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Original Research Article

Correlation of Gestational Age with Anterior-Posterior Thigh Diameter Measured by Two-Dimensional Sonography

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Abstract: ***Background:*** Anterior-posterior thigh diameter measurement via two-dimensional sonography (2D-US) correlates with fetal gestational age and reflects the growth and development of fetal thigh muscles and bones. This measurement, alongside estimated gestational age, offers valuable insights into fetal well-being and growth during pregnancy. This study aimed to evaluate the correlation of gestational age with anterior-posterior thigh diameter measured by two-dimensional sonography and estimated gestational age. ***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. As the study subjects, a total of 250 healthy women between the 24th and 38th weeks of normal pregnancy were enrolled by using a purposive sampling technique. For data analysis, SPSS version 23.0 was used. ***Results:*** The mean age of the participants was 24.79 ± 4.71 years with a range from 18 to 35 years. More than one-third (34.0%) of the women were in the age range of 21-25 years. The mean gestational age of all participants was 30.93 ± 4.32 weeks. Primigravida accounted for more than half (56.4%) of them. A statistically significant positive correlation was observed between fetal anterior-posterior thigh diameter and gestational age ($p<0.001$. ***Conclusion:*** There is a statistically significant positive correlation between fetal anterior-posterior thigh diameter and gestational age.

Keywords: Correlation, Gestational age, Fetal, anterior-posterior thigh diameter, APTD, Two-dimensional sonography.

INTRODUCTION

Ensuring a healthy newborn is the ultimate aim for expectant mothers and obstetricians. Birth is often considered the riskiest journey in life [1], underscoring the importance of fetal growth assessment for optimal prenatal care. Given the limitations of clinical gestational age estimation, prenatal ultrasonography offers a more precise approach to assessing fetal growth. Ultrasound biometry has become the gold standard for assessing fetal growth [2]. Accurate calculation of gestational age is crucial during prenatal ultrasound examinations. Uncertain gestational age correlates with higher perinatal mortality, increased rates of low birth weight, and preterm delivery [3]. Ultrasound plays a crucial role in determining gestational age through measurements such as gestational sac diameter, fetal crown-rump length (CRL), biparietal diameter (BPD), femoral length (FL), abdominal circumference (AC), length of other long bones like the arm, fetal transverse cerebellar diameter (TCD), and fetal foot length [4]. Accurate estimation hinges on precise measurement of these parameters [5]. Variations in fetal measurements among different individuals tend to increase with gestational age, with earlier measurements offering greater accuracy in determining gestational age [6]. Numerous studies worldwide have explored this area, leading to the development of various measurement charts for different diameters [7,8]. Textbooks highlight the impact of genetic factors on fetal growth, which is further influenced by ethnic and geographic disparities, particularly notable in the third trimester [9]. Mean gestational sac diameter and crown-rump length are

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pivotal for first-trimester gestational age determination, 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 parameter comes with its features and limitations [10]. In the third trimester, accuracy diminishes with BPD and FL for gestational age determination, especially in cases of fetal malposition or anomalies, posing challenges [11].

METHODOLOGY

This was a cross-sectional study that was conducted at the Department of Radiology and Imaging, Mymensingh Medical College & Hospital, Mymensingh, Bangladesh from January 2010 to January 2012. The study enrolled 250 healthy women in their 24th to 38th weeks of normal pregnancy using purposive sampling as study subjects. The study received approval from the hospital's ethical committee, and all participants provided written informed consent before data collection commenced. The inclusion criteria encompassed patients whose gestational age was confirmed using the last menstruation date and who underwent ultrasonographic evaluations between the 24th and 38th weeks of pregnancy. The exclusion criteria comprised fetuses with congenital anomalies, cases of intrauterine growth retardation (IUGR), and pregnancies involving multiple gestations. The study used fetal anthropometric parameters like BPD, FL, AC, and HC to determine gestational age. 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 the participants. In the study, 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 for accuracy. All the demographic and clinical data were recorded. For data analysis, SPSS version 23.0 was used. In statistical analysis, a P value <0.05 was considered as the indicator of significance.

RESULT

The majority of our participants, 85 (34.0%), were aged 21-25 years, followed by 72 (28.8%) aged <20 years, 63 (25.2%) aged 26-30 years, and 30 (12.0%) aged >30 years. The mean age was 24.79 ± 4.71 years. The mean gestational age ranged from 24 to 38 weeks, with an average of 30.93 ± 4.32 weeks. In this study of 250 cases, 54.0% were primigravida, 33.2% were 2nd gravida, 8.4% were 3rd gravida, and 4.4% were 4th or higher gravida. The majority of cases were primigravida and 2nd gravida. A positive significant correlation was 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).

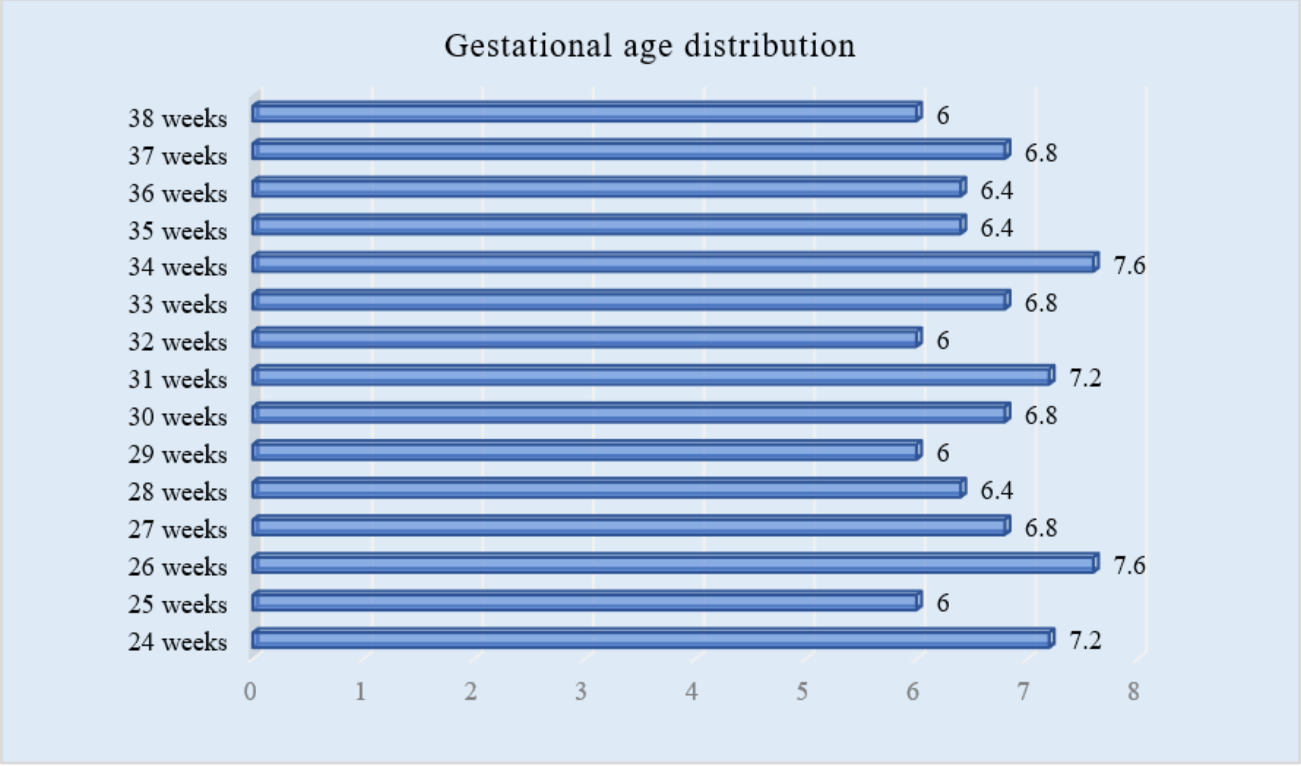

Figure I: Bar chart showed gestational age(weeks) of the *participants (N=250)*

Table 1: Distribution of biparietal diameter according to gestational age at different weeks of gestation *(N=250)*

Gestational age (Weeks)	n	Biparietal diameter		95% CI
		Mean (mm)	±SD	
24 wks.	18	60.7	0.98	59.1-62
25 wks.	15	63.7	1.73	60.9-66.8
26 wks.	19	69.1	6.83	64.2-88
27 wks.	17	72.2	7.95	65.4-88.5
28 wks.	16	73.8	6.22	67.4-88.5
29 wks.	15	74.2	1.83	72.1-78.4
30 wks.	17	76.9	2.31	72.1-79.8
31 wks.	18	78.6	1.16	77.4-80.3
32 wks.	15	79.4	1.69	77.4-82.7
33 wks.	17	77	6.96	59.8-82.7
34 wks.	19	82.8	2.48	79.8-88.3
35 wks.	16	83.7	3.84	80.3-92.8
36 wks.	16	84.2	3.33	76.9-88.5
37 wks.	17	86.4	1.46	83.7-88.6
38 wks.	15	86.5	0.93	85.1-88.5

Table 2: Distribution of head circumference according to gestational age at different weeks of gestation *(N=250)*

Gestational age (Weeks)	n	HC		95% CI	
		Mean (mm)	±SD	Low.	Upp.
24 wks.	18	220.3	1.03	219	222
25 wks.	15	231.3	7.04	220	237
26 wks.	19	243.9	8.35	232	269
27 wks.	17	250.6	5.46	240	262
28 wks.	16	256.8	5.32	249	264
29 wks.	15	266.7	4.68	261	274
30 wks.	17	276.7	5.64	271	287
31wks.	18	280.6	4.57	271	286
32 wks.	15	285.5	3.15	281	291
33 wks.	17	286.2	3.05	281	291
34 wks.	19	291	4.33	282	297
35 wks.	16	296.5	7.66	290	313
36 wks.	16	301.4	4.99	297	315
37 wks.	17	309.6	3.05	305	315
38 wks.	15	311.5	4.55	306	318

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

Gestational age (Weeks)	n	AC		95% CI	
		Mean (mm)	±SD	Low.	Upp.
24 wks.	18	191.9	2.45	188	196
25 wks.	15	202.6	8.02	188	214
26 wks.	19	214.4	5.58	204	222
27 wks.	17	222.9	9.53	207	236
28 wks.	16	232.7	5.95	226	240
29 wks.	15	244.8	9.69	217	257
30 wks.	17	257.9	4.68	251	264
31 wks.	18	262.5	5.29	257	278
32 wks.	15	267.8	8.13	258	281
33 wks.	17	271.8	5.93	262	278
34 wks.	19	280.4	7.78	266	297
35 wks.	16	283.7	7.93	276	300
36 wks.	16	293.3	5.2	287	305
37 wks.	17	301.9	2.5	299	307
38 wks.	15	303.6	11.06	290	316

Table 4: Distribution of femur length according to gestational age at different weeks of gestation *(N=250)*

Gestational age (Weeks)	n	FL		95% CI	
		Mean	±SD		
		(mm)		Low.	Upp.
24 wks.	18	41.8	1.13	40.9	43.8
25 wks.	15	43.9	1.88	40.9	46.6
26 wks.	19	45.3	1.38	42.8	47.1
27 wks.	17	49.1	2.6	45.2	56.5
28 wks.	16	50.4	2.61	48.1	58.8
29 wks.	15	52.5	1.64	50.7	56.7
30 wks.	17	54.2	1.55	51.5	56.7
31 wks.	18	55.9	1.77	52.4	59.6
32 wks.	15	56.6	2.03	51.3	59.6
33 wks.	17	56.6	1.05	54.3	58.1
34 wks.	19	57.7	1.95	54.3	59.6
35 wks.	16	60	4.46	54.6	69.2
36 wks.	16	60.6	1.83	57.2	64.2
37 wks.	17	62.4	0.83	60.6	63.5
38 wks.	15	63.6	0.89	62.5	64.9

Table 5: Distribution of fetal anterior-posterior thigh diameter (APTD) according to gestational age at different weeks of gestation. *(N=250)*

Gestational age (Weeks)	n	APTD		95% CI	
		Mean	±SD		
		(cm)		Low.	Upp.
24 wks.	18	2.42	0.01	2.4	2.4
25 wks.	15	2.53	0.02	2.5	2.6
26 wks.	19	2.65	0.02	2.6	2.7
27 wks.	17	2.75	0.02	2.7	2.8
28 wks.	16	2.85	0.02	2.8	2.9
29 wks.	15	2.94	0.02	2.9	3
30 wks.	17	3.04	0.02	3	3.1
31 wks.	18	3.13	0.03	3.1	3.2
32 wks.	15	3.23	0.03	3.2	3.3
33 wks.	17	3.34	0.03	3.3	3.4
34 wks.	19	3.44	0.02	3.4	3.5
35 wks.	16	3.54	0.02	3.5	3.6
36 wks.	16	3.64	0.02	3.6	3.7
37 wks.	17	3.74	0.03	3.7	3.8
38 wks.	15	3.84	0.03	3.8	3.9

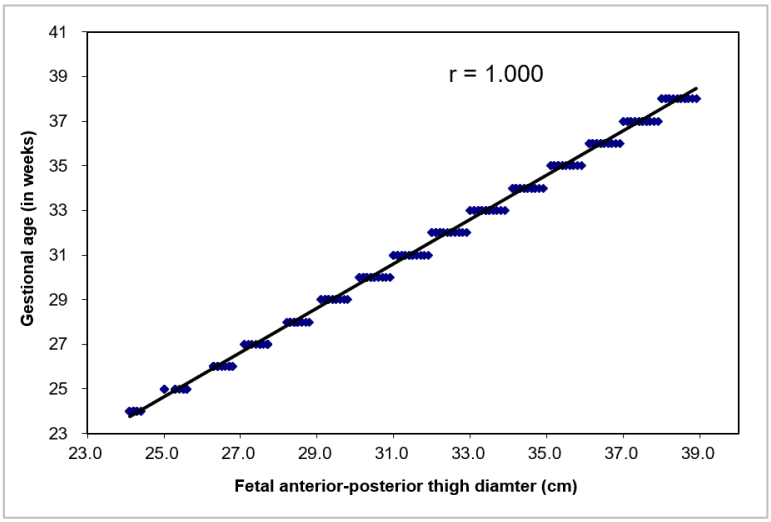

Figure II: Scatter diagram showed the positive correlation (r=1.000) between gestation age (wks.) with fetal anterior-posterior thigh diameter (cm) *(N=250)*

DISCUSSION

Assessing gestational age in early pregnancy is crucial for detecting later-stage growth aberrations. Fetal biometry aids in distinguishing normal from abnormal fetal structures. However, prenatal measurements of fetal parameters and estimated size and weights differ across populations due to racial, demographic, and nutritional variations. Therefore, it is crucial to perform fetal biometry tailored to the local population and construct and adhere to local charts of normal biometry for specific ethnic groups. The standardization of fetal ultrasound biometry began after the publication of Willocks *et al.*, in 1964 [12], likely the first paper on fetal ultrasound cephalometry. In this current 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 observed a gestational age range from 18 to 28 weeks. Using multiple predictors improves the accuracy of fetal age, weight, and estimated delivery date (EDD), particularly when obtaining fetal head biometry is challenging. Therefore, reliable methods for estimating fetal body weight and age without head measurement are essential [14]. The introduction of reliable new methods of fetal biometry has significantly reduced overall errors and increased reliability in fetal biometry [15]. The present study demonstrates that anterior-posterior thigh diameter (APTD) exhibits high validity and reliability. The straightforward correlation observed, with 1 mm APTD per week of fetal age, offers novel and practical insights. Previous research, such as the study by Isobe in 2004 [16], supports the notion that measuring the thigh parameter is a convenient method for assessing fetal growth in the second trimester. Furthermore, the current study highlights that fetal APTD enables accurate linear measurements, thereby enhancing the comprehensive profiling of the fetus. The significant correlation ($r=1.000$; $p<0.001$) of APTD with fetal age underscores its reliability, particularly when other fetal parameters may not accurately predict fetal age or are difficult to obtain. APTD measurements from the 15 groups in the study exhibited a perfect correlation with fetal age. A study by Hadlock at two different times demonstrated variability in femur length versus gestational age tables from ±1.8 to ±2.4 weeks between 18 and 30 weeks, whereas variability estimates in the APTD table were ±3 days [17]. In this present study, a positive and significant correlation was observed between fetal anterior-posterior thigh diameter and gestational age ($r=1.0$; $p<0.001$), as well as with other fetal parameters: 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, in the study by Saad and Kubaisi *et al.*, (2006) [18], with Rsq >0.9993 and p-value <0.001, anterior-posterior thigh diameter was positively correlated with fetal age, consistent with the findings of the current study.

LIMITATION OF THE STUDY

This study was conducted at a single center with a small sample size. Additionally, the study was conducted over a relatively short period. Therefore, the findings may not fully represent the broader situation across the entire country.

CONCLUSION

A statistically significant positive correlation between fetal anterior-posterior thigh diameter and gestational age suggests that as gestational age increases, so does the anterior-posterior thigh diameter of the fetus. This relationship implies that fetal growth and development are associated with an increase in thigh diameter overtime during pregnancy. Such findings are valuable for assessing fetal growth and monitoring developmental milestones throughout gestation, aiding in the evaluation of fetal well-being and the detection of any potential abnormalities or growth restrictions.

REFERENCES

1. Gibb, D. (2008), Fetal monitoring in practice, in Clinical assessment and practice, 11th edition, pp. 10.
2. Teoli, D. A., Zullig, K. J., & Hendryx, M. S. (2015). Maternal fair/poor self-rated health and adverse infant birth outcomes. *Health care for women international*, *36*(1), 108-120.
3. HALL, M. H., & CARR-HILL, R. A. (1985). The significance of uncertain gestation for obstetric outcome. *BJOG: An International Journal of Obstetrics & Gynaecology*, *92*(5), 452-460.
4. Cuningham, F.G., Leveno, K., Bloom, S., Spong, C.Y. & Dashe, J. (2014). Williams obstetrics. 24nd ed. New York: McGraw-Hill. p. 1111–36.
5. Goldberg, B. B. (2020). *Diagnostic ultrasound*. CRC Press.
6. Callen, P. W. (1988). Ultrasonography in obstetrics and gynecology.
7. Hadlock, F. P., Harrist, R. B., Deter, R. L., & Park, S. K. (1982). Fetal femur length as a predictor of menstrual age: sonographically measured. *American Journal of Roentgenology*, *138*(5), 875-878.
8. Hadlock, F. P., Deter, R. L., Harrist, R. B., & Park, S. K. (1982). Fetal biparietal diameter: a critical re-evaluation of the relation to menstrual age by means of real-time ultrasound. *Journal of ultrasound in Medicine*, *1*(3), 97-104.
9. David, S. (2003). Textbook of radiology and imaging. *David Sutton (ed.)*, 1075-1077.
10. Karki, D. B., Sharmqa, U. K., & Rauniyar, R. K. (2006). Study of accuracy of commonly used fetal parameters for estimation of gestational age. *JNMA; Journal of the Nepal Medical Association*, *45*(162), 233-237.
11. Saheb Ghalam, H., Panahi, G., Dadgar, S., Afzali, N., & Shaban, M. (2008). The Comparison of the Diagnostic Value of Fetal Foot length Measurement with the length of Femur and Fetal biparietal Diameter in Determining the Gestational Age. *The*

Iranian Journal of Obstetrics, Gynecology and Infertility, *11*(4), 9-13.
12. Willocks, J., Donald, I., Duggan, T. C., & Day, N. (1964). Foetal cephalometry by ultrasound. *Obstetrical & Gynecological Survey*, *19*(4), 597-599.
13. Ismail, S. R. (2007). Can the anterior-posterior thigh diameter be used as an indicator for fetal age using two-dimensional sonography?: peer reviewed research article. *South African Radiographer*, *45*(1), 14-18.
14. Ratanasiri, T., Jirapornkul, S., Somboonporn, W., Seejorn, K., & Patumnakul, P. (2002). Comparison of the accuracy of ultrasonic fetal weight estimation by using the various equations. *Journal of the Medical Association of Thailand= Chotmaihet Thangphaet*, *85*(9), 962-967.
15. Konje, J. C., Abrams, K. R., Bell, S. C., & Taylor, D. J. (2002). Determination of gestational age after the 24th week of gestation from fetal kidney length measurements. *Ultrasound in obstetrics and gynecology: the official journal of the international society of ultrasound in obstetrics and gynecology*, *19*(6), 592-597.
16. Isobe, T. (2004). Approach for estimating fetal body weight using two-dimensional ultrasound. *The Journal of Maternal-Fetal & Neonatal Medicine*, *15*(4), 225-231.
17. Hadlock, F. P., Deter, R. L., Harrist, R. B., & Park, S. K. (1984). Estimating fetal age: computer-assisted analysis of multiple fetal growth parameters. *Radiology*, *152*(2), 497-501.
18. Al-Kubaisi, S. R. (2006). Anterior-posterior thigh diameter measured by two-dimensional sonography: Indicator of fetal age at 18 to 28 weeks gestation?. *Sultan Qaboos University Medical Journal*, *6*(2), 47.

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