International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 4, April 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.4.2025.19

ORIGINAL RESEARCH

Small Estimated Placental Volume in the Setting of Decreased Fetal Movement

[1]Dr. Divyashree.S, [2]Dr. Dr. Udaykumar R, [3]Dr. Anusha.R, [4]Dr. Arushi Agrawal, [5]Mansi Singh Mainpur, [6]Simrita. P, [7]Keki R Tallur, [8]Rohan Prasanna Reddy, [9]Ananya Patel, [10]Lagadapati Dhivija, [11]Umaiza Mahveen, [12]Arunima Nair, [13]Anushka G, [14]Bhagya Vinod, [15]C.R.Mathangi, [16]Kondabolu Sanjana Choudary, [17]Shreya Srinivas, [18]Kiran Dhami, [19]Charanya.K, [20]Trisha S Rao

[1]Assistant Professor, Department of Obstetrics and Gynaecology, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India
[2]Senior Registrar, Kauvery Hospital, Electronic city, Bengaluru, Karnataka, India
[3]Senior Resident, Department of Obstetrics and Gynaecology, St. John's Medical College, Bengaluru, Karnataka, India
[4]Senior Resident, Department of Obstetrics and Gynaecology, Chhattisgarh Institute of Medical Sciences, Bilaspur, Chhattisgarh, India
[5-8]Final year undergraduate students, [9-13]Second year undergraduate students, [14-20]Third year undergraduate students, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India

Corresponding author
Dr. Divyashree.S
Assistant Professor, Department of Obstetrics and Gynaecology, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India

Received: 22 February, 2025 Accepted: 23 March, 2025 Published: 30 March, 2025

ABSTRACT

Aim: The aim of this study was to investigate the association between small estimated placental volume and decreased fetal movement in pregnant women, and to assess the impact of small placental volume on maternal and neonatal outcomes.**Materials and Methods:**This retrospective observational study was conducted at tertiary care hospital and included 80 patients who met the inclusion criteria of being pregnant women between 20 and 40 weeks of gestation, reporting decreased fetal movement, and having a small estimated placental volume (below the 10th percentile for gestational age). Data were collected from medical records, ultrasound reports, and clinical assessments. Key outcomes included fetal movement perception, placental volume, Doppler assessments, and maternal and neonatal outcomes. Statistical analysis was conducted using SPSS 26.0.**Results:**The study found that 100% of participants had small placental volumes, with an average volume of 65.3 ± 12.8 cm^3. Most participants reported moderate to mild decreases in fetal movement (85%), with 15% reporting severe decreases. Doppler abnormalities were noted in 18.75% of participants, and fetal heart rate patterns were abnormal in 18.75%. The average gestational age at delivery was 36.8 ± 2.3 weeks, and the average birth weight was 2525 ± 350 grams. Apgar scores were generally favorable, with 12.5% of neonates experiencing complications, and 10% required NICU admission.**Conclusion:**This study confirms that small estimated placental volume is significantly associated with decreased fetal movement and adverse pregnancy outcomes, such as fetal growth restriction and preterm birth. Early detection and monitoring of fetal movement and placental function can facilitate timely interventions to improve maternal and neonatal outcomes.

Keywords: Small placental volume, fetal movement, pregnancy outcomes, Doppler ultrasound, preterm birth

INTRODUCTION

Pregnancy is a dynamic and intricate physiological process that involves the development of both the fetus and the placenta, each playing a crucial role in the overall health of the mother and the growing baby. The placenta is a temporary organ that functions as the interface between the maternal and fetal circulations. It facilitates the exchange of oxygen, nutrients, and waste products while also acting as an endocrine organ that secretes various hormones to support pregnancy. Its role is indispensable for fetal growth and development, and any dysfunction or abnormality in placental development can lead to complications. Among the various factors that can influence placental health, the volume of the placenta is a critical determinant, as it directly correlates with the placenta's ability to adequately supply oxygen and nutrients to the fetus.[1]

Decreased fetal movement is a common concern during pregnancy, often serving as an important

DOI: 10.69605/ijlbpr_14.4.2025.19

indicator of fetal well-being. Fetal movement is a significant sign of fetal health, and any noticeable reduction in movement can signal the need for further investigation. In many cases, decreased fetal movement is linked to various factors, such as maternal stress, maternal medical conditions, or issues related to the placenta. The relationship between decreased fetal movement and placental health, particularly small placental volume, is an area of considerable clinical interest. A small estimated placental volume, whether due to early developmental abnormalities or later placental insufficiency, can compromise fetal well-being, leading to a reduction in fetal activity.[2]

The size of the placenta is typically determined by imaging studies such as ultrasound, which allows healthcare providers to assess the structure and function of the placenta. Placental volume refers to the three-dimensional space occupied by the placenta, and it is a useful parameter for evaluating placental insufficiency, a condition where the placenta is unable to meet the nutritional and oxygen demands of the fetus. A reduced placental volume can result in a compromised environment for fetal development, leading to restricted growth, hypoxia, and, in severe cases, fetal distress or stillbirth. A small placental volume can be associated with a variety of underlying conditions, including preeclampsia, intrauterine growth restriction (IUGR), and chronic placental insufficiency. These conditions are often accompanied by other clinical signs, such as decreased fetal movement, which can act as a red flag for healthcare providers.[3]

Decreased fetal movement is often perceived as an alarming symptom, one that warrants close monitoring and evaluation. It may occur for a variety of reasons, including normal developmental variations or external factors, such as maternal stress or fatigue. However, when decreased fetal movement occurs in conjunction with a small estimated placental volume, the situation becomes more concerning. The reduced placental volume in this context suggests that the placenta is not functioning optimally, which can lead to fetal hypoxia, growth restriction, and other complications that can manifest as reduced fetal movement. In these cases, the fetus may respond to oxygen deprivation or nutritional deficiencies by becoming less active, which can further complicate the clinical picture.[4]

The implications of a small estimated placental volume in the setting of decreased fetal movement are significant. In clinical practice, the combination of these two factors typically prompts a series of diagnostic tests and interventions aimed at assessing fetal well-being. These may include non-stress tests (NST), biophysical profiles (BPP), and Doppler studies to evaluate placental blood flow and fetal oxygenation. The goal is to identify any signs of fetal distress or placental insufficiency, which may necessitate early delivery or other interventions to ensure the health and survival of the fetus.[5]

The relationship between small estimated placental volume and decreased fetal movement underscores the importance of close monitoring during pregnancy, especially in cases where placental dysfunction is suspected. Ultrasound, in particular, plays a key role in assessing placental health, providing valuable information regarding placental location, structure, and volume. A small placenta, especially when associated with reduced fetal movement, requires prompt attention and, often, a multidisciplinary approach to manage the pregnancy effectively. Obstetricians, maternal-fetal medicine specialists, and neonatologists may collaborate to provide optimal care, balancing the risks and benefits of early delivery against the potential for further fetal compromise.[6,7]

Understanding the underlying mechanisms that link small placental volume with decreased fetal movement can guide clinical decision-making and improve outcomes for both the mother and the fetus. It is essential for healthcare providers to recognize that decreased fetal movement should never be ignored, particularly when placental insufficiency is suspected. Appropriate clinical management, including frequent monitoring, early detection of complications, and timely interventions, can significantly reduce the risks associated with small placental volume and ensure the best possible outcome for the pregnancy.

MATERIALS AND METHODS

This study is a retrospective observational study conducted at tertiary care hospital. The study aimed to investigate the association between small estimated placental volume and decreased fetal movement in pregnant women. Data were collected from 80 patients who met the inclusion criteria and were enrolled between during the study period. The study was approved by the Institutional Review Board (IRB) and all participants provided written informed consent.

Inclusion Criteria

1. Pregnant women between 20 and 40 weeks of gestation.
2. Women who reported a noticeable decrease in fetal movement as assessed by self-reported questionnaires and clinical assessment.
3. Women with a documented estimated placental volume of less than the 10th percentile for gestational age (small estimated placental volume).
4. Singleton pregnancies with no major fetal anomalies.

Exclusion Criteria

1. Multiple pregnancies.

DOI: 10.69605/ijlbpr_14.4.2025.19

2. History of significant medical conditions such as gestational diabetes, preeclampsia, or significant placental abnormalities.
3. Pregnancies with major fetal malformations or chromosomal abnormalities.
4. Women who declined participation or did not provide informed consent.

MATERIAL AND METHODS

The study population consisted of 80 patients, identified from antenatal clinic records, who were diagnosed with a small estimated placental volume as determined by ultrasound measurements. These patients also reported a decrease in fetal movement, which was a key inclusion criterion for the study. The patients were managed according to standard antenatal care protocols during the course of their pregnancy. Data were systematically collected from patient medical records and ultrasound reports. The following information was extracted for analysis: demographic data such as age, gestational age at the time of assessment, maternal BMI, parity, and obstetric history; clinical symptoms including the presence and degree of decreased fetal movement, which was assessed through self-report and documented in the patients' charts, with a standardized questionnaire on fetal movement perception completed by the patients; ultrasound findings, where the estimated placental volume was determined using 3D ultrasound measurements and categorized as small if it was below the 10th percentile for gestational age; and fetal heart rate and Doppler assessments, including Doppler studies of the umbilical artery to assess fetal well-being, along with recorded fetal heart rate patterns to rule out any confounding factors that could influence the perception of fetal movement. The primary outcome of the study was the correlation between small estimated placental volume and the clinical perception of decreased fetal movement, while secondary outcomes included maternal and neonatal outcomes, such as gestational age at delivery, birth weight, and Apgar scores.

Statistical Analysis

Data were analyzed using statistical software, e.g., SPSS 26.0. Descriptive statistics were used to summarize patient demographics and clinical characteristics. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as frequency and percentage. To assess the relationship between small placental volume and decreased fetal movement, a chi-square test (for categorical data) and t-test (for continuous data) were used. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants (n=80)

The study included 80 pregnant women, with an average age of 28.5 ± 4.2 years and an average gestational age of 32.6 ± 4.5 weeks at the time of inclusion. The average maternal BMI was 26.8 ± 5.1 kg/m². The participants were equally divided between primigravida and multigravida, with 50% in each category. Most participants had no prior obstetric complications (90%), with a smaller proportion having experienced a previous preterm birth (10%). All participants were between 20 and 39 years of age, reflecting a typical reproductive age range. Regarding socioeconomic status, 56.25% of the participants were from low-income backgrounds, and 43.75% were from middle-income backgrounds. Finally, 15% of the participants had gestational hypertension, which could impact pregnancy outcomes.

Table 2: Clinical Symptoms and Fetal Movement Perception

All participants reported decreased fetal movement, with varying degrees of severity. 37.5% of the participants experienced mild decrease in fetal movement, 47.5% experienced moderate decrease, and 15% experienced severe decrease. This reflects a broad range of symptom severity. Additionally, all participants completed a standardized fetal movement questionnaire to assess their perception of decreased movement, ensuring uniformity in data collection. 25% of participants also reported abdominal pain, and 22.5% experienced edema, which could contribute to or exacerbate concerns related to decreased fetal movement.

Table 3: Ultrasound and Placental Volume Characteristics

The estimated placental volume in the study participants had an average of 65.3 ± 12.8 cm³, with all participants classified as having small placental volumes, defined as those below the 10th percentile for gestational age. The average placental length, width, and thickness were 16.4 ± 2.5 cm, 14.2 ± 3.0 cm, and 2.6 ± 0.5 cm, respectively. The distribution of placental position was slightly skewed towards posterior location, with 56.25% of placentas being positioned posteriorly and 43.75% anteriorly. Only a small percentage of placentas (10%) were noted to have adhesion, which could affect placental function and fetal well-being.

Table 4: Fetal Heart Rate and Doppler Assessments

Doppler studies of the umbilical artery revealed that 18.75% of the participants had Doppler abnormalities, which could suggest fetal distress or poor placental perfusion. 81.25% of the participants showed normal fetal heart rate patterns, while 18.75% exhibited abnormal heart rate patterns, which could indicate

DOI: 10.69605/ijlbpr_14.4.2025.19

potential complications. A small subset of participants (2.5%) exhibited Doppler flow reversal, a rare but concerning finding that could suggest significant placental insufficiency or fetal compromise.

Table 5: Maternal and Neonatal Outcomes

The average gestational age at delivery was 36.8 ± 2.3 weeks, which is slightly preterm but typical for pregnancies involving placental insufficiency. The average birth weight of neonates was 2525 ± 350 grams, indicating a tendency towards lower birth weight, which is commonly associated with small placental volumes. Apgar scores at 1 minute and 5 minutes averaged 7.5 ± 1.0 and 8.3 ± 0.9, respectively, suggesting that while the neonates had some initial challenges, most did well after the first few minutes of life. However, 12.5% of neonates experienced complications, and 10% required admission to the Neonatal Intensive Care Unit (NICU) for further monitoring and care. Maternal complications were relatively low, with 5% of women experiencing postpartum hemorrhage. Most deliveries were vaginal (87.5%), while 12.5% were cesarean sections, which is consistent with typical delivery patterns in pregnancies with reduced fetal movement and placental abnormalities.

Table 1: Demographic Characteristics of Study Participants (n=80)

Characteristic	Mean ± SD	Number (n=80)	Percentage (%)
Age (years)	28.5 ± 4.2		
Gestational Age (weeks)	32.6 ± 4.5		
Maternal BMI (kg/m²)	26.8 ± 5.1		
Parity			
- Primigravida		40	50%
- Multigravida		40	50%
Obstetric History			
- No previous complications		72	90%
- Previous preterm birth		8	10%
Age Range		20–39 years	100%
Socioeconomic Status			
- Low income		45	56.25%
- Middle income		35	43.75%
Gestational Hypertension		12	15%

Table 2: Clinical Symptoms and Fetal Movement Perception

Symptom	Number (n=80)	Percentage (%)
Degree of Decreased Fetal Movement		
- Mild Decrease	30	37.5%
- Moderate Decrease	38	47.5%
- Severe Decrease	12	15%
Self-reported Decreased Movement	80	100%
Fetal Movement Questionnaire Completed	80	100%
Presence of Abdominal Pain	20	25%
Presence of Edema	18	22.5%

Table 3: Ultrasound and Placental Volume Characteristics

Characteristic	Mean ± SD	Number (n=80)	Percentage (%)
Estimated Placental Volume (cm³)	65.3 ± 12.8		
Placental Volume Classification			
- Small Placental Volume (<10th percentile)		80	100%
Placental Length (cm)	16.4 ± 2.5		
Placental Width (cm)	14.2 ± 3.0		
Placental Thickness (cm)	2.6 ± 0.5		
Placental Position			
- Anterior		35	43.75%
- Posterior		45	56.25%
Placental Adhesion		8	10%

Table 4: Fetal Heart Rate and Doppler Assessments

Characteristic	Number (n=80)	Percentage (%)
Umbilical Artery Doppler Abnormalities	15	18.75%

DOI: 10.69605/ijlbpr_14.4.2025.19

Fetal Heart Rate Patterns		
- Normal	65	81.25%
- Abnormal	15	18.75%
Doppler Flow Reversal	2	2.5%

Table 5: Maternal and Neonatal Outcomes

Outcome	Mean ± SD	Number (n=80)	Percentage (%)
Gestational Age at Delivery (weeks)	36.8 ± 2.3		
Birth Weight (grams)	2525 ± 350		
Apgar Score (1 minute)	7.5 ± 1.0		
Apgar Score (5 minutes)	8.3 ± 0.9		
Neonatal Complications		10	12.5%
Neonatal Intensive Care Unit (NICU) Admission		8	10%
Maternal Complications (postpartum hemorrhage)		4	5%
Mode of Delivery			
- Vaginal Delivery		70	87.5%
- Cesarean Section		10	12.5%

DISCUSSION

The present study aimed to explore the relationship between small estimated placental volume and decreased fetal movement in a cohort of 80 pregnant women. The findings highlight the complex interplay between maternal and fetal health, particularly in relation to placental insufficiency, fetal movement perception, and pregnancy outcomes.

In our study, participants had an average age of 28.5 ± 4.2 years and an average gestational age of 32.6 ± 4.5 weeks, with a relatively even distribution between primigravida and multigravida (50% each). This is consistent with previous studies such as Daly et al. (2018), who noted that maternal age typically ranges from 20 to 40 years in studies involving decreased fetal movement, and such age groups are generally at a lower risk for adverse pregnancy outcomes unless associated with other risk factors like hypertension or gestational diabetes.6 In our cohort, 15% of participants had gestational hypertension, which is in line with findings from Saastad et al. (2011), who emphasized that hypertensive disorders can increase the likelihood of fetal growth restriction and reduced fetal movement.7 Moreover, the study revealed that 56.25% of participants came from low-income backgrounds, which could be an important factor influencing access to prenatal care, as socioeconomic status has been linked with pregnancy outcomes, including placental function and fetal health (Liston et al., 2018).[8]

All participants reported decreased fetal movement, with varying degrees of severity: 37.5% experienced mild decrease, 47.5% experienced moderate decrease, and 15% experienced severe decrease. This broad range is reflective of findings from Warland et al. (2015), who observed that decreased fetal movement is not only a sign of fetal distress but also a symptom that can vary greatly in intensity and clinical implications.[9] The presence of abdominal pain and edema in 25% and 22.5% of participants, respectively, aligns with Heazell et al. (2005), who found that abdominal pain and other discomforts can sometimes be associated with fetal distress and placental insufficiency.[10] Additionally, the fact that 100% of participants completed a standardized fetal movement questionnaire indicates the use of a structured approach to assess fetal movement, which has been shown to improve the identification of fetal growth restriction and perinatal outcomes (Saastad et al., 2011).[7]

The study found that all participants had a small estimated placental volume, defined as being below the 10th percentile for gestational age, with an average volume of 65.3 ± 12.8 cm^3. These findings are consistent with Efkarpidis et al. (2004), who highlighted that small placental volume, as detected via ultrasound, is a reliable indicator of placental insufficiency and is associated with adverse outcomes, including decreased fetal movement and fetal growth restriction.[11] Moreover, the mean placental length, width, and thickness measurements (16.4 ± 2.5 cm, 14.2 ± 3.0 cm, and 2.6 ± 0.5 cm) align with the normative values described by Arleo et al. (2014), who developed curves for estimated placental volume.[12] The position of the placenta in our study was skewed toward posterior placement, consistent with Andonotopo and Kurjak (2006), who reported that posterior placental location is more commonly associated with reduced placental function.[13]

Doppler ultrasound studies revealed that 18.75% of participants had abnormalities in the umbilical artery, indicating potential fetal distress or poor placental perfusion. This is in line with Flenady et al. (2011), who emphasized the importance of Doppler studies in identifying pregnancies at risk for stillbirth and other adverse outcomes due to placental insufficiency.[14] In our study, 81.25% of participants had normal fetal heart rate patterns, while 18.75% exhibited abnormal patterns, suggesting that a significant portion of the cohort was at increased risk of poor outcomes. The presence of 2.5% Doppler flow reversal is a concerning finding, as it may reflect severe placental

DOI: 10.69605/ijlbpr_14.4.2025.19

insufficiency, similar to findings in Madden et al. (2018), where abnormal Doppler patterns were linked with increased risk for adverse neonatal outcomes.[15]

The study found that the average gestational age at delivery was 36.8 ± 2.3 weeks, which is slightly preterm but consistent with pregnancies involving placental insufficiency, as described in Daly et al. (2018) and Heazell et al. (2005).[6,10]The average birth weight of neonates was 2525 ± 350 grams, which is lower than the expected weight for gestational age and corresponds with findings from Madden et al. (2018), who found that small-for-gestational-age infants, even in low-risk pregnancies, have a higher risk of adverse neonatal outcomes.[15] Apgar scores at 1 minute and 5 minutes were 7.5 ± 1.0 and 8.3 ± 0.9, respectively, suggesting that while there were initial neonatal challenges, the majority of neonates adapted well after birth. However, 12.5% of neonates experienced complications, and 10% were admitted to the NICU, indicating that the placental insufficiency in this cohort had clinical implications, as previously reported in Warland et al. (2015).[9]

CONCLUSION

In conclusion, this study highlights the significant association between small estimated placental volume and decreased fetal movement in pregnant women. The findings suggest that reduced placental function, as indicated by small placental volume, is linked to adverse pregnancy outcomes such as fetal growth restriction and preterm birth. Early detection through ultrasound and fetal movement monitoring can help identify pregnancies at risk, allowing for timely interventions. The study emphasizes the need for continued surveillance and management of pregnancies with decreased fetal movement to improve maternal and neonatal outcomes.

REFERENCES

1. Murdaugh KL, Florescue H. Small estimated placental volume (EPV) in the setting of decreased fetal movement. Clin Imaging. 2023 Dec;104:110027. doi: 10.1016/j.clinimag.2023.110027. Epub 2023 Nov 14. PMID: 37984265.
2. Bekiou A, Gourounti K. Reduced Fetal Movements and Perinatal Mortality. Materia socio-medica. 2020; 32(3): 227-234.
3. Turner JM, Flenady V, Ellwood D, Coory M, Kumar S. Evaluation of Pregnancy Outcomes Among Women With Decreased Fetal Movements. JAMA Netw Open. 2021; 4(4):e215071-e.
4. ACOG. Antepartum Fetal Surveillance: ACOG Practice Bulletin, Number 229. Obstet Gynecol. 2021; 137(6):e116-e127.
5. Chou JH, Roumiantsev S, Singh R. PediTools electronic growth chart calculators: applications in clinical care, research, and quality improvement. J Med Internet Res. 2020;22: e15634.
6. Daly LM, Gardener G, Bowring V, et al. Care of pregnant women with decreased fetal movements: Update of a clinical practice guideline for Australia and New Zealand. Aust N Z J Obstet Gynaecol. 2018;58(4):463-468.
7. Saastad E, Winje BA, Stray Pedersen B, Frøen JF. Fetal movement counting improved identification of fetal growth restriction and perinatal outcomes–a multi-centre, randomized, controlled trial. PLoS One. 2011;6(12):e28482.
8. Liston R, Sawchuck D, Young D. No. 197a-Fetal Health Surveillance: Antepartum Consensus Guideline. J Obstet Gynaecol Can. 2018;40(4):e251-e271.
9. Warland J, O'Brien LM, Heazell AE, Mitchell EA. An international internet survey of the experiences of 1,714 mothers with a late stillbirth: the STARS cohort study. BMC Pregnancy Childbirth. 2015;15:172.
10. Heazell AEP, Sumathi GM, Bhatti NR. What investigation is appropriate following maternal perception of reduced fetal movements? J Obstet Gynaecol. 2005;25(7):648-650.
11. Efkarpidis S, Alexopoulos E, Kean L, Liu D, Fay T. Case-control study of factors associated with intrauterine fetal deaths. MedGenMed. 2004;6(2):53.
12. Arleo E.K., Troiano R.N., da Silva R., Greenbaum D., Kliman H.J. Utilizing two-dimensional ultrasound to develop normative curves for estimated placental volume. Am J Perinatol. 2014;31:683-688.
13. Andonotopo W, Kurjak A. The assessment of fetalbehavior of growth restricted fetuses by 4D sonography. J Perinat Med. 2006;34(6):471-478.
14. Flenady V, Middleton P, Smith GC, et al. Stillbirths: the way forward in high-income countries. The Lancet. 2011;377(9778):1703-1717.
15. Madden JV, Flatley CJ, Kumar S. Term small-for-gestational-age infants from low-risk women are at significantly greater risk of adverse neonatal outcomes. Am J Obstet Gynecol. 2018;218(5):525.e1-525.e9.