Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4656-4662 | ISSN:2251-6727

Assessment of Placental Elasticity Using Strain Elastography in Late Trimester Singleton Pregnancies.A Comparative Study Between Gdm and Non Gdm Mothers: A Cross Sectional Study

Dr.R.Kalanithi Agiladevi[A], Dr.V.S.Balaghanapathy[B]*, Dr.Shaik Farid Bin Abdul Jabbar[C]

A. Department of Radiodiagnosis, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Chengalpattu, Tamil Nadu, India. ORCID ID:0009-0007-9233-1104

B. Assistant Professor, Department of Radiodiagnosis, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Chengalpattu, Tamil Nadu, India. ORCID ID:0009-0003-7048-4733

C. Professor and Head, Department of Radiodiagnosis, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Chengalpattu, Tamil Nadu, India. ORCID ID:0000-0001-8436-9320

Corresponding Author*

Dr.V.S.Balaghanapathy DMRD, Assistant Professor, Department of Radiodiagnosis, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Chengalpattu, Tamil Nadu, India.

(Received: 16 February 2026 Revised: 14 March 2026 Accepted: 25 April 2026)

KEYWORDS

Gestational diabetes mellitus, Placental elasticity, Strain elastography, Placental stiffness, Neonatal outcomes.

ABSTRACT:

Background: Gestational diabetes mellitus (GDM) is associated with placental structural and functional alterations that may influence fetal outcomes. Strain elastography is a novel, non-invasive imaging modality that assesses tissue stiffness and may help detect placental changes in GDM pregnancies.

Objective: To assess placental elasticity using strain elastography in late trimester singleton pregnancies and to compare findings between GDM and non-GDM mothers.

Methods: This hospital-based cross-sectional comparative study was conducted in the Department of Radiodiagnosis at a tertiary care centre over six months. A total of 80 pregnant women (≥28 weeks gestation) were included and divided into two groups: GDM (n=40) and non-GDM (n=40) based on WHO criteria. Placental elasticity was measured using strain elastography during third-trimester ultrasonography. Data were analyzed using independent t-test and chi-square test, with $p < 0.05$ considered statistically significant.

Results: Placental elasticity values were significantly higher in the GDM group compared to the non-GDM group ($p < 0.001$), indicating increased placental stiffness in diabetic pregnancies. Elevated placental stiffness was also associated with adverse neonatal outcomes such as increased NICU admissions and respiratory distress.

Conclusion: Strain elastography is a promising tool for assessing placental changes in GDM pregnancies. Increased placental stiffness may serve as an early indicator of placental dysfunction and adverse fetal outcomes, supporting its role in antenatal risk stratification.

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders complicating pregnancy, characterized by glucose intolerance with onset or first recognition during gestation. It affects approximately 5–20% of pregnancies globally, with a rising prevalence attributed to increasing maternal age, obesity, and sedentary lifestyle patterns [1]. GDM is associated with significant maternal and fetal complications, including preeclampsia, macrosomia, neonatal hypoglycemia, and long-term metabolic risks in offspring. Among the various organs affected, the placenta plays a crucial role as the interface between mother and fetus, and its structural and functional alterations are central to the pathophysiology of GDM [2].

The placenta undergoes dynamic changes throughout pregnancy, adapting to meet increasing fetal demands. In GDM, hyperglycemia leads to alterations such as villous edema, increased fibrinoid deposition, chorangiosis, and abnormal vascularization, which can impair placental perfusion and nutrient exchange [3]. These histopathological changes may not always be evident on conventional imaging modalities such as grayscale ultrasonography or Doppler studies, thereby necessitating more sensitive techniques for early detection of placental dysfunction [4].

Elastography is an emerging ultrasound-based imaging modality that evaluates tissue stiffness, providing additional functional information beyond conventional imaging. Strain elastography, in particular, assesses relative tissue deformation in response to applied mechanical force and has been widely used in evaluating liver fibrosis, breast lesions, and thyroid nodules [5]. Recently, its application has been extended to obstetrics, especially in assessing placental elasticity, which may reflect underlying microstructural changes [6].

Placental stiffness is considered a surrogate marker of placental health, with increased stiffness potentially indicating fibrosis, calcification, or vascular compromise. Studies have demonstrated that pathological conditions such as GDM, preeclampsia, and intrauterine growth restriction (IUGR) are associated with altered placental elasticity patterns [7]. These changes may precede clinical manifestations, making elastography a promising tool for early diagnosis and risk stratification.

In late trimester pregnancies, when placental maturation is near completion, evaluating placental elasticity becomes particularly relevant for predicting adverse fetal outcomes. Comparative assessment between GDM and non-GDM pregnancies can help establish normative values and identify deviations associated with metabolic disorders [8]. Despite its potential, the use of strain elastography in placental evaluation remains underexplored, especially in the Indian population, where the burden of GDM is substantial [9].

Therefore, this study aims to assess placental fetal elasticity using strain elastography in late trimester singleton pregnancies and to compare findings between GDM and non-GDM mothers, thereby contributing to improved antenatal surveillance and fetal outcome prediction.

METHODOLOGY

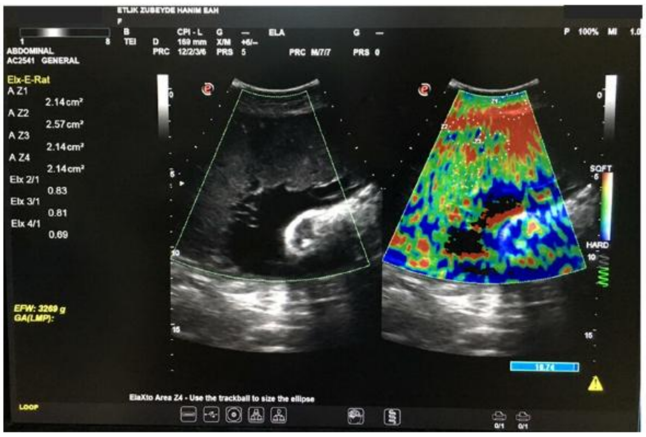
This hospital-based cross-sectional comparative study was conducted in the Department of Radiodiagnosis at KIMS & Research Centre, a tertiary care hospital with advanced ultrasonography and elastography facilities, in collaboration with the Department of Obstetrics and Gynaecology. The study was carried out over a period of six months, during which pregnant women in the late trimester were recruited and evaluated. A total of 80 antenatal women aged 18–40 years with singleton pregnancies of ≥28 weeks gestation were included after obtaining informed consent. Participants were categorized into two groups based on WHO diagnostic criteria: GDM group (n = 40) and non-GDM group (n = 40). Women with pre-existing diabetes mellitus, multiple gestations, known fetal congenital anomalies, placental abnormalities such as placenta previa or abruption, chronic systemic illnesses, or poor ultrasound visualization were excluded from the study.

Consecutive sampling was employed, and all eligible women attending the antenatal clinic or referred for obstetric ultrasound during the study period were included until the required sample size was achieved. The primary study parameter was placental elasticity measured using strain elastography, while secondary parameters included gestational age, maternal demographic characteristics, and relevant fetal or neonatal outcomes. All participants underwent detailed obstetric ultrasonography in the third trimester. Placental strain elastography was performed using a standardized technique, with measurements taken from the fetal side of the placenta while carefully avoiding calcified and vascular areas. Multiple readings were obtained for each patient, and the average value was used for analysis to improve reliability.

Data were collected using a structured proforma that included maternal demographic details, obstetric history, GDM status, ultrasound findings, and elastography measurements. Relevant clinical and laboratory data were verified from hospital records to

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 4656-4662 | ISSN:2251-6727

ensure accuracy. Statistical analysis was performed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and compared using independent t-test, while categorical variables were analyzed using chi-square test. A p-value of less than 0.05 was considered statistically significant. Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all participants, and strict confidentiality of patient information was maintained throughout the study, with all procedures conducted in accordance with standard ethical and clinical guidelines.



Elastographic image and strain elastogram obtained by real-time sonoelastography. The green color on the right side of the bar scale shows that optimum compression and decompression has been achived. First region of interest (ROI) (Z1 circle) is set for subcutaneous fat (Elx1) and three consequtive ROIs (Z2, Z3, and Z4 circles) are set for placenta (Elx2, Elx3, and Elx4) in elastographic images.The strain ratio values (Elx2/Elx1, Elx3/Elx1, and Elx4/Elx1) for each are 0.83, 0.81, and 0.69, respectively (Elx 2/1, Elx 3/1, and Elx 4/1 in the figure: elasticity strain ratio values)

Figure 1: Elastographic image and strain elastogram obtained by real-time sonoelastography [10]

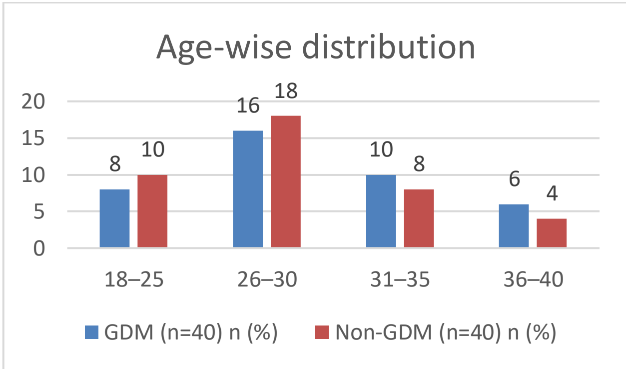
RESULTS

Age Distribution of Study Participants

The age distribution between GDM and non-GDM groups was comparable, with the majority of participants belonging to the 26–30 years age group in both cohorts. There was no statistically significant difference in age distribution between the groups ($p > 0.05$), indicating that age did not act as a confounding factor in this study (Table 1).

Table 1: Age-wise Distribution of Study Participants

Age Group (years)	**GDM (n=40) n (%)**	**Non-GDM (n=40) n (%)**	**χ^2 value**	**p-value**
18–25	8 (20.0)	10 (25.0)	0.96	0.81
26–30	16 (40.0)	18 (45.0)		
31–35	10 (25.0)	8 (20.0)		
36–40	6 (15.0)	4 (10.0)		
Total	**40 (100)**	**40 (100)**		



Graph 1: Age-wise Distribution of Study Participants

Comparison of Placental Elasticity between GDM and Non-GDM Groups

Placental elasticity values were significantly higher in the GDM group compared to the non-GDM group, suggesting increased placental stiffness in diabetic pregnancies. This difference was statistically significant ($p < 0.001$), indicating a strong association between GDM and altered placental biomechanical properties (Table 2).

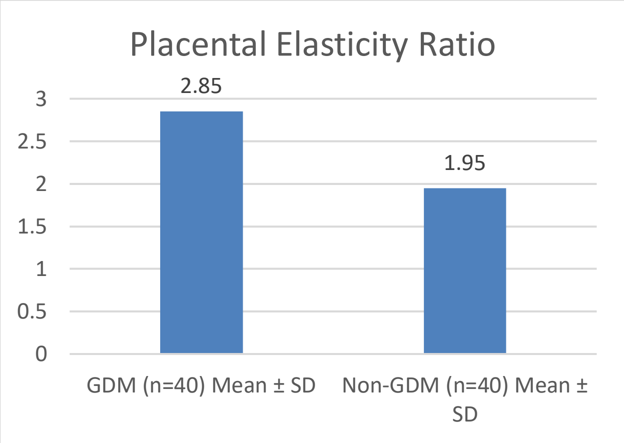
Table 2: Comparison of Placental Elasticity between Study Groups

Parameter	**GDM (n=40) Mean ± SD**	**Non-GDM (n=40) Mean ± SD**	**t-value**	**p-value**
Placental Elasticity Ratio	2.85 ± 0.45	1.95 ± 0.38	9.12	<0.001

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4656-4662 | ISSN:2251-6727



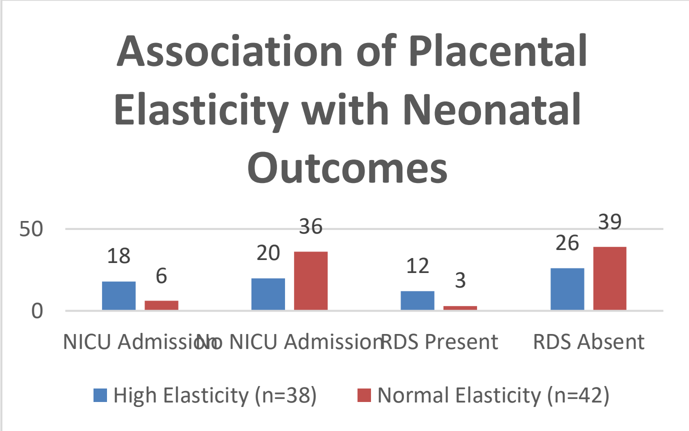
Graph 2: Comparison of Placental Elasticity between Study Groups

Association between Placental Elasticity and Neonatal Outcomes

Higher placental elasticity values were significantly associated with adverse neonatal outcomes such as NICU admission and respiratory distress syndrome (RDS). A greater proportion of neonates with higher placental stiffness required NICU care, demonstrating the predictive potential of elastography in fetal risk assessment (Table 3).

Table 3: Association of Placental Elasticity with Neonatal Outcomes

Outcome	High Elasticity (n=38)	Normal Elasticity (n=42)	χ^2 value	p-value
NICU Admission	18 (47.4%)	6 (14.3%)	10.84	0.001
No NICU Admission	20 (52.6%)	36 (85.7%)		
RDS Present	12 (31.6%)	3 (7.1%)	8.72	0.003
RDS Absent	26 (68.4%)	39 (92.9%)		



Graph 3: Association of Placental Elasticity with Neonatal Outcomes

Correlation between Placental Elasticity and Gestational Age

A weak negative correlation was observed between placental elasticity and gestational age, suggesting that as gestation advances, placental stiffness may slightly increase. However, this correlation was not statistically significant ($p > 0.05$), indicating limited clinical relevance (Table 4).

Table 4: Correlation between Placental Elasticity and Gestational Age

Parameter	Correlation Coefficient (r)	p-value
Gestational Age vs Elasticity	-0.18	0.11

DISCUSSION

The present study evaluated placental elasticity using strain elastography in late trimester singleton pregnancies and demonstrated significantly higher placental stiffness in gestational diabetes mellitus (GDM) cases compared to non-GDM controls. Additionally, increased placental elasticity was associated with adverse neonatal outcomes, while gestational age showed no significant correlation with elasticity values. These findings are largely consistent with existing literature, supporting the growing role of

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 4656-4662 | ISSN:2251-6727

elastography in assessing placental function and predicting perinatal risk.

In this study, the age distribution between GDM and non-GDM groups was comparable, with no statistically significant difference ($p = 0.81$), indicating that maternal age did not confound the observed outcomes. This aligns with previous elastography-based studies, which also reported no significant association between maternal age and placental stiffness measurements (Spiliopoulos et al., 2020) [10]. Similarly, other studies have emphasized that biomechanical placental properties are more strongly influenced by pathological conditions rather than demographic variables (Altunkeser et al., 2018) [11]. Thus, the comparability of age groups in the present study strengthens the internal validity of the findings.

A key observation in this study was the significantly higher placental elasticity ratio in the GDM group (2.85 ± 0.45) compared to the non-GDM group (1.95 ± 0.38), with strong statistical significance ($p < 0.001$). This finding is in agreement with multiple previous studies demonstrating increased placental stiffness in diabetic pregnancies. For instance, (Yuksel et al., 2016) reported significantly higher elasticity values in both central and peripheral placental regions in GDM patients compared to healthy controls [12]. Similarly, (Anuk et al., 2021) found elevated shear wave elastography (SWE) values in GDM pregnancies, particularly in those requiring pharmacological treatment, suggesting a relationship between glycemic control and placental stiffness [13]. Furthermore, increased stiffness in high-risk pregnancies including GDM has also been demonstrated by (Najee & Al-Tameemi, 2023) [14]. These consistent findings suggest that hyperglycemia-induced structural and vascular changes in the placenta contribute to altered biomechanical properties, which can be effectively quantified using elastography.

The present study also demonstrated a significant association between increased placental elasticity and adverse neonatal outcomes such as NICU admission and respiratory distress syndrome (RDS). This observation is supported by prior research showing that higher placental stiffness correlates with poorer perinatal outcomes. For example, (Anuk et al., 2021) reported a positive correlation between increased placental stiffness and NICU admission rates in GDM pregnancies [13]. Similarly, studies in other high-risk conditions such as preeclampsia have shown that increased placental stiffness is associated with reduced birth weight and earlier gestational age at delivery (Spiliopoulos et al., 2020). Advanced imaging studies using magnetic resonance elastography also support these findings, indicating that stiffer placentas are predictive of adverse neonatal outcomes, particularly in small-for-gestational-age infants (Deng et al., 2023) [15]. These findings collectively reinforce the potential of placental elastography as a non-invasive biomarker for fetal risk stratification.

Regarding the correlation between placental elasticity and gestational age, the present study found a weak negative correlation ($r = -0.18$) that was not statistically significant ($p = 0.11$). This finding is consistent with several previous studies that reported no significant relationship between gestational age and placental stiffness. (Altunkeser et al., 2018) [11] found that placental elasticity did not significantly vary with gestational week in normal pregnancies. Similarly, (Spiliopoulos et al., 2020) [10] and (Deng et al., 2023) also reported no significant correlation between placental stiffness and gestational age [15]. These findings suggest that placental stiffness is more reflective of pathological changes rather than physiological maturation during pregnancy.

The clinical implications of this study are significant. Placental elastography, particularly strain elastography, offers a non-invasive, real-time, and quantitative method to assess placental health. As highlighted in recent reviews, elastography can detect subtle biomechanical changes in placental tissue before they become apparent on conventional ultrasound (Alfuraih, 2024); (Hu et al., 2023) [6,16]. This makes it a promising adjunct tool in the early detection and monitoring of placental dysfunction, particularly in high-risk pregnancies such as GDM.

However, certain limitations must be acknowledged. Variability in elastography techniques (strain vs shear wave), measurement protocols, and region of interest selection may affect comparability across studies. Additionally, larger multicentric studies are required to establish standardized cutoff values and validate clinical applicability.

In conclusion, the findings of this study are consistent with existing literature, demonstrating increased placental stiffness in GDM pregnancies and its association with adverse neonatal outcomes. Placental elastography shows promise as a valuable non-invasive tool for assessing placental function and improving perinatal outcomes, though further research is needed to standardize its clinical use.

CONCLUSION

The present study demonstrates that placental elasticity assessed by strain elastography is significantly altered in pregnancies complicated by gestational diabetes mellitus. Increased placental stiffness observed in the GDM group reflects underlying structural and microvascular changes associated with hyperglycemia. These alterations may contribute to impaired placental function and adverse neonatal outcomes. The findings highlight the potential of strain elastography as a non-invasive, adjunctive imaging modality for early detection of placental dysfunction in late trimester pregnancies. Its ability to differentiate between GDM and non-GDM cases suggests its utility in antenatal risk stratification and clinical decision-making. Incorporating placental elastography into routine obstetric evaluation may improve monitoring and timely intervention. However, larger multicentric studies are required to establish standardized reference values and validate its widespread clinical application.

Disclaimer: Author's statement that the views expressed in the submitted article are his or her own and not an official position of the institution or funder.

Source of funding: Nil.

Conflict of interest:

The authors declare that there is no conflict of interest.

REFERENCES

1. ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, et al. Management of diabetes in pregnancy: Standards of care in diabetes—2023. *Diabetes Care*. 2023;46(Suppl 1):S254–S266.
2. Burton GJ, Fowden AL. The placenta: a multifaceted, transient organ. *Philos Trans R Soc Lond B Biol Sci*. 2015;370(1663):20140066.
3. Huynh J, Dawson D, Roberts D, Bentley-Lewis R. A systematic review of placental pathology in maternal diabetes mellitus. *Placenta*. 2015;36(2):101–114.
4. Figueras F, Caradeux J, Crispi F, Eixarch E, Peguero A, Gratacos E. Diagnosis and surveillance of late-onset fetal growth restriction. *Am J Obstet Gynecol*. 2018;218(2 Suppl):S790–S802.e1.
5. Sigrist RMS, Liau J, Kaffas AE, Chammas MC, Willmann JK. Ultrasound elastography: review of techniques and clinical applications. *Theranostics*. 2017;7(5):1303–1329.
6. Alfuraih AM. The emerging role of sonoelastography in pregnancy: applications in assessing maternal and fetal health. *Diagnostics (Basel)*. 2024;15(1):47.
7. Çelik AO, Günay B, Çoker GB, Ustabaşıoğlu FE, Ateş S, Tunçbilek N. Evaluation of placenta in patients with gestational diabetes using shear wave elastography and superb microvascular imaging. *Acta Radiol*. 2024;65(3):318–323.
8. Millischer AE, Salomon LJ, Porcher R, Brasseur-Daudruy M, Gourdier AL, Hornoy P, et al. Magnetic resonance imaging for abnormally invasive placenta: the added value of intravenous gadolinium injection. *BJOG*. 2017;124(1):88–95.
9. Seshiah V, Balaji V, Balaji MS, Sanjeevi CB, Green A. Gestational diabetes mellitus in India. *J Assoc Physicians India*. 2004;52:707–711.
10. Spiliopoulos M, Kuo CY, Eranki A, Jacobs M, Rossi CT, Iqbal S, et al. Characterizing placental stiffness using ultrasound shear-wave elastography in healthy and preeclamptic pregnancies. *Arch Gynecol Obstet*. 2020;302:1103–1112.
11. Altunkeser A, Alkan E, Gunenc O, Tolu I, Korez MK. Evaluation of a healthy pregnant

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4656-4662 | ISSN:2251-6727

placenta with shear wave elastography. *Iran J Radiol*. 2018;15:e68280.

12. Yuksel MA, Kılıç F, Kayadibi Y, Davutoğlu EA, Imamoglu M, Bakan S, et al. Shear wave elastography of the placenta in patients with gestational diabetes mellitus. *J Obstet Gynaecol*. 2016;36(5):585–588.

13. Anuk AT, Tanaçan A, Erol SA, Alkan M, Altınboğa O, Oğuz Y, et al. Evaluation of the relationship between placental stiffness measured by shear wave elastography and perinatal outcomes in women with gestational diabetes mellitus. *Acta Radiol*. 2021;63(12):1721–1728.

14. Najee FK, Al-Tameemi H. Evaluation of placental stiffness in normal versus high-risk pregnancy using shear wave elastography. *Int J Radiol Diagn Imaging*. 2023;6(4):355.

15. Deng J, Cao Y, Lu Y, Song JC, Zhang A, Zhao M, et al. Value of placental virtual magnetic resonance elastography and intravoxel incoherent motion-based diffusion and perfusion in predicting adverse outcomes of small-for-gestational-age infants. *Insights Imaging*. 2023;14:Article number not specified.

16. Hu J, Lv Z, Liu W. Review of shear wave elastography in placental function evaluations. *J Matern Fetal Neonatal Med*. 2023;36:Article number not specified.