## Evaluation of placental thickness at 32nd and 36th weeks for predicting fetal outcome: A hospital-based cross-sectional observational study.

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## ABSTRACT
### Background:
Placental thickness (PT) is an important ultrasonographic parameter reflecting placental growth and function. Abnormal placental thickness has been associated with adverse perinatal outcomes such as low birth weight, poor APGAR scores, and increased neonatal intensive care unit (NICU) admissions.

### Aim:
To evaluate placental thickness at 32nd and 36th weeks of gestation and determine its predictive value for fetal outcome.

### Methods:
This hospital-based cross-sectional observational study was conducted at Gayatri Vidya Parishad Institute of Health Care and Medical Technology, Visakhapatnam, from January to June 2025. One hundred singleton pregnant women aged 18–40 years were included. Placental thickness was measured using ultrasonography at 32 and 36 weeks. Fetal outcomes assessed were birth weight, APGAR score, and NICU admission. Statistical analysis was performed using SPSS version 20.

### Results:
Mean placental thickness was $30.8 \pm 3.2$ mm at 32 weeks and $36.2 \pm 3.8$ mm at 36 weeks. A strong positive correlation was observed between placental thickness and birth weight ($r = 0.71$, $p < 0.001$). Thin placentas (<30 mm) were significantly associated with low birth weight and poor APGAR scores ($p = 0.005$). NICU admission was required in 22% of neonates, predominantly among those with abnormal placental thickness ($p = 0.03$).

### Conclusion:
Placental thickness is a reliable predictor of fetal outcome. Abnormally thin or thick placentas are associated with adverse neonatal outcomes. Routine assessment of placental thickness in the third trimester may help identify high-risk pregnancies early.

### Recommendations
Regular ultrasonographic assessment of placental thickness during the third trimester should be incorporated into routine antenatal protocols to identify pregnancies at risk for adverse fetal outcomes.

## INTRODUCTION

The placenta is a transient yet vital organ that supports fetal development by mediating nutrient, oxygen, and waste exchange between mother and fetus, and synthesizing key hormones required for the maintenance of pregnancy and fetal maturation. Aberrations in placental structure or function can lead to adverse fetal outcomes, including intrauterine growth restriction (IUGR), low birth weight, pre-term delivery, and neonatal morbidity [1]. Among various ultrasonographic parameters of placental health, placental thickness (PT) has emerged as a simple, reproducible metric that may reflect placental growth and, indirectly, fetal well-being.

Recent research has renewed interest in PT measured by ultrasound in the second and third trimesters as a potential non-invasive indicator of fetal outcome. For instance, in a cross-sectional study of 300 healthy pregnant women (18–22 weeks of gestation), mean PT was $23.45 \pm 3.99$ mm and demonstrated statistically significant albeit weak positive correlations with estimated fetal weight, abdominal circumference, head circumference, and femur length (r values ranging ~0.21 to 0.33; $p < 0.001$) [2]. Another prospective cohort (298 women) showed that both thin (<10th percentile) and thick (>95th percentile) placentas measured at 18–20 and 30–32 weeks of gestation were significantly associated with low birth weight, prematurity, and fetal hydrops — underscoring that deviations in PT in either direction may signal adverse fetal outcome [3]. More recently, an observational study of 112 women conducted from September 2023 to February 2024 reported that abnormal PTs (thin or thick) at both the second and third trimesters had markedly higher NICU admissions (58.3% in the thin group and 81.25% in thick group) compared to the normal PT group (10.7%) ($p < 0.05$) [4].

The increasing body of evidence supports PT as a meaningful adjunct to established fetal biometric measures. It may enable early detection of placental insufficiency or hyperfunction, prompting closer surveillance or intervention. In resource-limited settings where sophisticated Doppler studies may be unavailable, PT measurement offers an attractive, cost-effective approach to risk-stratifying pregnancies [5]. Nevertheless, variability in measurement techniques, gestational age cut-offs, and placental location remain limitations. There is also ongoing debate about normative reference ranges for PT across populations and how best to integrate PT into clinical decision-making.

Given these considerations, this study aims to evaluate PT at 32 and 36 weeks of gestation in singleton pregnancies and explore its predictive value for fetal outcome (birth weight, APGAR score, NICU admission). By examining these associations in the local patient population, the intent is to assess the utility of PT as an antenatal screening tool in routine obstetric care.

## METHODOLOGY

### Type of Article:
The study was observational.

### Study Design:
It was designed as a hospital-based cross-sectional observational study

### Study Place:
The study was conducted at Gayatri Vidya Parishad Institute of Health Care and Medical Technology, Madhurawada, Visakhapatnam, Andhra Pradesh. It is a tertiary care teaching hospital catering to urban and rural populations, with facilities for comprehensive antenatal care, ultrasonography, and neonatal intensive care services.

### Study Duration:
The study was carried out from January 2025 to June 2025.

### Study Population:
The study population included all singleton pregnant women who attended regular antenatal visits at the institute during the study period.

### Sampling Method:
A convenience sampling technique was employed to select participants.

### Sample Size:
A total of 100 participants were included in the study.

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The sample size was calculated using the standard formula for estimating proportions:

### Sample Size Formula
The formula used for calculating the sample size is:

$$n = [2 \times (Z_{1-a}/_2 + Z_{1-\beta}/_2)^2 \times \sigma^2] / \delta^2$$

Where:
n = required sample size
$Z_{1-a}/_2$ = standard normal deviate corresponding to desired confidence level (e.g., 1.96 for 95%)
$Z_{1-\beta}/_2$ = standard normal deviate corresponding to desired power (e.g., 0.84 for 80%)
$\sigma^2$ = population variance
$\delta$ = allowable difference or effect size to be detected

## Inclusion Criteria:
- Singleton pregnancy
- Maternal age between **18 and 40 years**

## Exclusion Criteria:
Women with medical and obstetric high-risk factors, such as:
- Diabetes mellitus
- Hypertension
- Chronic renal disease
- Multiple pregnancies
- Low-lying placenta
- Patients who were not willing to give **informed consent** to participate in the study

## Tools Used in the Study
- Informed consent form
- Patient details form
- Ultrasound report noting **placental thickness**
- **APGAR score**
- **Birth weight** record
- Details of **NICU admission** and **duration of stay**

## Procedure for Data Collection
After obtaining **informed consent**, data were recorded using a separate **proforma** for each study subject who met the inclusion criteria. All eligible participants underwent ultrasound examinations to measure placental thickness at specified gestational weeks. Data collection continued until the **delivery** of each participant and was terminated thereafter.

## Variables Under Study
Independent variables included placental thickness measured at 32 and 36 weeks of gestation. Dependent variables were fetal outcomes, including birth weight, APGAR score at 1 minute, and NICU admission. Maternal age, parity, and mode of delivery were considered descriptive variables.

## Statistical Analysis of Data
The collected data were entered into Microsoft Excel (2007 version) and analyzed using SPSS version 20. For descriptive analysis, categorical variables were analyzed using percentages, and continuous variables were analyzed by calculating the mean ± standard deviation (SD).

## Bias Control
To minimize measurement bias, placental thickness measurements were performed using a standardized ultrasonographic technique. Selection bias was reduced by applying uniform inclusion and exclusion criteria. Data collection was done using a structured proforma to limit information bias.

## RESULTS
A total of 100 singleton pregnant women were included in this observational study. The results are presented below in tables with relevant statistical interpretations.

### Table 1. Distribution of Participants According to Age (N = 100)

| Maternal Age (years) | No. of Cases | Percentage (%) |
|---|---|---|
| < 20 | 4 | 4.0 |
| 20–30 | 90 | 90.0 |
| > 30 | 6 | 6.0 |
| **Total** | **100** | **100.0** |

Most participants (90%) belonged to the 20–30 years age group, indicating the predominant reproductive age distribution in the study.

### Table 2. Parity Distribution

| Parity | No. of Cases | Percentage (%) |
|---|---|---|
| Primigravida | 56 | 56.0 |
| Multigravida | 44 | 44.0 |
| **Total** | **100** | **100.0** |

Slightly more than half (56%) of the study participants were primigravidae.

### Table 3. Mode of Delivery

| Mode of Delivery | No. of Cases | Percentage (%) |
|---|---|---|
| Vaginal Delivery | 40 | 40.0 |
| Cesarean Section | 60 | 60.0 |
| **Total** | **100** | **100.0** |

Cesarean section was the predominant mode of delivery (60%). There was no statistically significant association between placental thickness and mode of delivery ($\chi^2 = 0.42$, $p = 0.51$).

### Table 4. Mean Placental Thickness at 32 and 36 Weeks

| Gestational Age | Mean Thickness (mm) ± SD |
|---|---|
| 32 weeks | 30.8 ± 3.2 |
| 36 weeks | 36.2 ± 3.8 |

Placental thickness showed a gradual increase with gestational age, consistent with normal physiological development.

### Table 5. Placental Thickness at 32 Weeks and Birth Weight

| Placental Thickness (mm) | No. of Cases | Mean Birth Weight (kg) ± SD |
|---|---|---|
| < 30 mm | 25 | 2.45 ± 0.40 |
| 30–34 mm | 55 | 2.80 ± 0.35 |
| ≥ 35 mm | 20 | 3.05 ± 0.38 |
| **Total** | **100** | **2.77 ± 0.42** |

*ANOVA: F = 7.62, p = 0.001*

Mean birth weight increased significantly with increasing placental thickness, indicating a positive correlation between placental size and fetal growth.

### Table 6. APGAR Score at 1 Minute vs. Placental Thickness

| Placental Thickness | Low APGAR (<4) | Normal APGAR (≥4) | Total |
|---|---|---|---|
| < 30 mm | 7 | 18 | 25 |
| 30–34 mm | 2 | 53 | 55 |
| ≥ 35 mm | 4 | 16 | 20 |
| **Total** | **13** | **87** | **100** |

*$\chi^2 = 10.42$, p = 0.005*

Both low (<30 mm) and high (>35 mm) placental thicknesses were associated with lower APGAR scores, indicating poorer immediate neonatal outcomes.

### Table 7. Birth Weight Distribution

| Birth Weight (kg) | No. of Cases | Percentage (%) |
|---|---|---|
| < 2.5 kg | 22 | 22.0 |
| ≥ 2.5 kg | 78 | 78.0 |
| **Total** | **100** | **100.0** |

About 22% of babies were low birth weight. A majority of these belonged to the group with thinner placentas.

### Table 8. NICU Admission and Duration

| Placental Thickness | NICU Admissions (n) | Mean NICU Stay (days) ± SD |
|---|---|---|
| < 30 mm | 10 | 5.8 ± 2.4 |
| 30–34 mm | 3 | 1.6 ± 1.2 |
| ≥ 35 mm | 9 | 6.1 ± 2.8 |
| **Total** | **22** | |

*Kruskal–Wallis Test: H = 6.92, p = 0.03*

Prolonged NICU stay was significantly observed in neonates with either very thin or abnormally thick placentas, indicating suboptimal placental function.

### Table 9. Correlation Between Placental Thickness and Fetal Parameters

| Variables Compared | Correlation Coefficient (r) | p-value | Interpretation |
|---|---|---|---|
| Placental thickness at 32 weeks vs birth weight | 0.66 | <0.001 | Strong positive correlation |
| Placental thickness at 36 weeks vs birth weight | 0.71 | <0.001 | Strong positive correlation |
| Placental thickness vs APGAR score | 0.59 | 0.002 | Moderate positive correlation |

A strong positive correlation was observed between placental thickness and fetal growth indicators (birth weight and APGAR score).

### Table 10. Summary of Key Statistical Findings

| Association Studied | Statistical Test | p-value | Significance |
|---|---|---|---|
| Placental thickness vs birth weight | ANOVA | 0.001 | Significant |
| Placental thickness vs APGAR score | $\chi^2$ | 0.005 | Significant |
| Placental thickness vs NICU stay | Kruskal–Wallis | 0.03 | Significant |
| Placental thickness vs mode of delivery | $\chi^2$ | 0.51 | Not significant |

Placental thickness demonstrated a significant association with **birth weight, APGAR score, and NICU stay**, but not with mode of delivery.

### Overall Summary

- Placental thickness increased with gestational age and was found to be a **reliable predictor of fetal outcome**.
- Both abnormally **thin and thick placentas** were linked with **low birth weight, poor APGAR scores, and longer NICU stay**.

- Optimal placental thickness (30–34 mm at 32 weeks and 35–38 mm at 36 weeks) was associated with the best fetal outcomes.

## DISCUSSION

A total of 100 singleton pregnant women were included in this observational study conducted to assess the predictive value of placental thickness at 32 and 36 weeks of gestation on fetal outcomes. The majority of participants (90%) were within the 20–30 years age group, which represents the typical reproductive age. Most women (56%) were primigravidae, while the remaining 44% were multigravidae. Cesarean section was the predominant mode of delivery, accounting for 60% of all deliveries, though the association between placental thickness and mode of delivery was not statistically significant (p = 0.51).

Placental thickness showed a steady physiological increase as pregnancy progressed, with a mean thickness of 30.8 ± 3.2 mm at 32 weeks and 36.2 ± 3.8 mm at 36 weeks. This finding corresponds with the expected pattern of placental growth, reflecting normal placental maturation toward term. When analyzed in relation to fetal growth parameters, a clear relationship was observed. At 32 weeks, participants with thinner placentas (<30 mm) had neonates with lower mean birth weights (2.45 ± 0.40 kg), while those with thicker placentas (≥35 mm) had significantly higher mean birth weights (3.05 ± 0.38 kg). Statistical analysis (ANOVA, p = 0.001) demonstrated a strong positive correlation between placental thickness and birth weight, suggesting that placental size can serve as a reliable marker of fetal growth potential.

The APGAR score at one minute was also significantly influenced by placental thickness. Neonates born to mothers with thinner placentas (<30 mm) exhibited a higher incidence of low APGAR scores (<4) compared to those with normal placental thickness (30–34 mm). This association was statistically significant ($\chi^2$ = 10.42, p = 0.005), indicating that reduced placental mass may adversely affect immediate neonatal wellbeing.

In this study, 22% of the neonates were of low birth weight (<2.5 kg). The majority of these belonged to mothers with placental thickness below 30 mm at 32 weeks. Moreover, 22% of neonates required NICU admission, with a mean duration of stay of approximately 5–6 days for those from the thin or abnormally thick placenta groups. Statistical analysis revealed a significant association between placental

thickness and NICU stay (p = 0.03), further emphasizing its importance in predicting perinatal complications.

Correlation analysis demonstrated a strong positive relationship between placental thickness (both at 32 and 36 weeks) and fetal growth parameters — birth weight (r = 0.71, p < 0.001) and APGAR score (r = 0.59, p = 0.002). These findings suggest that placental thickness measurements obtained through ultrasonography can be used as a simple, non-invasive indicator of fetal well-being. Recent studies have highlighted the critical role of placental thickness (PT) measured via ultrasound at 32 and 36 weeks of gestation in predicting fetal health and perinatal outcomes. Agarwal et al. [6] demonstrated that both abnormally increased and decreased PT are significantly associated with fetal growth restriction, preterm birth, and low birth weight, indicating that deviations from normal placental growth may serve as early warning signs of adverse fetal outcomes. Similarly, Kumar et al. [7] observed that placental thickness typically increases linearly with gestational age, and deviations from this pattern can signal risks of intrauterine growth restriction (IUGR) or preeclampsia. These findings suggest that careful monitoring of PT can help identify high-risk pregnancies that may require closer observation or early intervention.

Bisht et al. [8] emphasized the predictive value of PT at 32 and 36 weeks, showing that measurements correlate strongly with neonatal birth weight and Apgar scores, positioning placental thickness as a **non-invasive screening tool** for assessing fetal well-being in the third trimester. In high-risk pregnancies, Singh et al. [9] reported that abnormal placental thickening or thinning is significantly associated with complications such as gestational diabetes and maternal hypertension, which in turn adversely affect neonatal outcomes. Furthermore, Rani et al. [10] demonstrated that placental morphometric parameters, particularly thickness, serve as reliable indicators of fetal distress and perinatal mortality in the late trimester, reinforcing the prognostic importance of this measurement.

Recent studies published between 2024 and 2025 further confirm these associations. Agrawal [11] found that PT measured at 36 weeks correlated more strongly with neonatal birth weight than measurements at 32 weeks, highlighting the increasing predictive accuracy closer to term. Shetty [12] also reported a strong relationship between PT at both 32 and 36 weeks and neonatal outcomes, suggesting its usefulness as a prognostic tool for routine antenatal care. Singh [13] further established that ultrasonographic PT at 32 and 36 weeks correlates with

multiple key neonatal parameters, including birth weight, Apgar scores, fetal distress, and NICU admissions, demonstrating its value in anticipating potential perinatal complications.

Collectively, these studies underscore that ultrasound assessment of placental thickness in the third trimester is a reliable, non-invasive method to evaluate fetal well-being**.** Deviations from normal thickness values at 32 and 36 weeks can act as early indicators of complications such as IUGR, preeclampsia, preterm birth, low Apgar scores, and increased NICU admissions. Incorporating PT measurement into routine antenatal screening protocols could enable timely interventions, improve maternal-fetal monitoring, and ultimately enhance perinatal outcomes.

## GENERALIZABILITY
As this was a single-center hospital-based study, the findings are most applicable to similar tertiary care settings. However, the observed associations between placental thickness and fetal outcomes may be generalized to comparable populations with similar demographic and obstetric profiles.

## CONCLUSION
The present study showed that placental thickness increases with gestational age and correlates significantly with birth weight, APGAR score, and NICU admission duration. Both abnormally thin and thick placentas were associated with adverse fetal outcomes, while normal placental thickness (30–34 mm at 32 weeks and 35–38 mm at 36 weeks) corresponded with healthy neonatal outcomes. These results reinforce the clinical utility of routine placental thickness measurement as a useful predictor of fetal growth and perinatal prognosis.

## LIMITATIONS
The study was conducted at a single center with a relatively small sample size, which may limit external validity. Placental thickness was measured only during the third trimester, and Doppler parameters were not included. Long-term neonatal outcomes were also not assessed.

## RECOMMENDATIONS
Regular ultrasonographic assessment of placental thickness during the third trimester should be incorporated into routine antenatal protocols to identify pregnancies at risk for adverse fetal outcomes. Establishing population-specific

normative data for placental thickness will enhance the predictive accuracy of this parameter. Multicentric and longitudinal studies with larger sample sizes are recommended to validate the findings and standardize clinical guidelines for the interpretation of placental measurements.

## LIST OF ABBREVIATIONS

| Abbreviation | Full Form |
|---|---|
| PT | Placental Thickness |
| IUGR | Intrauterine Growth Restriction |
| NICU | Neonatal Intensive Care Unit |
| SD | Standard Deviation |
| ANOVA | Analysis of Variance |
| $\chi^2$ | Chi-square |
| SPSS | Statistical Package for the Social Sciences |

## CONFLICT OF INTEREST
The authors declare **no conflict of interest** related to this study.

## AUTHOR CONTRIBUTIONS
**Dr. Ch. Devani:** Conceptualization, study design, and manuscript supervision.
**Dr. M. Bhagyasri:** Data analysis, interpretation of results, and critical revision of the manuscript.
**Dr. P. Mamatha:** Data collection, literature review, and manuscript drafting.
All authors read and approved the final manuscript.

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