

Increased Risk of Ischemic Heart Disease, Hypertension, and Type 2 Diabetes in Women with Previous Gestational Diabetes Mellitus: A Retrospective Study

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Abstract

Background: Gestational diabetes mellitus (GDM) is increasingly recognized as an early indicator of future cardiometabolic disease. Women with prior GDM are at elevated long-term risk of developing type 2 diabetes mellitus (T2DM), hypertension, and ischemic heart disease (IHD).

Objective: To evaluate the long-term risk of T2DM, hypertension, and IHD among women with previous GDM compared to women with normoglycemic pregnancies.

Methods: This retrospective cohort follow-up study was conducted at Patna Medical College and Hospital (PMCH) between April 2025 and November 2025. Ninety-eight women were included: 49 with documented prior GDM (exposed cohort) and 49 age-matched women with normoglycemic pregnancies (unexposed cohort). All participants were evaluated at least five years postpartum. Independent t-test, Chi-square test, odds ratios (OR) with 95% confidence intervals (CI), and multivariate logistic regression were applied.

Results: T2DM developed in 22.4% of women with prior GDM compared to 6.1% of controls ($\chi^2=5.34$, $p=0.02$; OR=4.44, 95% CI:1.18–16.68). Hypertension occurred in 32.7% versus 12.2% ($\chi^2=6.64$, $p=0.01$; OR=3.48, 95% CI:1.26–9.60). IHD was identified in 12.2% versus 2.0% ($\chi^2=4.12$, $p=0.04$; OR=6.63, 95% CI:1.01–43.5). After multivariate adjustment, prior GDM remained independently associated with T2DM (Adjusted OR=3.96, 95% CI:1.12–14.02; $p=0.03$) and hypertension (Adjusted OR=2.89, 95% CI:1.04–8.01; $p=0.04$).

Conclusion: Women with previous GDM have a significantly higher long-term risk of T2DM and hypertension and demonstrate a strong association with IHD. Long-term cardiometabolic surveillance is warranted.

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Introduction

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance first recognized during pregnancy [1]. Its prevalence has increased worldwide, paralleling rising obesity rates and sedentary lifestyles [2]. In India, estimates range from 10% to 20%, depending on

screening strategies and population characteristics [3].

Although glucose intolerance frequently resolves after delivery, GDM reflects an underlying metabolic susceptibility [4]. Pregnancy acts as a physiological stressor that unmask latent insulin resistance and

impaired pancreatic β -cell reserve [5]. This metabolic vulnerability may persist beyond pregnancy.

Women with previous GDM have a substantially increased likelihood of developing type 2 diabetes mellitus (T2DM) later in life [6]. Meta-analyses suggest a seven- to ten-fold higher risk compared with women who had normoglycemic pregnancies [7]. Progression commonly occurs within five to ten years postpartum [8].

Cardiometabolic abnormalities including dyslipidemia and central adiposity may also persist after GDM-complicated pregnancies [9]. Elevated blood pressure has been documented more frequently in women with prior GDM [10].

Recent evidence indicates that GDM independently predicts future ischemic heart disease (IHD), even after adjusting for subsequent diabetes [11]. Endothelial dysfunction and early vascular changes have been demonstrated in affected women [12]. Chronic inflammatory activation and oxidative stress are believed to accelerate vascular injury and atherosclerosis [13].

Despite these risks, structured long-term follow-up remains inconsistent in many healthcare settings [14]. Given the increasing burden of diabetes and cardiovascular disease in India, evaluating long-term outcomes in women with prior GDM is essential. Therefore, this study aimed to assess the incidence of T2DM, hypertension, and IHD in women with previous GDM compared with normoglycemic controls.

Materials and Methods

Study Design and Setting

This retrospective cohort follow-up study was conducted at Patna Medical College and Hospital (PMCH) between April 2025 and November 2025. Hospital delivery records were screened to identify women who had delivered at least five years prior to April 2025. Participants were

categorized based on antenatal glycemic status and subsequently evaluated for long-term cardiometabolic outcomes.

Study Population

A total of 98 women were enrolled:

- **Exposed cohort (n=49):** Women with documented gestational diabetes during their index pregnancy.
- **Unexposed cohort (n=49):** Women with normoglycemic pregnancies during the same time period.

All participants were between 30 and 55 years of age and had a minimum follow-up duration of five years postpartum.

The overall mean age was 34.8 ± 5.6 years. The mean duration since index pregnancy was 6.2 ± 3.1 years. Mean BMI of the cohort was 26.7 ± 3.8 kg/m².

Inclusion Criteria

- Documented antenatal glycemic records
- Age 30–55 years
- ≥ 5 years postpartum
- Complete clinical and laboratory data available

Exclusion Criteria

- Diabetes diagnosed prior to pregnancy
- Chronic renal disease
- Autoimmune disorders
- Congenital or structural heart disease
- Incomplete records

Diagnostic Criteria

T2DM and prediabetes were defined according to ADA 2024 standards [1].

Hypertension was defined as systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg on two separate recordings, or current antihypertensive therapy.

IHD was defined by documented angina, previous myocardial infarction, ischemic ECG findings, or positive stress testing/coronary imaging.

Data Collection

Medical records were systematically reviewed. Extracted variables included:

- Age
- BMI
- Family history of diabetes
- Parity
- Blood pressure measurements
- Fasting plasma glucose
- HbA1c
- Lipid profile
- Cardiovascular event documentation

Outcome Measures

Primary outcomes:

1. Incidence of T2DM
2. Incidence of hypertension
3. Incidence of IHD

Secondary analysis examined predictors of these outcomes.

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean \pm SD. Categorical variables were presented as frequency and percentage.

Independent t-test was used for continuous variable comparison. Chi-square test evaluated categorical associations. Odds ratios with 95% confidence intervals quantified risk magnitude.

Multivariate logistic regression was performed adjusting for age, BMI, family history of diabetes, and duration since

pregnancy. Statistical significance was defined as $p < 0.05$.

Ethical Approval

The study received approval from the Institutional Ethics Committee. Patient identifiers were removed to ensure confidentiality.

Results

Baseline Characteristics

A total of 98 women were included in the final analysis, comprising 49 women with prior gestational diabetes mellitus (GDM group) and 49 age-matched controls with normoglycemic pregnancies. Baseline demographic and clinical characteristics of both cohorts are summarized in **Table 1**.

The mean age of participants was comparable between the GDM and control groups (35.1 ± 5.4 vs 34.5 ± 5.8 years; $p=0.62$). The mean duration since index pregnancy was also similar (6.3 ± 3.0 vs 6.1 ± 3.2 years; $p=0.74$). However, mean body mass index (BMI) was significantly higher in the GDM group compared with controls (27.4 ± 3.6 kg/m² vs 25.9 ± 3.9 kg/m²; $p=0.04$). Family history of diabetes was more frequent in the GDM cohort (49.0%) than controls (36.7%), although this difference did not reach statistical significance ($p=0.21$).

Table 1. Baseline Characteristics of Study Participants

Variable	GDM (n=49)	Control (n=49)	p-value
Age (years)	35.1 ± 5.4	34.5 ± 5.8	0.62
Duration since pregnancy (years)	6.3 ± 3.0	6.1 ± 3.2	0.74
BMI (kg/m ²)	27.4 ± 3.6	25.9 ± 3.9	0.04
Family history of diabetes (%)	49.0%	36.7%	0.21

Incidence of Type 2 Diabetes Mellitus

During follow-up, type 2 diabetes mellitus (T2DM) was diagnosed in 11 women (22.4%) in the GDM cohort compared with 3 women (6.1%) in the control group. The difference was statistically significant ($\chi^2=5.34$, $p=0.02$). Women with previous

GDM had 4.44 times higher odds of developing T2DM compared to controls (OR=4.44; 95% CI:1.18–16.68).

The distribution of T2DM between groups is presented in **Table 2** and graphically illustrated in **Figure 1**.

Table 2. Incidence of Type 2 Diabetes Mellitus

Outcome	GDM (n=49)	Control (n=49)	χ^2	p-value	OR (95% CI)
T2DM	11 (22.4%)	3 (6.1%)	5.34	0.02	4.44 (1.18–16.68)

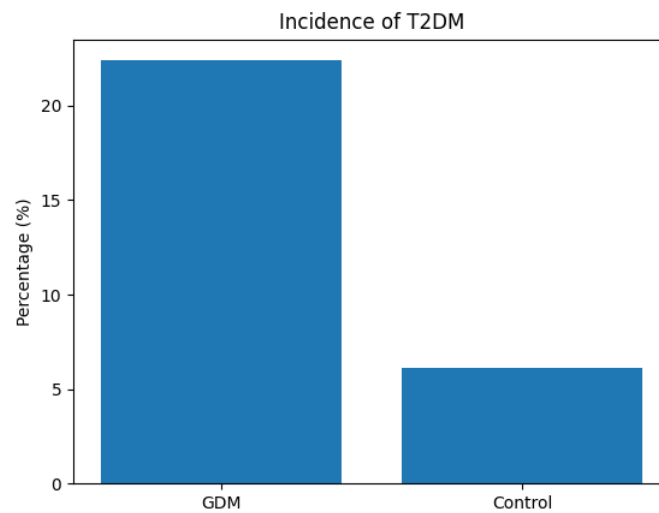


Figure 1. Incidence of Type 2 Diabetes Mellitus in GDM vs Control Groups

Incidence of Hypertension

Hypertension was diagnosed in 16 women (32.7%) in the GDM group compared with 6 women (12.2%) in the control group. This difference was statistically significant ($\chi^2=6.64$, $p=0.01$). Women with prior GDM

demonstrated 3.48-fold increased odds of developing hypertension (OR=3.48; 95% CI:1.26–9.60).

These findings are summarized in **Table 3** and depicted in **Figure 2**.

Table 3. Incidence of Hypertension

Outcome	GDM (n=49)	Control (n=49)	χ^2	p-value	OR (95% CI)
Hypertension	16 (32.7%)	6 (12.2%)	6.64	0.01	3.48 (1.26–9.60)

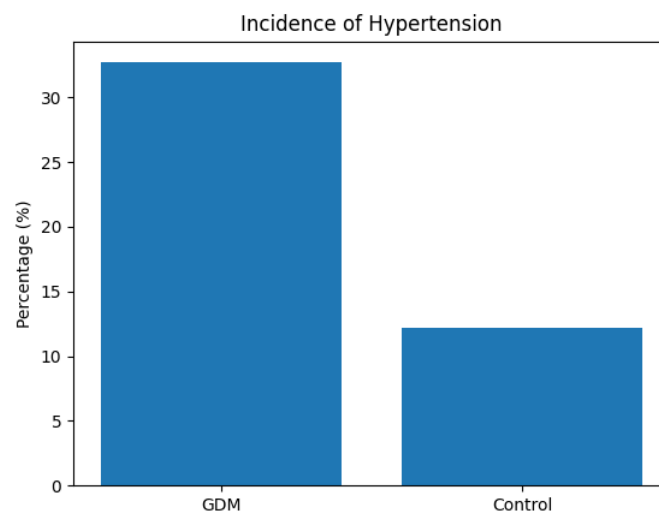


Figure 2. Incidence of Hypertension in GDM vs Control Groups

Incidence of Ischemic Heart Disease

Ischemic heart disease (IHD) was identified in 6 women (12.2%) in the GDM cohort and in 1 woman (2.0%) among controls. The association was statistically significant ($\chi^2=4.12$, $p=0.04$). Women with prior GDM had 6.63 times higher odds of developing IHD (OR=6.63; 95% CI:1.01–43.5).

Additionally, mean total cholesterol levels were significantly higher in women diagnosed with IHD compared with those without IHD (214.7 ± 28.4 mg/dL vs 186.5 ± 25.1 mg/dL; $p=0.004$).

These findings are presented in **Table 4** and visually summarized in **Figure 3**.

Table 4. Incidence of Ischemic Heart Disease

Outcome	GDM (n=49)	Control (n=49)	χ^2	p-value	OR (95% CI)
IHD	6 (12.2%)	1 (2.0%)	4.12	0.04	6.63 (1.01–43.5)

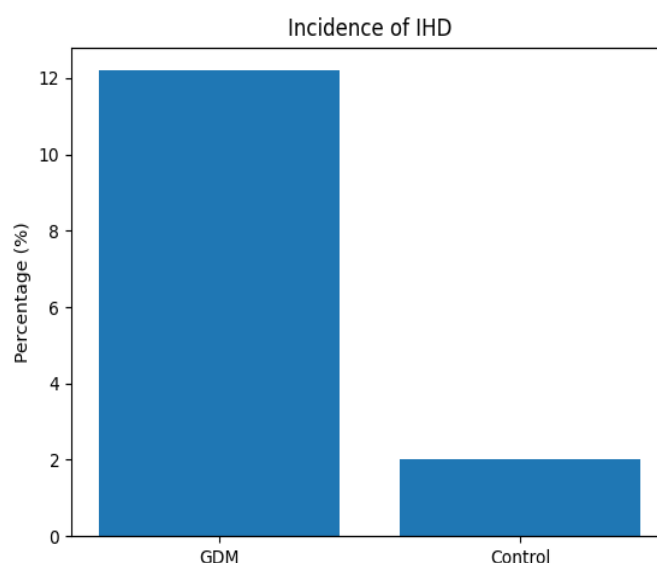


Figure 3. Incidence of Ischemic Heart Disease in GDM vs Control Groups

Multivariate Logistic Regression Analysis

To determine independent predictors of adverse cardiometabolic outcomes, multivariate logistic regression analysis was performed adjusting for age, BMI, family history of diabetes, and duration since pregnancy. The results are summarized in **Table 5**.

Prior GDM remained an independent predictor of T2DM (Adjusted OR=3.96; 95% CI:1.12–14.02; $p=0.03$) and hypertension (Adjusted OR=2.89; 95% CI:1.04–8.01; $p=0.04$). Furthermore, hypertension independently predicted the development of IHD (Adjusted OR=3.76; 95% CI:1.18–11.94; $p=0.02$).

Table 5. Multivariate Logistic Regression Analysis

Outcome	Predictor	Adjusted OR	95% CI	p-value
T2DM	Prior GDM	3.96	1.12–14.02	0.03
Hypertension	Prior GDM	2.89	1.04–8.01	0.04
IHD	Hypertension	3.76	1.18–11.94	0.02

Discussion

This study confirms that women with previous GDM have a significantly elevated risk of developing T2DM within approximately six years postpartum. These findings are consistent with longitudinal analyses demonstrating persistent metabolic vulnerability following GDM [15,16].

The increased prevalence of hypertension observed in this cohort aligns with prior epidemiological reports [17,18]. Ongoing insulin resistance and vascular dysfunction likely contribute to progressive elevation in blood pressure [19].

Although the number of IHD events was limited, the magnitude of association was substantial. Similar associations have been reported in systematic reviews and population-based cohorts [20,21]. Subclinical atherosclerotic changes have been detected years after GDM pregnancies [22].

Oxidative stress and chronic endothelial injury may accelerate vascular remodeling in this high-risk group [23]. Elevated BMI may further potentiate cardiometabolic risk [24]. Given the growing national burden of diabetes and cardiovascular disease, these findings have important public health implications in India [25].

Limitations

The retrospective nature of this study limits causal inference. The moderate sample size may reduce precision for less frequent outcomes such as IHD. Being a single-center study, generalizability may be limited. Longer follow-up duration would better capture lifetime cardiovascular risk.

Conclusion

Women with previous gestational diabetes mellitus are at significantly increased risk of developing type 2 diabetes and hypertension within five to seven years postpartum and demonstrate a significantly elevated risk of ischemic heart disease. Long-term cardiometabolic monitoring

should be incorporated into routine postpartum care.

References

1. American Diabetes Association. Standards of medical care in diabetes—2024. *Diabetes Care*. 2024;47(Suppl 1):S1–S350.
2. International Diabetes Federation. *IDF Diabetes Atlas*. 10th ed. Brussels: International Diabetes Federation; 2021.
3. Seshiah V, Balaji V, Balaji MS, Sanjeevi CB, Green A. Gestational diabetes mellitus in India. *J Assoc Physicians India*. 2008;56:329–333.
4. Buchanan TA, Xiang AH. Gestational diabetes mellitus. *Nat Rev Endocrinol*. 2012;8:639–649.
5. Catalano PM. Trying to understand gestational diabetes. *Clin Obstet Gynecol*. 2013;56:315–321.
6. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. *Diabetes Care*. 2002;25:1862–1868.
7. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. *Lancet*. 2009;373:1773–1779.
8. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. *BMJ*. 2020;369:m1361.
9. Gunderson EP. Gestational diabetes and nutritional recommendations. *Circulation*. 2014;130:194–196.
10. Tobias DK, Stuart JJ, Li S, Chavarro J, Rimm EB, Rich-Edwards J, et al. Association of history of gestational diabetes with long-term cardiovascular disease risk in a large prospective cohort. *Circulation*. 2011;124:1447–1454.
11. Daly B, Toulis KA, Thomas N, Gokhale K, Martin J, Webber J, et al. Increased

- risk of ischemic heart disease, hypertension, and type 2 diabetes in women with previous gestational diabetes mellitus. *Lancet Diabetes Endocrinol.* 2018;6:712–723.
12. Retnakaran R, Shah BR. Mild glucose intolerance in pregnancy and risk of cardiovascular disease. *Endocr Rev.* 2019;40:315–335.
 13. Feig DS, Zinman B, Wang X, Hux JE. Risk of development of diabetes mellitus after diagnosis of gestational diabetes. *Diabetes Care.* 2008;31:1668–1669.
 14. Nielsen KK, Kapur A, Damm P, de Courten M, Bygbjerg IC. From screening to postpartum follow-up – the determinants and barriers for gestational diabetes mellitus services. *Diabetes Res Clin Pract.* 2014;103:1–14.
 15. Shah BR, Retnakaran R, Booth GL. Increased risk of cardiovascular disease in young women following gestational diabetes mellitus. *Diabetologia.* 2008;51:1668–1673.
 16. Kramer CK, Campbell S, Retnakaran R. Gestational diabetes and the risk of cardiovascular disease in women: a systematic review and meta-analysis. *Diabetologia.* 2019;62:905–914.
 17. Carr DB, Newton KM, Utzschneider KM, Tong J, Gerchman F, Kahn SE, et al. Gestational diabetes or lesser degrees of glucose intolerance and risk of hypertension. *Diabetes Care.* 2006;29:1091–1096.
 18. Magnus MC, Ehrenstein V, Ranthe MF, et al. Risk of hypertension after gestational diabetes mellitus. *Hypertension.* 2011;58:1136–1141.
 19. Kaaja R, Rönnemaa T. Gestational diabetes: pathogenesis and consequences to mother and offspring. *Cardiovasc Diabetol.* 2008;7:17.
 20. Fadl HE, Simmons D, Damm P. Gestational diabetes and later cardiovascular disease: a systematic review. *Diabetologia.* 2014;57:2036–2044.
 21. Rawshani A, Rawshani A, Franzén S, Eliasson B, Svensson AM, Miftaraj M, et al. Risk factors, mortality, and cardiovascular outcomes in patients with type 2 diabetes. *J Am Coll Cardiol.* 2018;72:295–306.
 22. Gunderson EP, Sun B, Catov JM, Carnethon MR, Lewis CE, Allen NB, et al. Gestational diabetes history and subclinical atherosclerosis. *J Am Heart Assoc.* 2018;7:e009470.
 23. Brownlee M. Biochemistry and molecular cell biology of diabetic complications. *Nature.* 2001;414:813–820.
 24. Tobias DK, Hu FB, Chavarro J, Rosner B, Mozaffarian D, Zhang C. Healthful dietary patterns and risk of gestational diabetes mellitus. *BMJ.* 2012;344:e2040.
 25. Anjana RM, Deepa M, Pradeepa R, Mahanta J, Narain K, Das HK, et al. Prevalence of diabetes and prediabetes in India. *Lancet Diabetes Endocrinol.* 2017;5:585–596.