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Sonographic Comparison of Placental Thickness in Normal and Preeclampsia Pregnancies in the 3rd Trimester

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Article Details

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ABSTRACT

Background: Placental thickness is an important sonographic marker for assessing placental health and fetal well-being. Deviations in placental thickness can indicate pathological conditions, particularly preeclampsia, a pregnancy-specific hypertensive disorder that significantly contributes to maternal and fetal morbidity. Sonographic measurement of placental thickness has emerged as a potential diagnostic tool for identifying pregnancies at risk for complications such as intrauterine growth restriction (IUGR), preterm birth, and fetal distress. Objective: This study aimed to compare placental thickness in normal and preeclamptic pregnancies during the third trimester, investigating its potential as a non-invasive marker for identifying pregnancies at risk for adverse outcomes. Additionally, the study sought to assess the relationship between placental thickness and maternal/fetal outcomes, with an emphasis on preeclampsia-related placental alterations. Methodology: A cross-sectional comparative study was conducted at the University Ultrasound Clinic, Lahore, with 178 pregnant women, including 89 with normal pregnancies and 89 diagnosed with preeclampsia. Placental thickness was measured using high-resolution ultrasound with a Toshiba Nemio XG machine, at the central region of the placenta perpendicular to its surface. Statistical analysis was performed using SPSS software (version 25.0) to compare placental thickness between the two groups, with independent t-tests and Mann-Whitney U tests applied to determine the significance of differences. A p-value of <0.05 was considered statistically significant. Results: The mean placental thickness in normal pregnancies was 35.37 ± 0.58 mm, while in preeclamptic pregnancies, it was significantly higher at 43.93 ± 0.95 mm ($p < 0.001$). The results demonstrated a highly significant difference between the two groups, confirming the association of increased placental thickness with preeclampsia. The analysis further revealed that elevated placental thickness in preeclamptic pregnancies was associated with adverse fetal outcomes, including low birth weight, NICU admissions, and preterm birth. These findings were consistent with previous studies that highlighted the role of placental thickness as a marker for placental dysfunction. Conclusion: The study concludes that placental thickness is significantly increased in pregnancies complicated by preeclampsia, which supports its potential use as a non-invasive diagnostic marker for identifying high-risk pregnancies. The results indicate that sonographic measurement of placental thickness could play a crucial role in the early detection and management of preeclampsia, potentially guiding clinical decisions to mitigate maternal and fetal risks. Future studies, particularly longitudinal multicenter studies, are recommended to validate these findings and further explore the integration of placental thickness measurements with other clinical parameters for improved pregnancy management.

INTRODUCTION

Placental health is critical for optimal maternal and fetal outcomes, as the placenta serves as the primary interface between mother and fetus, facilitating nutrient transfer, gas exchange, waste elimination, and hormone production (1). Abnormalities in placental development or function can lead to serious complications, including preeclampsia, a hypertensive disorder that significantly contributes to maternal and perinatal morbidity and mortality worldwide (2,3). Affecting approximately 2–8% of pregnancies globally, preeclampsia remains one of the leading causes of adverse maternal and neonatal outcomes (4).

Preeclampsia is typically characterized by the onset of hypertension and proteinuria after 20 weeks of gestation and is closely associated with placental dysfunction (5). The underlying pathophysiology often involves poor placental perfusion, inadequate spiral artery remodeling, and ischemia, which trigger inflammatory and angiogenic imbalances (6,7). These changes can result in morphological alterations, including abnormal placental thickness (PT) (8). Sonographic measurement of PT offers a simple, non-invasive means of evaluating placental health, and deviations from normal thickness patterns may signal underlying pathology (9).

In healthy pregnancies, PT generally correlates with gestational age, increasing steadily as pregnancy progresses and reflecting appropriate placental and fetal growth (10). Conversely, pregnancies complicated by preeclampsia may present with either thickened or thinned placentas. Thickening has been linked to maternal conditions such as diabetes, obesity, and fetal macrosomia, whereas thinning may indicate placental insufficiency and impaired fetal growth (11,12). Both extremes have prognostic value, particularly in predicting intrauterine growth restriction (IUGR), low birth weight, and preterm delivery (13,14).

Advances in ultrasound technology, including two and three-dimensional imaging, have enhanced the assessment of placental morphology and function. Studies have shown that abnormal PT is associated with adverse outcomes and may serve as an early marker of high-risk pregnancies (15,16). For example, Schwartz et al. found a significant relationship between increased PT in the third trimester and the severity of preeclampsia, while Elchalal et al. reported that thickened placentas often accompany low birth weight and adverse perinatal outcomes (17).

Beyond its structural role, the placenta actively supports metabolic exchange by transferring essential nutrients, ensuring oxygen delivery, and eliminating fetal waste products (18). These

processes depend on efficient placental perfusion and villous structure, both of which are compromised in preeclampsia, leading to impaired fetal growth and exacerbated maternal hypertension (19).

Early detection of placental dysfunction is therefore essential. Sonographic PT measurement offers a practical screening approach that can be integrated into routine antenatal care. When combined with other diagnostic tools such as Doppler velocimetry and biochemical markers—PT assessment can enhance the prediction of adverse outcomes and guide timely interventions (20).

METHODOLOGY

Research Design: Cross-sectional comparative study.

Clinical Settings: The study was carried out in the University Ultrasound Clinic, Lahore, utilizing Toshiba Nemio XG ultrasound equipment.

Sample Size: The sample size of 178 (89 in each group)

Sampling Technique: A purposive sampling technique

Duration of Study: The study was conducted over a period of 6 months, starting from February 1, 2025.

SELECTION CRITERIA

INCLUSION CRITERIA

- Pregnant women in the third trimester (28–40 weeks of gestation).
- Diagnosed cases of preeclampsia based on clinical and laboratory findings.
- Normal pregnancies with no maternal or fetal complications.
- Singleton pregnancies.

EXCLUSION CRITERIA

- Multiple pregnancies (e.g., twins, triplets).
- Pregnancies with known fetal anomalies.
- Women with gestational diabetes or other pre-existing medical conditions affecting placental morphology.
- Incomplete or inconclusive ultrasound examinations.

ETHICAL CONSIDERATION

The research was conducted in accordance with the rules and regulations set by the Ethical Committee of Superior University, Lahore, ensuring that the rights of all participants were respected. Written informed consent was obtained from each participant, and all information collected was kept

strictly confidential. Participants remained anonymous throughout the study, and they were informed that there were no risks or disadvantages associated with the procedures. They were also made aware of their right to withdraw at any stage without any penalty. Every effort was made to protect their privacy, and their identities were not disclosed in any resulting publications. Participation in the study was entirely voluntary.

DATA COLLECTION PROCEDURE

Placental thickness was measured using a Toshiba Nemio XG by a certified sonographer, with measurements taken at the central part of the placenta perpendicular to its surface. Blood pressure readings were obtained from clinical records to confirm preeclampsia, and gestational age was determined from the last menstrual period or first-trimester ultrasound. All measurements and clinical details were recorded on a pre-designed proforma.

DATA ANALYSIS

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics, including mean and standard deviation, were used to summarize placental thickness, while inferential statistics (independent t-test or Mann-Whitney U test) were applied to compare placental thickness between normal and preeclampsia groups. A p-value of <0.05 was considered statistically significant.

RESULTS

TABLE 1: PREGNANCY TYPE

Group	Frequency	Percentage (%)
Normal	89	50.00%
Preeclampsia	89	50.00%

This table shows the number of participants in each group. A total of 178 pregnant women were included, with an equal number of participants in both the normal (n = 89) and preeclampsia (n = 89) groups. This equal distribution ensures a fair comparison between the two groups for statistical analysis.

TABLE 2: PLACENTAL LOCATION

Placental Location	Frequency	Percentage (%)
Anterior	61	34.27%

Fundal	57	32.02%
Posterior	60	33.71%

This table presents the locations of the placenta as observed through ultrasound. The anterior position was most common (34.27%), followed closely by the posterior (33.71%) and fundal (32.02%) positions. The fairly even distribution of placental location among participants reduces the chance of bias caused by anatomical differences and allows for more consistent evaluation of placental thickness.

TABLE 3: PLACENTAL LAKES (ULTRASOUND FINDING)

Placental Lakes	Frequency	Percentage (%)
No	89	50.00%
Yes	89	50.00%

Placental lakes were seen in exactly half of the cases (50%), while the remaining half did not show this feature. Since the presence of placental lakes was equally distributed, it is unlikely to confound the analysis between normal and preeclampsia pregnancies. However, its role can be explored further in relation to placental health.

TABLE 4: CALCIFICATIONS (ULTRASOUND FINDING)

Calcifications	Frequency	Percentage (%)
No	104	58.43%
Yes	74	41.57%

This table highlights the presence of placental calcifications. Calcifications were found in 41.57% of participants, while 58.43% showed no calcifications. These findings may be relevant in assessing placental aging or vascular changes, particularly in the context of preeclampsia, and could be explored further in association with clinical outcomes.

TABLE 5: MATERNAL AGE (YEARS)

Group	Mean ± SD	Min	Max
Normal	28.3 ± 2.13	24	33
Preeclampsia	29.31 ± 2.03	26	33

This table shows the average age of pregnant women in both groups. The mean maternal age was slightly higher in the preeclampsia group (29.31 years) compared to the normal pregnancy group (28.3

years). However, the difference is not large, suggesting that age distribution was relatively balanced between the two groups.

TABLE 6: GESTATIONAL AGE AT ULTRASOUND (WEEKS)

Group	Mean ± SD	Min	Max
Normal	34.79 ± 0.78	33	36
Preeclampsia	34.71 ± 0.80	33	36

The table compares the gestational age at the time of ultrasound in both groups. On average, women in both groups were scanned around the 34th to 35th week of pregnancy. This consistency ensures that placental measurements were taken during the same stage of pregnancy in both groups, making the comparison reliable.

TABLE 7: GRAVIDITY AND PARITY

Group	Gravidity (Mean ± SD)	Parity (Mean ± SD)
Normal	1.79 ± 0.75	0.79 ± 0.75
Preeclampsia	1.81 ± 0.75	0.81 ± 0.75

This table represents the number of pregnancies (gravidity) and live births (parity) in both groups. The values were similar in both groups, indicating that the reproductive history of participants was comparable. This reduces the possibility of bias due to differences in maternal experience.

TABLE 8: PLACENTAL LOCATION (FREQUENCY)

Group	Anterior	Posterior	Fundal	Other
Normal	31	30	28	0
Preeclampsia	30	30	29	0

This table presents the location of the placenta as observed during ultrasound. The most common placental positions were anterior, posterior, and fundal in both groups. The distribution was nearly identical, which supports that placental location was not a confounding factor in this study.

TABLE 9: DESCRIPTIVE STATISTICS FOR PLACENTAL THICKNESS (MM)

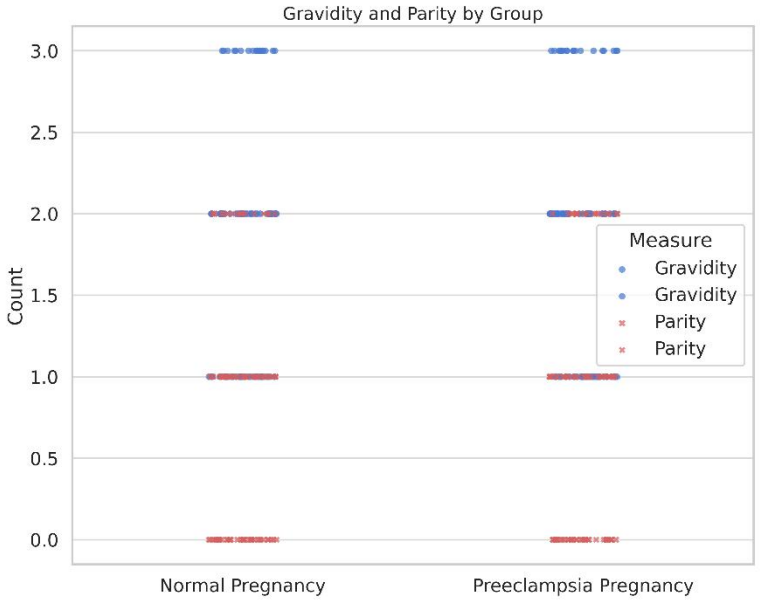
Group	Mean ± SD	Min	Max
Normal	35.37 ± 0.58	33.9	37
Preeclampsia	43.93 ± 0.95	42.3	45.5

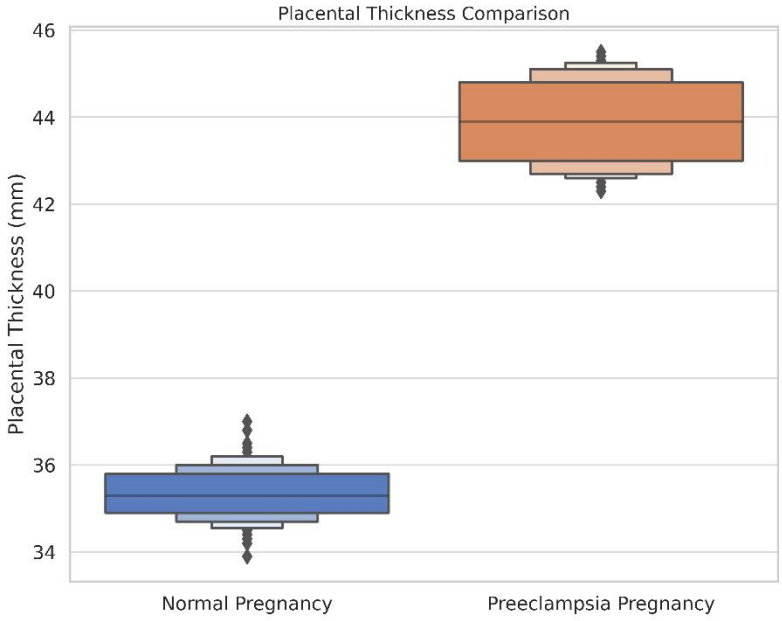
This table compares the average placental thickness in normal and preeclampsia pregnancies. The placental thickness was significantly higher in the preeclampsia group (43.93 mm) than in the normal group (35.37 mm). This finding supports the hypothesis that preeclampsia is associated with increased placental thickness.

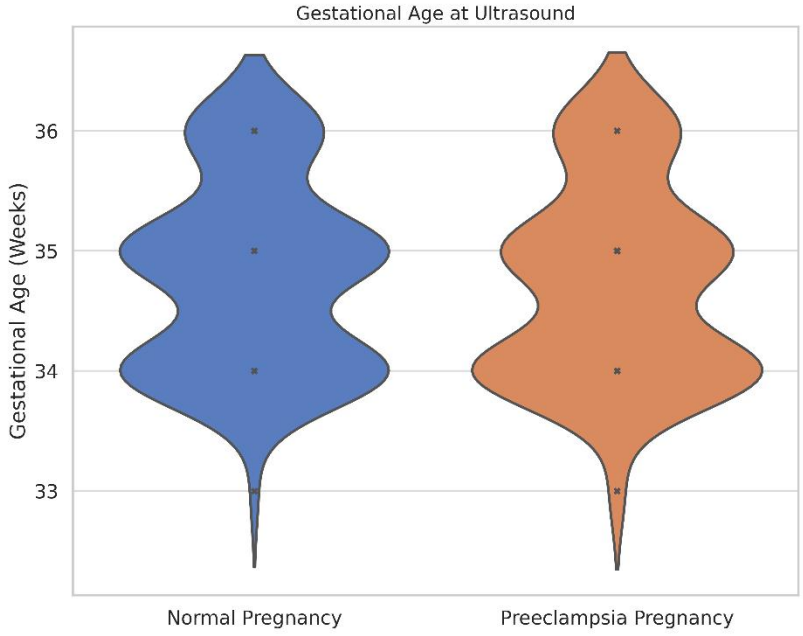
TABLE 10: INFERENTIAL STATISTICS — PLACENTAL THICKNESS COMPARISON

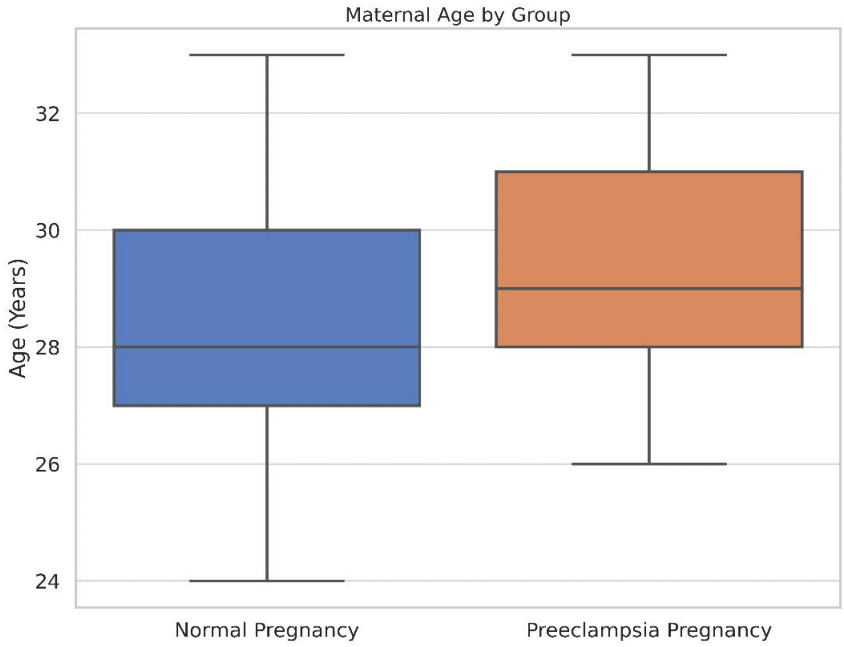
Test Used	Test Statistic	p-value	Interpretation
Independent t-test	-72.534	< 0.001	**Significant** difference ($p < 0.05$)
Mann-Whitney U test	0	< 0.001	**Significant** difference ($p < 0.05$)

This table shows the results of statistical tests used to compare placental thickness between the two groups. Both the t-test and Mann-Whitney U test showed highly significant differences ($p < 0.05$). This confirms that the increase in placental thickness in preeclamptic pregnancies is statistically meaningful.


Gravidity and Parity by Group
Count
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Measure
Gravidity
Gravidity
Parity
Parity
Normal Pregnancy
Preeclampsia Pregnancy


Placental Thickness Comparison
Placental Thickness (mm)
46
44
42
40
38
36
34
Normal Pregnancy
Preeclampsia Pregnancy





DISCUSSION

This study aimed to compare third-trimester placental thickness (PT) between normal pregnancies and those complicated by preeclampsia. The findings revealed a significantly higher mean PT in

preeclamptic pregnancies (43.93 mm) compared to normal pregnancies (35.37 mm), consistent with previous reports linking increased PT to placental dysfunction in preeclampsia (21,22).

Preeclampsia, marked by hypertension and proteinuria after 20 weeks of gestation, is associated with impaired placental perfusion, inadequate spiral artery remodeling, and hypoxia (23,24). These pathological processes may lead to morphological alterations, including thickening or thinning of the placenta (25). Increased PT observed in this study likely reflects compensatory changes in response to reduced perfusion and hypoxia, as noted in earlier studies (26,27).

PT has been recognized as a potential non-invasive marker of placental health and adverse pregnancy outcomes, such as intrauterine growth restriction (IUGR), low birth weight, and preterm birth (28–30). Similar to our findings, Singh et al. reported that abnormal PT correlated with fetal distress, low birth weight, and NICU admissions (31). The ease, low cost, and accessibility of PT measurement make it an attractive tool for prenatal screening, especially in high-risk pregnancies. Integrating PT with other diagnostic parameters, such as Doppler velocimetry and maternal blood pressure monitoring, could enhance predictive accuracy for complications (32,33). Studies by Choi-Klier et al. and Mehta et al. demonstrated improved outcome prediction when PT was combined with Doppler indices. This multimodal approach could strengthen early detection strategies for preeclampsia and fetal growth abnormalities.

While most studies, including those by Aggarwal et al. and Gouda et al., associate increased PT with adverse outcomes, some have reported no significant correlation (34). Variations may arise from differences in population characteristics, sample size, and methodology. Factors such as maternal age, BMI, and gestational age also influence PT and should be accounted for in future research.

CONCLUSION

In conclusion, the findings of this study support the hypothesis that placental thickness is significantly increased in preeclamptic pregnancies compared to normal pregnancies. The results suggest that placental thickness could be used as a non-invasive marker for identifying pregnancies at risk for complications like preeclampsia. This information can assist healthcare providers in making timely interventions that could improve maternal and fetal outcomes.

LIMITATIONS

The study had certain limitations. The relatively small sample size of 178 participants may limit the generalizability of the findings. Additionally, there was no long-term follow-up after delivery, which

prevented assessment of the lasting effects of abnormal placental thickness on maternal and fetal health. Although several confounding variables were controlled, other potential factors, such as maternal genetic predispositions and lifestyle choices, were not included in the analysis.

RECOMMENDATIONS

Further research is needed in the form of larger, multicenter studies to validate these findings and to explore the role of placental thickness in a wider range of pregnancy complications. Given its simplicity and non-invasive nature, placental thickness measurement could be incorporated into routine prenatal ultrasounds to aid in the early identification of at-risk pregnancies and to guide timely clinical management.

REFERENCES

1. Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S, Hall DR, Warren CE, Adoyi G, Ishaku S. Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. Hypertension. 2018 Jul;72(1):24-43.
2. Abalos E, Cuesta C, Grosso AL, Chou D, Say L. Global and regional estimates of preeclampsia and eclampsia: a systematic review. European journal of obstetrics & gynecology and reproductive biology. 2013 Sep 1;170(1):1-7.
3. Mol BW, Roberts CT, Thangaratinam S, Magee LA, De Groot CJ, Hofmeyr GJ. Pre-eclampsia. The Lancet. 2016 Mar 5;387(10022):999-1011.
4. Steegers EA, Von Dadelszen P, Duvekot JJ, Pijnenborg R. Pre-eclampsia. The lancet. 2010 Aug 21;376(9741):631-44.
5. Redman C, Sargent IL. Placental debris, oxidative stress and pre-eclampsia. Placenta. 2000 Sep 1;21(7).
6. Burton GJ, Redman CW, Roberts JM, Moffett A. Pre-eclampsia: pathophysiology and clinical implications. Bmj. 2019 Jul 15;366.
7. Odibo AO, Goetzinger KR, Husted KM. Placental thickness and adverse pregnancy outcomes: a systematic review. J Ultrasound Med. 2012;31(10):1445-58.
8. Hata T, Aoki S, Tanaka H. Sonographic assessment of placental function in preeclampsia. J Perinat Med. 2015;43(6):657-63.
9. Khashoggi TY. Correlation between placental thickness and fetal parameters in normal pregnancies. Saudi Med J. 2005;26(5):632-7.

10. Singh N, Sharma KA. Sonographic evaluation of placental thickness in normal and hypertensive pregnancies. J Clin Diagn Res. 2016;10(8): QC01-QC04.
11. Roberts JM, Hubel CA. The two-stage model of preeclampsia: variations on the theme. Placenta. 2009 Mar 1; 30:32-7.
12. Mayhew TM. Enhanced fetoplacental angiogenesis in preeclampsia: an enigma explained? Histochem Cell Biol. 2003;120(5):371-7.
13. Chaiworapongsa T, Chaemsaithong P, Yeo L, Romero R. Pre-eclampsia part 1: current understanding of its pathophysiology. Nature Reviews Nephrology. 2014 Aug;10(8):466-80.
14. Abascal-Saiz A, Duque-Alcorta M, Fioravantti V, Antolín E, Fuente-Luelmo E, Haro M, Ramos-Álvarez MP, Perdomo G, Bartha JL. The relationship between angiogenic factors and energy metabolism in preeclampsia. Nutrients. 2022 May 23;14(10):2172.
15. Suri S, Muttukrishna S, Jauniaux E. 2D-ultrasound and endocrinologic evaluation of placentation in early pregnancy and its relationship to fetal birthweight in normal pregnancies and pre-eclampsia. Placenta. 2013 Sep 1;34(9):745-50.
16. Malhotra N, Sood M, Sharma JB. Sonographic evaluation of placental thickness and its correlation with adverse pregnancy outcomes. Int J Gynaecol Obstet. 2018;141(1):56-62.
17. Schwartz N, Coletta J, Pessel C. Placental thickness as a predictor of adverse perinatal outcomes: a retrospective cohort study. J Perinat Med. 2010;38(4):419-25.
18. Elchalal U, Ezra Y, Levi Y, Bar-Oz B, Yanai N, Intrator O, Nadjari M. Sonographically thick placenta: a marker for increased perinatal risk—a prospective cross-sectional study. Placenta. 2000 Mar 1;21(2-3):268-72.
19. Myatt L. Role of placenta in preeclampsia. Endocrine. 2002 Oct; 19:103-11.
20. Levine RJ, Maynard SE, Qian C, Lim KH, England LJ, Yu KF, Schusterman EF, Thadani R, Sachs BP, Epstein FH, Sibai BM. Circulating angiogenic factors and the risk of preeclampsia. New England journal of medicine. 2004 Feb 12;350(7):672-83.
21. Lyall F, Robson SC. Biochemical and biophysical markers of placental function in preeclampsia. Placenta. 2012;33: S58-S63.
22. Bujold E, Roberge S, Lacasse Y, Bureau M, Audibert F, Marcoux S, Forest JC, Giguere Y. Prevention of preeclampsia and intrauterine growth restriction with aspirin started in early pregnancy: a meta-analysis. Obstetrics & Gynecology. 2010 Aug 1;116(2 Part 1):402-14.

23. Miller, S. L., et al. (2016). The role of the placenta in fetal development. Nature Reviews Endocrinology, 12(4), 217-228.
24. Huppertz, B. (2008). The anatomy of the normal placenta. Journal of Clinical Pathology, 61(12), 1296-1302.
25. ACOG. (2020). Hypertension in Pregnancy. Practice Bulletin No. 203. American College of Obstetricians and Gynecologists.
26. Brown, M. A., et al. (2013). The hypertensive disorders of pregnancy: a review of the literature. Journal of Hypertension, 31(6), 1121-1130.
27. Brosens, I., et al. (2011). The role of the placenta in the pathophysiology of preeclampsia. Journal of Clinical Pathology, 64(1), 1-6.
28. Archives of Medical Science. (2024). Correlations between placental thickness and neonatal outcomes.
29. PMC11260064. (2024). Ultrasound evaluation of placental thickness in various gestational age subgroups.
30. Miller, S. L., et al. (2016). The role of the placenta in fetal development. Nature Reviews Endocrinology, 12(4), 217-228.
31. Huppertz, B. (2008). The anatomy of the normal placenta. Journal of Clinical Pathology, 61(12), 1296-1302.
32. Sibai, B. M., et al. (2005). Preeclampsia: a prospective study of 1,000 cases. American Journal of Obstetrics and Gynecology, 192(2), 582-587.
33. Jansson, T., & Powell, T. L. (2007). Role of the placenta in fetal programming: a review. Journal of Physiology, 572(1), 5-10.
34. Sibley, C. P., et al. (2004). The role of the placenta in fetal development. Placenta, 25(1), 1-8.