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Correlation of Second and Third Trimester Placental Thickness with Ultrasonographic Gestational Age

Arjumand Bano, Atif Latif, Amna Zafar, Ayma Aftab, Tabassum Rasul, Maryam Iqbal

Department of Diagnostic Radiology, Combined Military Hospital, Multan/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To determine the correlation between placental thickness and ultrasonographic gestational age based on foetal biometry.

Study Design: Prospective Observational Study.

Place and Duration of Study: Department of Diagnostic Radiology, Combined Military Hospital, Multan, Pakistan, from Dec 2024 to Sept 2025.

Methodology: The study included 60 pregnant women with accurately known last menstrual periods and singleton pregnancies. Non-probability consecutive sampling was used. Patients with irregular cycles, multiple gestations, foetal anomalies or chronic medical conditions were excluded. Transabdominal ultrasonography was performed using a 3–5 MHz curved transducer to assess foetal biometric parameters (HC, BPD, FL, AC) and placental thickness in millimetres. Measurements were recorded during three gestational ages: 22–27, 28–32 and 33–36 weeks. Spearman's correlation coefficient was applied to assess the correlation between placental thickness and gestational age. A *p*-value of <0.05 was considered statistically significant.

Results: The median (IQR) of maternal age was 26.00 (5.00) years, median (IQR) BMI of 25.45 (3.50) kg/m² and median (IQR) parity count of 2.00 (1.00). Placental thickness increased consistently across each trimester. Strong positive correlations were observed between placental thickness and gestational age with Speraman's rho of 0.856, 0.907 and 0.782 for the first, second and third visits respectively (p<0.001 for all).

Conclusion: Placental thickness is significantly correlated with gestational age and can be utilised as a supplementary parameter in obstetric ultrasonography to estimate foetal maturity. However, the study's single-centre design and relatively small sample size may limit generalisability.

Keywords: Fetal Age; Fetal Growth; Placentas.

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INTRODUCTION

The placenta plays a pivotal role in sustaining foetal development by transfer of oxygen and essential nutrients.[1] Accurate assessment of gestational age is fundamental for optimal antenatal and perinatal care.[2] Pregnancy may be complicated by several pathological conditions, including placental abnormalities, which can result in adverse outcomes.[3] The reported prevalence of placental disorders in singleton pregnancies ranges from 7% to 9%, and is notably higher in twin gestations, ranging from 24% to 33%.[4] Throughout gestation, the placenta undergoes dynamic morphological changes. In a typical pregnancy, placental dimensions measure approximately 22 cm in diameter and 2–2.5 cm in thickness by the third trimester.[5] Transabdominal ultrasonography, by the end of the first trimester, commonly depicts the placenta as a hyperechoic ring bordering the gestational sac.[6]

Although placental surface area reaches its maximal extent by the third trimester, placental thickness continues to increase until term. [7] Studies indicate that a term placental thickness of 20 mm and a diameter of 18 cm are predictive of low birth weight. Furthermore, reduced placental size has been associated with conditions such as preeclampsia and intrauterine growth restriction.[8] In recent years, ultrasonography has been increasingly recognized as a non-invasive, cost-effective and reproducible modality for placental assessment, particularly valuable in populations with limited access to advanced imaging.

The incorporation of placental thickness measurement alongside foetal biometric parameters has demonstrated improved accuracy in estimating gestational age and predicting neonatal outcomes.[9] Limited literature suggests a statistically significant

Correspondence: Dr Arjumand Bano, Department of Diagnostic Radiology, Combined Military Hospital, Multan Pakistan

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positive correlation between placental thickness and gestational age.[10]

A review of existing literature revealed a paucity of local data on this subject, particularly among the Southern Punjab population. The current study was therefore designed to investigate the correlation between placental thickness and gestational age determined via ultrasonography, to establish a baseline reference database for this population cohort.

METHODOLOGY:

Following approval from the Institutional Ethics Committee (Reference No. EC-102/2024 dated 06-07-2024), a prospective observational study was conducted in the Department of Diagnostic Radiology, CMH Multan, Pakistan, from Dec 2024 to Sep 2025. The required sample size for the correlation analysis was calculated a priori using Fisher's Z transformation. Based on previously published data indicating an anticipated Pearson's correlation coefficient ($r = 0.729$),[11] between placental thickness and fetal gestational age, a two-tailed significance level of $\alpha = 0.05$ and a desired study power of 95%, the minimum sample size required was 17 participants. To improve the precision of the estimated correlation coefficient, ensure robustness, and account for potential dropouts, a total of 60 participants were ultimately recruited. A non-probability consecutive sampling technique was adopted to ensure adequate representation of the target population.

Inclusion Criteria: Pregnant women aged 20–35 years with a singleton pregnancy, confirmed last menstrual period (LMP), and regular menstrual cycles were included in the study.

Exclusion Criteria: Patients with uncertain LMP, history of irregular menstrual cycles, foetal structural anomalies, pre-existing maternal illnesses (e.g., anemia, diabetes mellitus, hypertension, chronic renal disease), multiple gestations, and body mass index (BMI) >30 kg/m² were excluded.

Ethical clearance was secured before data collection. Informed written consent was obtained from all participants following a detailed explanation of the study's purpose and methodology. Baseline demographic data, including maternal age, parity, and BMI, were documented. BMI was calculated using the standard formula: weight (kg) divided by height squared (m²). Ultrasound evaluations were performed using a Toshiba machine with a 3–5 MHz low-frequency curvilinear transducer. Foetal biometric parameters, including biparietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC), were measured in millimetres and used to estimate gestational age via built-in software (Hadlock's formula). BPD and HC were measured in a transverse axial plane at the level of the thalami and third ventricle. FL was determined as the maximal length of the femoral shaft, excluding the epiphyseal cartilages. AC was assessed in a transverse section just above the level of the umbilical cord insertion. All the patients then underwent USG evaluation to calculate placental thickness. To minimize inter-observer variability, all ultrasound examinations to calculate foetal gestational age were performed by a single consultant radiologist with over five years of post-fellowship experience. To reduce observer bias, the radiologist measuring placental thickness was blinded to gestational age estimates derived from foetal biometric parameters. Placental thickness was defined as the distance from the chorionic (foetal) surface to the basal (maternal) surface and was measured in millimetres at the level of umbilical cord insertion, in a plane perpendicular to the uterine wall. Care was taken to exclude the retroplacental veins and adjacent myometrium. To ensure consistency, all scans were conducted in the supine position with a full urinary bladder, and each patient was examined at three gestational age intervals: 22–27 weeks, 28–32 weeks, and 33–36 weeks. The patient flow sheet is shown in figure-1.

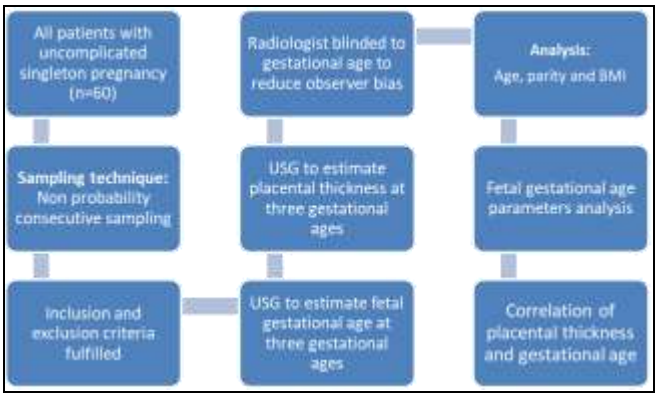

Figure-1: Patient flow sheet (n=60)

Data normality was assessed by the Shapiro-Wilk test. Age, BMI, and parity, all were not normally distributed and presented as median (IQR). Maternal age was categorized into three groups (≤25, 26–30, >30 years), BMI into two groups (18.5–25, >25 kg/m²), and parity into two groups (≤2, >2). Differences in median placental thickness across age groups were analyzed

using the Kruskal-Wallis H test, while differences between BMI groups and parity groups were analyzed using the Mann-Whitney U test. Spearman's rank correlation (Spearman's rho) was used to determine the association between placental thickness and ultrasonographic gestational age. Additionally, scatter plots were generated to visually demonstrate the strength and direction of correlation. A *p*-value <0.05 was considered statistically significant.

RESULTS

The study enrolled 60 pregnant women with a median (IQR) age of 26.00 (5) years and a median (IQR) BMI of 25.45 (3.5) kg/m². Among them, 34 patients (56.7%) had a BMI between 25.1 and 30 kg/m², while 26 women (43.3%) had a BMI between 18.5 and 25 kg/m². The median (IQR) parity was 2.00 (1), with 20 patients (33.3%) having parity of two, followed by 18 women (30%) with parity of three (Table-I). Overall, baseline maternal parameters were comparable to values reported in prior South Asian cohorts, supporting the representativeness of the study population.

Table-I: Data of baseline parameters of patients (n=60)

Parameter	Groups	n (%)	Median (IQR)	*p*-value
Age in years	≤25	22 (36.647%)	24.00 (1.00)	0.636
	26-30	33 (55%)	28.00 (3.00)	
	>30	5(8.33%)	32.00 (1)	
BMI in kg/m2	≤25	26(43.44%)	23.25 (1.9)	0.849
	>25	34(56.66%)	27.10 (2.4)	
Parity count	≤2	34 (56.66%)	2.00 (1)	0.819
	>2	26 (43.44%)	3.00 (1)	

**BMI= Body mass index, Age groups compared by Kruskal-Wallis H test, BMI and parity groups analyzed using Mann-Whitney U test*

Foetal biometric parameters, HC, BPD, FL, and AC, were recorded during each follow-up visit, and their mean values demonstrated a consistent increase across trimesters. All parameters showed a statistically significant correlation with placental thickness (p<0.001). The progressive rise in foetal biometry was paralleled by a steady increase in placental thickness, highlighting its predictive value in gestational age assessment. Placental thickness also progressively increased across trimesters. Final analysis revealed a strong and statistically significant positive correlation between placental thickness and gestational age at all follow-ups, with the highest correlation observed during the second trimester (r=0.907) (Table-II). Notably, even in late gestation, placental thickness retained predictive reliability (r=0.782), underscoring its role as an excellent complementary marker for foetal dating in conjunction with standard biometry.

A scatter plot was constructed to illustrate the relationship between placental thickness and gestational age across the three follow-up visits. As shown in Figure-2, placental thickness increased from approximately 22–26 mm in early gestation to 34–37 mm in late gestation, with an estimated linear increase of ~1 mm per week and minimal dispersion around the fitted regression line.

Table-II: Correlation Between Placental Thickness and Foetal Gestational age (n=60)

Parameter (in mm)	Follow-up visit	Mean±SD	Spearman's rho	*p*-value
Placental thickness	1st visit	25.27±1.247	0.856	<0.001
	2nd visit	30.20±1.312	0.907	
	3rd visit	34.57±1.064	0.782	

**Spearman's rank correlation test*

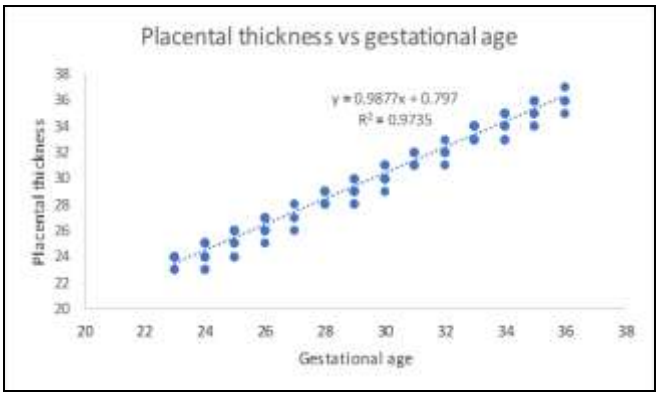

Figure-2: Scatter of Placental Thickness Versus Gestational age Across three Follow-up visits (n=60)

DISCUSSION

Placental thickness is increasingly recognized as a reliable sonographic marker of fetoplacental health and a valuable adjunct in gestational age estimation.[12] In this study, a consistent linear relationship was observed between increasing gestational age and placental thickness, with strong Pearson correlation values across the second and third trimesters. These findings agree with Ahmad *et al.*,[13] who reported a significant correlation (r = 0.729, p<0.001), and Idowu *et al.*,[14] who demonstrated a robust association (r = 0.896, p<0.001), both underscoring the clinical potential of placental thickness as a marker of gestational maturity.

Similarly, Shakir *et al.*, in a larger cohort of 210 participants, documented an exceptionally high correlation (r = 0.9969, p<0.001) between placental thickness and gestational age from 24 to 37 weeks.[15] This reinforces our findings, particularly during the second and third trimesters, and highlights the

capacity of placental morphometry to reflect adequacy of maternal–foetal exchange while providing an additional tool for early detection of growth restriction.

Our trimester-specific findings are also supported by Zerban *et al.*,[16] who observed the highest correlation during the second trimester (r = 0.943, p<0.001), closely resembling our results (r = 0.894). Ali *et al.*,[17] further demonstrated strong associations of placental thickness with both gestational age (r = 0.966) and foetal weight (r = 0.876), aligning with our conclusions and those of other regional and international studies. The consistency of results across diverse populations indicates a broad consensus on the clinical utility of placental thickness in antenatal assessment.[18]

Beyond gestational age estimation, several studies have examined the predictive value of placental thickness for neonatal outcomes. Oun *et al.*, reported significant associations with birth weight and APGAR scores, while an Egyptian cohort,[19] similarly demonstrated positive correlations between placental thickness, foetal weight and APGAR scores in late gestation. These findings suggest that placental measurement may serve a dual purpose in antenatal assessment. In addition to supporting estimation of gestational age, it may provide useful information about foetal growth, placental adequacy and expected perinatal well-being. Therefore, when interpreted alongside conventional biometric parameters, placental thickness can strengthen clinical judgement, help identify pregnancies that may require closer surveillance and contribute to timely obstetric decision-making.

LIMITATIONS OF STUDY

Despite its strengths, this single-centre study with a modest sample size may not fully represent the wider population. Follow-up until delivery was not performed, limiting correlation with birth weight and neonatal outcomes, and ultrasound measurements remain operator dependent. Future multicentre studies with larger, diverse cohorts, delivery follow-up, and outcome assessment are needed. Regional placental thickness nomograms across trimesters would further support its use as an adjunct in obstetric care.

CONCLUSION

This study shows a strong, statistically significant positive correlation between placental thickness and gestational age in the second and third trimesters. Its linear increase on ultrasonography supports its use as a reliable supplementary marker for gestational age estimation, especially in resource-limited settings. Incorporating placental thickness into routine obstetric ultrasound may improve dating accuracy and clinical decision-making. Larger multicentre studies are needed to establish population-specific reference values and validate their predictive role.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AB & AL: Data acquisition, data analysis, critical review, approval of the final version to be published.

AZ & AA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TR & MI: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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