter with biparietal diameter

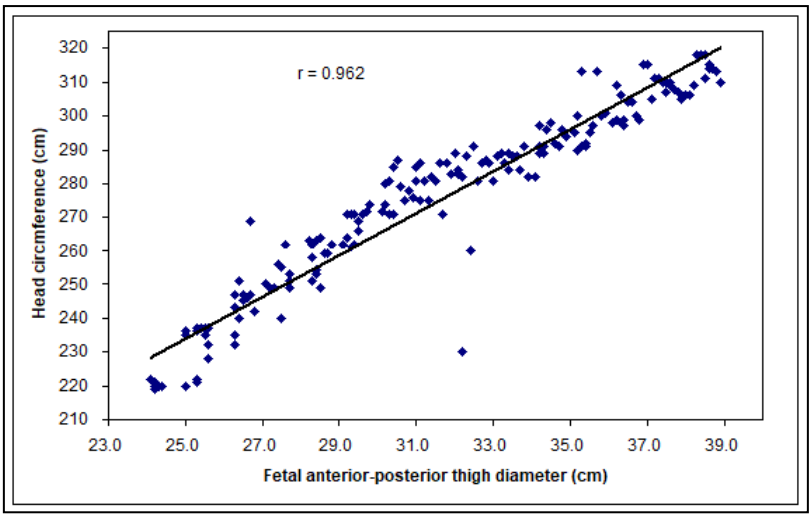

Figure VI: Positive correlation between fetal APTD diameter with head circumference

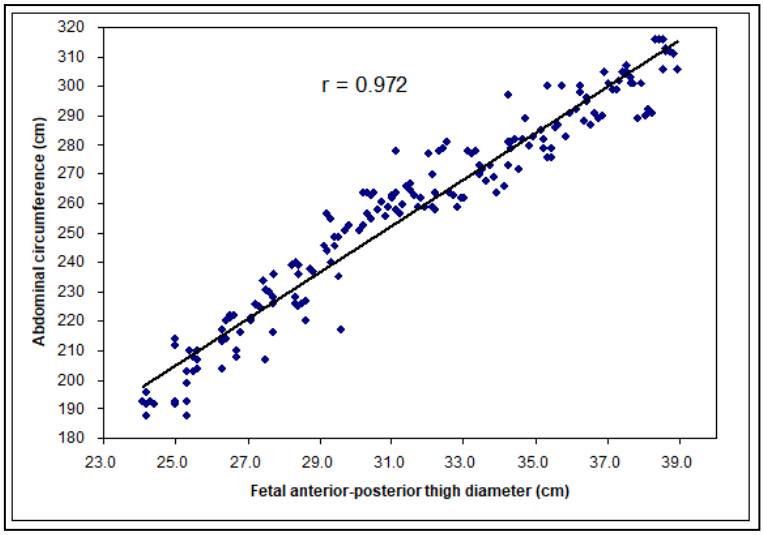

Figure VII: Positive correlation between fetal APTD diameter with abdominal circumference

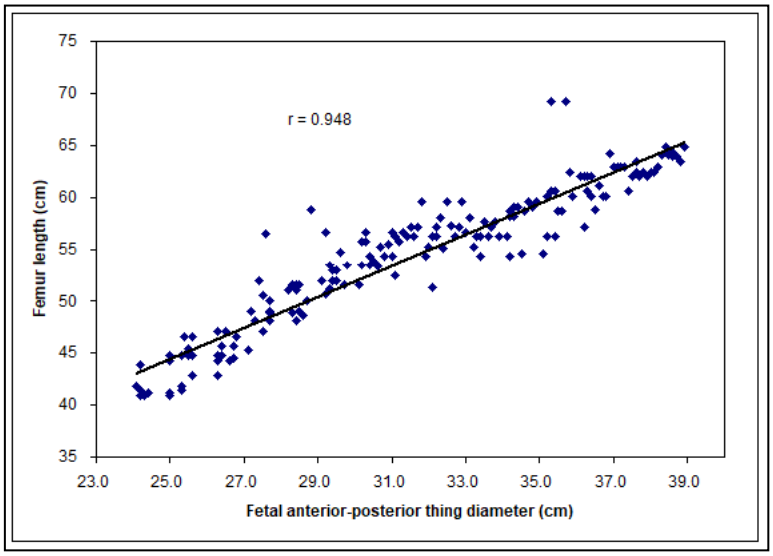

Figure VIII: Positive correlation between fetal APTD diameter with femur length

Table 2: Correlation between anthropometric parameters with fetal anterior-posterior thigh diameter

Characteristics	FATD
Gestational age	**1.000**
BD	0.856
HC	0.962
AC	0.972
FL	0.948

DISCUSSION

Measuring gestational age early in pregnancy is critical for identifying potential growth abnormalities later on. Fetal biometry plays a key role in distinguishing between normal and abnormal fetal development. However, variations in prenatal measurements of fetal parameters and estimated size and weights exist among different populations due to racial, demographic, and nutritional differences. Therefore, it is essential to conduct fetal biometry tailored to the local population and establish local charts of normal biometry specific to ethnic groups. The standardization of fetal ultrasound biometry began with Willocks *et al.*,'s seminal paper in 1964 [12], one of the earliest works on fetal ultrasound cephalometry. In our study, the mean gestational age was 30.93 ± 4.32 weeks, ranging from 24 to 38 weeks, consistent with the findings of Ismail *et al.*, in 2007 [13], which reported a gestational age range of 18 to 28 weeks. However, since fetal weight is influenced not just by head and body dimensions but also by extremity size, exploring the contribution of other body measurements to enhance fetal weight estimates is logical. Hoffbauer and colleagues were pioneers in incorporating fetal thigh

diameter into weight estimation formulas. According to Hadlock *et al.*, [14], measurements of fetal thigh circumference can be conducted reliably and utilized to monitor changes in soft tissue mass, potentially enhancing the accuracy of fetal weight estimation. The precision of determining fetal age, weight, and estimated delivery date (EDD) is enhanced when multiple predictors are utilized, particularly in challenging scenarios where obtaining fetal head biometry is hindered by factors such as pelvic positioning, or conditions like hydrocephalus, anencephaly, or fetal renal disease. Therefore, robust methods for estimating fetal body weight and age independent of head measurements are essential [15]. The findings from this study suggest that anterior-posterior thigh diameter (APTD) exhibits strong validity and reliability. The straightforward correlation identified in this research—a 1 mm increase in APTD per week of fetal age—is a novel and valuable discovery. Prior studies have indicated that measuring thigh parameters is a practical approach for monitoring fetal growth during the second trimester [16]. Anterior-posterior thigh diameter (APTD) can aid in the quality assurance of ultrasound exams and help detect fetal growth abnormalities. Accurate fetal biometry, especially involving long-bone measurements, is crucial [17], given the associations between intrauterine growth restriction (IUGR), reduced fetal biometry, and smaller thigh circumference. APTD serves as a potential indicator of fetal biometric disruptions, facilitating improved pregnancy management [18]. This study underscores that fetal APTD offers a precise linear measurement of the fetus, enhancing comprehensive fetal profiling. Significant correlations ($r=1.000$; $p<0.001$) between anterior-posterior thigh diameter (APTD) and fetal age highlight its reliability, especially when other fetal parameters may be challenging to obtain or less predictive of fetal age. This study also identified significant positive correlations between APTD and various fetal parameters: gestational age ($r=1.0$; $p<0.001$), 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 ($r=0.948$; $p<0.001$). These findings align with previous research by Saad and Kubaisi *et al.*, (2006) [13], who similarly reported high Rsq (>0.9993) and significant p-values (<0.001), confirming the positive correlation between APTD and fetal age.

LIMITATION OF THE STUDY

This study was conducted at a single center with a limited sample size and within a short timeframe. Therefore, the results may not be fully representative of the entire country.

CONCLUSION

The significant positive correlations observed between fetal anterior-posterior thigh diameter and parameters such as gestational age, biparietal diameter, head circumference, abdominal circumference, and femur length highlight the importance of these measurements in prenatal assessments. These correlations indicate that monitoring anterior-posterior thigh diameter can provide valuable insights into fetal development and overall health. Integrating this metric into routine prenatal checkups could improve the accuracy of fetal growth evaluations, facilitating early detection of potential issues and enabling more targeted and effective care for expectant mothers and their babies. This approach supports proactive management and promotes optimal outcomes in prenatal care.

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