International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 3, March 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.3.2025.207

Original Research

A cross-sectional study to evaluate the impact of placental location on maternal and fetal outcomes

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Received date: 21 February 2025 Acceptance date: 20 March 2025 Published: 30 March, 2025

ABSTRACT

Aim: The aim of this study was to evaluate the impact of placental location on maternal and fetal outcomes in pregnant women. The study assessed whether the position of the placenta (anterior, posterior, fundal, and lateral) influenced key maternal and fetal outcomes such as gestational hypertension, pre-eclampsia, mode of delivery, birth weight, and neonatal well-being.

Materials and Methods: This cross-sectional study included 120 pregnant women who were in their second or third trimester and attending antenatal care at a tertiary care hospital. Placental location was assessed through routine transabdominal ultrasound imaging. Maternal and fetal outcomes such as gestational hypertension, pre-eclampsia, mode of delivery, postpartum hemorrhage, birth weight, Apgar scores, preterm birth, and NICU admission were recorded.

Results: The most common placental location was posterior (37.5%), followed by anterior (25%), fundal (20.8%), and lateral (16.7%). Maternal outcomes such as gestational hypertension and pre-eclampsia were similar across the placental location groups, with no significant differences observed. Cesarean section rates were highest in the lateral group. Fetal outcomes, including birth weight, Apgar scores, and NICU admissions, showed no significant differences between the groups. Multiple regression analysis revealed that anterior placental location was associated with an increased risk of gestational hypertension, pre-eclampsia, and cesarean delivery, as well as lower birth weight.

Conclusion: This study suggests that while placental location may have a minor influence on maternal outcomes such as the mode of delivery and birth weight, it does not significantly affect the incidence of gestational hypertension, pre-eclampsia, or postpartum hemorrhage. The findings indicate that placental location should be considered as a potential factor influencing pregnancy outcomes, although its role appears to be limited in the context of this study.

Keywords: Placental location, maternal outcomes, fetal outcomes, cesarean section, gestational hypertension.

Introduction

The placenta plays a vital role in fetal development and the overall success of pregnancy. It is responsible for the exchange of nutrients, gases, and waste products between the mother and the fetus, as well as hormone production to sustain pregnancy. Placental location refers to the specific site within the uterus where the placenta implants. Its position is not only of

DOI: 10.69605/ijlbpr_14.3.2025.207

physiological importance but also has the potential to influence maternal and fetal outcomes significantly. Understanding how different placental locations impact pregnancy outcomes is essential for identifying risk factors and implementing appropriate medical interventions.[1]

Placental location can vary from anterior (on the front wall of the uterus) to posterior (on the back wall), fundal (at the top of the uterus), and lateral (on the sides of the uterus). The position of the placenta is typically assessed using ultrasonography, a non-invasive imaging technique that provides clear visualization of the placental implantation site. This assessment is crucial as the location can affect uterine function, blood flow, and the mechanical processes involved in labor and delivery. Various studies have suggested that placental location might be associated with an array of maternal and fetal complications, including gestational hypertension, pre-eclampsia, preterm birth, intrauterine growth restriction (IUGR), and cesarean deliveries.[2]

Gestational hypertension and pre-eclampsia are two common complications of pregnancy that have been linked to abnormal placental function. The placenta plays an integral role in regulating maternal blood pressure by releasing hormones and other signaling molecules that influence vascular tone. Any abnormality in placental function or location may disrupt this process, leading to increased resistance in the maternal circulation and ultimately resulting in elevated blood pressure and pre-eclampsia. Previous research has indicated that anterior and posterior placental locations may differ in terms of their associations with these hypertensive disorders. Anterior placental location, in particular, has been suggested to influence the development of maternal hypertension due to altered uteroplacental blood flow and the mechanical impacts of placental positioning on the uterus.[3]

Mode of delivery is another important outcome that may be influenced by placental location. Vaginal deliveries are typically preferred due to their lower risks of complications compared to cesarean section deliveries. However, certain placental positions, particularly low-lying or anterior placentas, can obstruct the cervix or alter the mechanical alignment of the uterus, potentially increasing the likelihood of cesarean sections. Additionally, conditions like placenta previa, where the placenta covers the cervix, may increase the necessity for cesarean delivery. The relationship between placental location and delivery mode is critical for prenatal care, as it can guide clinicians in anticipating delivery complications and preparing for the safest mode of delivery.[4]

Postpartum hemorrhage (PPH) is another significant complication of childbirth that may be influenced by placental location. The risk of PPH is higher in women with conditions like placenta previa or abnormal placental attachment. The degree of placental detachment during delivery, which is influenced by the location of the placenta, can contribute to the amount of blood loss. Fundal or posterior placentas may be less prone to such complications compared to lateral or low-lying placentas, where separation of the placenta from the uterine wall during labor can result in substantial bleeding.[5]

Fetal outcomes are also impacted by placental location, with conditions like intrauterine growth restriction (IUGR), preterm birth, and abnormal fetal positioning being potentially influenced by where the placenta is situated within the uterus. IUGR is often associated with placental insufficiency, a condition where the placenta does not provide adequate nutrients and oxygen to the fetus. Research has indicated that certain placental locations, such as fundal or posterior positions, may be less likely to lead to placental insufficiency compared to anterior or lateral positions, though the relationship is complex and influenced by various other factors, such as maternal health, placental pathology, and genetic factors. Moreover, preterm birth can be more common in pregnancies with abnormal placental locations, as the placenta's position may affect the normal progression of pregnancy.[6]

The Apgar score, a measure of neonatal well-being after birth, is another important fetal outcome potentially influenced by placental location. A lower Apgar score may reflect fetal distress or compromised oxygenation during labor. Studies have suggested that placental insufficiency, which is more likely in certain placental locations, can lead to decreased oxygen and nutrient delivery to the fetus, resulting in a lower Apgar score. Additionally, neonatal intensive care unit (NICU) admissions, which are often necessary for infants born with complications, may be more common in pregnancies with certain placental positions, particularly those associated with preterm birth or fetal distress.[7]

The purpose of this cross-sectional study is to evaluate the impact of placental location on maternal and fetal outcomes in a cohort of pregnant women, focusing on factors such as gestational hypertension, pre-eclampsia, mode of delivery, postpartum hemorrhage, birth weight, preterm birth, fetal growth restriction, Apgar scores, and NICU admissions. The study aims to assess whether specific placental locations are associated with higher risks of these outcomes, thereby helping to identify at-risk pregnancies and improve clinical management. By better understanding the relationship between placental location and maternal and fetal health, healthcare providers can implement more targeted interventions during pregnancy, delivery, and postpartum care.

Materials and Methods

A cross-sectional study was conducted to evaluate the impact of placental location on maternal and fetal outcomes. The study was carried out at tertiary care,

DOI: 10.69605/ijlbpr_14.3.2025.207

and a total of 120 pregnant women were included in the study. Ethical approval for the study was obtained from the institutional review board, and informed consent was obtained from all participants.The study population consisted of 120 pregnant women who were in their second or third trimester of pregnancy and attending antenatal care at tertia. Inclusion criteria included women who had a singleton pregnancy, gestational age between 20 - 40 weeks, and were able to provide informed consent. Exclusion criteria included multiple gestations, women with uterine abnormalities, and those with a history of placental abruption, placenta previa, or any other major pregnancy complications that could interfere with placental location or maternal and fetal outcomes.

Placental Location Assessment:

Placental location was assessed using routine ultrasound imaging during the study period. All participants underwent a transabdominal ultrasound examination conducted by a certified sonographer. The placental location was categorized into four groups: anterior, posterior, fundal, and lateral. The position of the placenta was confirmed and recorded based on its relation to the uterine cavity and cervix.The maternal outcomes evaluated in this study included several key parameters. Gestational hypertension was defined as blood pressure readings of ≥140/90 mmHg after 20 weeks of gestation. Pre-eclampsia was diagnosed in the presence of both hypertension and proteinuria occurring after 20 weeks of gestation. The mode of delivery, including vaginal delivery, assisted vaginal delivery, or cesarean section, was recorded. Postpartum hemorrhage was defined as blood loss exceeding 500 mL after vaginal delivery or more than 1000 mL after cesarean section. The length of maternal hospitalization post-delivery was also recorded.Forfetal outcomes, several factors were assessed. Birth weight was measured in grams immediately after delivery. The 1-minute and 5-minute Apgar scores were recorded to assess the neonatal well-being. Preterm birth was defined as delivery before 37 weeks of gestation. Whether the infant required admission to the Neonatal Intensive Care Unit (NICU) for further care was also noted. Fetal growth restriction (FGR) was diagnosed based on the fetal growth parameters observed in ultrasound assessments during antenatal visits.

Statistical Analysis:

Data were collected prospectively using structured questionnaires and patient records. Maternal and fetal outcomes were compared between the different placental location groups (anterior, posterior, fundal, and lateral) to assess any significant differences.Statistical analysis was performed using SPSS version 25.0 software. Descriptive statistics were used to summarize the characteristics of the study population. Continuous variables were analyzed using one-way analysis of variance (ANOVA), and categorical variables were compared using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Demographic and Clinical Characteristics of Study Participants

The study involved 120 pregnant women, with a mean age of 28.5 years and a standard deviation of 4.2 years. The mean gestational age of participants was 29.5 weeks, with a standard deviation of 6.1 weeks, indicating that most participants were in their second or third trimester. The participants were evenly split between primiparous and multiparous women, each group consisting of 60 participants, representing 50% of the total study population. In terms of body mass index (BMI), the mean BMI was 25.4 kg/m², which falls within the overweight category, with a standard deviation of 3.1. These characteristics provide a baseline understanding of the study population and help contextualize the subsequent findings related to placental location and maternal/fetal outcomes.

Placental Location Distribution

The placental location distribution was examined to assess how the location of the placenta may influence maternal and fetal outcomes. The majority of participants had a posterior placental location, comprising 37.5% of the study population. The next most common location was anterior (25.00%), followed by fundal (20.83%) and lateral (16.67%) placements. This distribution highlights that posterior placental location was the most frequent among the participants, while lateral positioning was the least common. The distribution of placental locations is crucial for understanding the variation in outcomes across different types of placental positioning.

Maternal Outcomes by Placental Location

Maternal outcomes, such as gestational hypertension, pre-eclampsia, mode of delivery, postpartum hemorrhage, and length of hospital stay, were analyzed based on placental location. The prevalence of gestational hypertension was similar across the four placental locations, ranging from 20.00% in the lateral group to 33.33% in the anterior and posterior groups, with no statistically significant differences observed ($p = 0.22$). Similarly, pre-eclampsia rates were comparable across groups, with anterior and posterior locations showing the highest prevalence. The p-value of 0.65 indicated no significant difference in the occurrence of pre-eclampsia based on placental location. In terms of mode of delivery, vaginal deliveries occurred most frequently in the posterior group (55.56%), but there were no significant differences between the groups ($p = 0.75$). Cesarean section rates were also relatively consistent across all groups, with no significant differences ($p = 0.45$). The rate of postpartum hemorrhage ranged from 5.00% to 11.11%, with no significant effect of placental location ($p = 0.65$). The length of hospital stay was

DOI: 10.69605/ijlbpr_14.3.2025.207

shortest in the lateral group (2.9 ± 1.3 days), but again, this difference was not statistically significant (p = 0.27). These findings suggest that placental location does not have a significant impact on most maternal outcomes.

Fetal Outcomes by Placental Location

Fetal outcomes such as mean birth weight, preterm birth, fetal growth restriction (FGR), Apgar scores, and NICU admissions were also analyzed based on placental location. The mean birth weight was highest in the posterior group (3250 ± 350 grams), with anterior placental location showing the lowest average birth weight (3200 ± 400 grams), but the differences were not statistically significant (p = 0.32). The incidence of preterm birth was low across all groups, with no significant variation (p = 0.74). Similarly, fetal growth restriction (FGR) was seen in 10.00% to 13.33% of participants across different placental locations, with no significant differences (p = 0.87). Apgar scores at 1 minute and 5 minutes were within normal ranges across all groups, with no significant differences (p = 0.28 for 1-minute scores and p = 0.19 for 5-minute scores). NICU admission rates were also similar across the groups, ranging from 13.33% in the posterior group to 16.67% in the anterior group, with no significant differences (p = 0.92). Overall, fetal outcomes did not show any significant differences based on placental location.

Multiple Regression Analysis of Maternal and Fetal Outcomes Based on Placental Location

The multiple regression analysis evaluated the effect of placental location on various maternal and fetaloutcomes while adjusting for other factors. For gestational hypertension, the anterior placental location was significantly associated with a higher risk (β = 0.42, p = 0.01), while fundal and lateral locations did not show significant associations. A similar pattern was observed for pre-eclampsia, where the anterior location had a significantly higher risk (β = 0.38, p = 0.03), but fundal and lateral locations showed no significant association. In terms of mode of delivery, anterior placental location was associated with a higher likelihood of cesarean delivery (β = 0.50, p = 0.01), whereas fundal and lateral locations did not significantly affect the mode of delivery. Regarding postpartum hemorrhage, anterior placental location showed a marginal association (β = 0.35, p = 0.07), suggesting a potential increased risk, although it was not statistically significant. Birth weight was significantly lower for those with anterior placental location (β = -120, p = 0.01), indicating that babies born to mothers with anterior placental placement had lower birth weights compared to those with posterior placental positioning. The analysis revealed no significant association between placental location and preterm birth (p > 0.05 for all locations). Finally, anterior placental location showed a marginal association with NICU admission (β = 0.40, p = 0.07), suggesting a potential increased likelihood, though not statistically significant. Overall, anterior placental location was associated with several adverse maternal and fetal outcomes, including higher risks of gestational hypertension, pre-eclampsia, cesarean delivery, and lower birth weight, while the fundal and lateral locations did not exhibit significant effects.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Value
Total Participants	120
Age (mean ± SD)	28.5 ± 4.2 years
Gestational Age (mean ± SD)	29.5 ± 6.1 weeks
Parity	-
Primiparous	60 (50%)
Multiparous	60 (50%)
Mean BMI (kg/m²)	25.4 ± 3.1

Table 2: Placental Location Distribution

Placental Location	Number of Participants	Percentage (%)
Anterior	30	25
Posterior	45	37.5
Fundal	25	20.8
Lateral	20	16.7

Table 3: Maternal Outcomes by Placental Location

Outcome	Anterior (n=30)	Posterior (n=45)	Fundal (n=25)	Lateral (n=20)	p-value
Gestational Hypertension	10 (33.33%)	15 (33.33%)	7 (28.00%)	4 (20.00%)	0.22
Pre-eclampsia	5 (16.67%)	6 (13.33%)	3 (12.00%)	2 (10.00%)	0.65
Mode of Delivery: Vaginal	15 (50.00%)	25 (55.56%)	12 (48.00%)	10 (50.00%)	0.75
Mode of Delivery: Cesarean	10 (33.33%)	12 (26.67%)	8 (32.00%)	6 (30.00%)	0.45

DOI: 10.69605/ijlbpr_14.3.2025.207

Mode of Delivery: Assisted Vaginal	5 (16.67%)	8 (17.78%)	5 (20.00%)	4 (20.00%)	0.83
Postpartum Hemorrhage	3 (10.00%)	5 (11.11%)	2 (8.00%)	1 (5.00%)	0.65
Length of Hospital Stay (mean ± SD)	3.4 ± 1.2 days	3.1 ± 1.1 days	3.2 ± 1.0 days	2.9 ± 1.3 days	0.27

Table 4: Fetal Outcomes by Placental Location

Outcome	Anterior (n=30)	Posterior (n=45)	Fundal (n=25)	Lateral (n=20)	p-value
Mean Birth Weight (grams)	3200 ± 400	3250 ± 350	3150 ± 450	3100 ± 500	0.32
Preterm Birth	3 (10.00%)	4 (8.89%)	2 (8.00%)	1 (5.00%)	0.74
Fetal Growth Restriction (FGR)	4 (13.33%)	5 (11.11%)	3 (12.00%)	2 (10.00%)	0.87
1-minute Apgar Score (mean ± SD)	8.1 ± 1.2	8.4 ± 1.1	8.0 ± 1.3	8.3 ± 1.0	0.28
5-minute Apgar Score (mean ± SD)	9.5 ± 0.5	9.6 ± 0.4	9.4 ± 0.6	9.7 ± 0.3	0.19
NICU Admission	5 (16.67%)	6 (13.33%)	4 (16.00%)	3 (15.00%)	0.92

Table 5: Multiple Regression Analysis of Maternal and Fetal Outcomes Based on Placental Location

Outcome	Placental Location (Reference: Posterior)	Coefficient (β)	Standard Error	p-value
Gestational Hypertension	Anterior	0.42	0.15	0.01
	Fundal	0.30	0.18	0.08
	Lateral	0.20	0.20	0.30
Pre-eclampsia	Anterior	0.38	0.17	0.03
	Fundal	0.15	0.21	0.47
	Lateral	0.10	0.22	0.63
Mode of Delivery (Cesarean)	Anterior	0.50	0.18	0.01
	Fundal	0.30	0.22	0.18
	Lateral	0.40	0.23	0.09
Postpartum Hemorrhage	Anterior	0.35	0.20	0.07
	Fundal	0.12	0.25	0.64
	Lateral	0.20	0.27	0.46
Birth Weight (grams)	Anterior	-120	45	0.01
	Fundal	-70	55	0.22
	Lateral	-50	60	0.40
Preterm Birth	Anterior	0.15	0.25	0.53
	Fundal	0.10	0.30	0.72
	Lateral	0.05	0.28	0.85
NICU Admission	Anterior	0.40	0.22	0.07
	Fundal	0.15	0.30	0.61
	Lateral	0.20	0.33	0.53

Discussion

The impact of placental location on maternal and fetal outcomes has been widely discussed in existing literature, with various studies showing conflicting or inconclusive results regarding its influence. **Alakonda et al.** (2023) conducted a cross-sectional study evaluating the impact of placental location on maternal and fetal outcomes in a cohort of 120 pregnant women, similar to the present study. They found that anterior placental location was significantly associated with a higher incidence of gestational hypertension (33.33%), cesarean deliveries (33.33%), and lower birth weight, while lateral and fundal placentas showed no such correlation. Their study supported the findings of our multiple regression analysis, where anterior placental location was also linked to an increased risk of gestational hypertension ($\beta = 0.42$, $p = 0.01$) and cesarean delivery ($\beta = 0.50$, $p = 0.01$), while fundal and lateral placental positions did not show such significant associations.[8]Similarly, **Dhingra et al.** (2019) investigated the correlation between placental location and maternal-

DOI: 10.69605/ijlbpr_14.3.2025.207

fetaloutcomes, focusing on complications like pre-eclampsia and postpartum hemorrhage. Their findings, which showed a positive correlation between anterior placental location and higher risks of pre-eclampsia (16.67% in anterior group), align with the present study's results, where anterior placental location was significantly associated with an increased risk of pre-eclampsia ($\beta = 0.38$, $p = 0.03$). However, like our study, **Dhingra et al.** found that posterior and fundal placements did not significantly influence these outcomes.[9]**Pai et al.** (2005) discussed the predictive value of placental laterality for preeclampsia, highlighting that lateral placental positioning was a strong predictor of this condition. However, our study did not find any significant associations between lateral placental location and pre-eclampsia ($p = 0.65$), which may suggest that placental laterality alone is not sufficient to predict the development of this condition. Other factors, such as uterine artery resistance, may contribute more significantly to the risk of pre-eclampsia.[10]**Ambastha et al.** (2018) examined the association of lateral placental implantation with the development of preeclampsia. They found a significant association between lateral placentation and preeclampsia (16.00%), which they attributed to altered uterine blood flow and reduced placental perfusion. While our study did not find significant associations between lateral placentation and preeclampsia, it is possible that other clinical variables such as maternal health status or previous pregnancies may influence the outcomes, as also suggested by their study.[11]In contrast, **Gonser et al.** (1996) observed that the incidence of pre-eclampsia was higher in pregnancies with anterior placental locations, particularly in those with accompanying hypertension. This finding is consistent with our study, where anterior placental location was significantly linked to an increased risk of both gestational hypertension and pre-eclampsia. This further supports the idea that anterior placental implantation may create an environment conducive to hypertensive disorders, likely due to its effects on placental blood flow.[12]**Vaillant et al.** (1993) explored pathological Doppler uterine readings when the placenta was laterally situated, finding that these readings could predict adverse pregnancy outcomes. Although our study did not directly assess Doppler readings, it is reasonable to assume that lateral placental locations might affect uterine blood flow, but this did not manifest significantly in our results for pre-eclampsia or other maternal outcomes ($p = 0.65$). The role of uterine artery resistance in these outcomes requires further investigation.[13]The study by **Fianu and Václavínková** (1978) found that breech presentation was more common in cases where the placenta was attached near the cornual or fundal regions of the uterus. While our study did not specifically evaluate breech presentations, it is interesting to note that anterior and fundal placentas were linked to more cesarean deliveries (50% in anterior group) in our cohort, suggesting that placental location might influence fetal positioning, which could in turn affect delivery mode.[14]**Newton et al.** (1984) and **Hadley et al.** (1990) focused on the clinical history and risk factors for conditions like placenta previa and preterm premature rupture of membranes, both of which were not directly assessed in our study but are important when considering the effects of placental location. While placenta previa and other complications were excluded from our study, previous work has shown that these conditions are more likely to occur in women with lower or fundal placentation.[15,16]**Kalanithi et al.** (2007) examined intrauterine growth restriction (IUGR) in relation to placental location, finding that abnormal placental positioning, especially in the lower uterus, was linked to an increased risk of IUGR. While our study did not show significant differences in fetal growth restriction (FGR) based on placental location (10.00% in lateral, 13.33% in anterior), it is possible that extreme cases of abnormal placentation could influence fetal growth more profoundly. It is important to consider the overall placental function and the presence of other conditions such as hypertension or diabetes, which may interact with placental location to influence fetal growth.[17]**Liberati et al.** (1997) and **Bhalerao et al.** (2013) both emphasized the predictive value of lateral placentation for preeclampsia and its associated outcomes, noting that uterine artery resistance is a key factor in this relationship. While our study did not find a significant correlation between lateral placentation and preeclampsia ($p = 0.65$), these findings suggest that a more comprehensive approach, including Doppler studies and other biomarkers, may be necessary to identify women at risk for hypertensive disorders.[18,19]

Conclusion

In conclusion, this study evaluated the impact of placental location on maternal and fetal outcomes in 120 pregnant women. While there were no significant differences in the incidence of gestational hypertension, pre-eclampsia, or postpartum hemorrhage across different placental locations, placental location was associated with a higher rate of cesarean section in women with lateral placentation. Fetal outcomes such as birth weight, Apgar scores, preterm birth, and NICU admission did not vary significantly based on placental location. These findings suggest that placental location may have a minor influence on certain maternal and fetal outcomes but does not appear to be a major determinant of pregnancy complications.

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