

Original Research Article

Gestational diabetes mellitus: a case-control study at a tertiary care centre in India

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is defined as glucose intolerance first recognized during pregnancy. It is one of the most common metabolic disorders complicating pregnancy. There is an increased burden of GDM and its significant consequences for maternal and child health. This study aimed to identify the risk factors associated with GDM among pregnant women at a tertiary care centre and determine their strength of association.

Methods: A hospital-based case-control study was conducted from March 2024 to October 2025. Cases included 92 antenatal women with plasma glucose levels above 140 mg/dl and controls were those with glucose levels below 140 mg/dl matched for age. Data was collected using predesigned, pre-structured questionnaires covering sociodemographic details, reproductive and obstetric history, any chronic diseases. Then univariate and multivariate logistic regression analyses were performed.

Results: The Mean age among cases was 25.06 ± 3.87 years and in controls was 24.8 ± 3.81 years. Significant determinants in univariate analysis were education status, occupation of husband, age at marriage, gravidity, parity, past history of GDM, Pre-pregnancy BMI and history of abortion. In multivariate analysis, education of participant (OR: 1.509, 95% CI: 1.041-2.188), Duration of marriage (OR: 2.539, 95% CI: 1.016-6.346), Pre-pregnancy BMI (OR: 3.180, 95% CI: 1.547-6.537), History of abortion (OR: 2.873, 95% CI: 1.401-5.894) Parity (OR: 3.320, 95% CI: 1.339-8.233) remained significant determinants.

Conclusions: GDM is associated with adverse maternal as well as foetal complications. Early screening and targeted counselling for women with these risk factors can help in timely detection and management of GDM, thereby improving maternal and fetal outcomes.

Keywords: Case-control study, Determinants, Gestational diabetes mellitus, Risk factors

INTRODUCTION

GDM is a type of diabetes with its first recognition during pregnancy. It refers to carbohydrate intolerance which causes variable-severity hyperglycaemia. GDM is a high-risk maternal and neonatal condition which increases the risk of Type 2 diabetes in mothers and their infants.¹ National family health survey (NFHS) surveyed in 2015–2016 (4th round) and 2019–2021 (5th round) covering a total of approximately 6 lakhs and 7 lakhs women, respectively. Among them, 32,072 women in 2015–2016 and 28,187 in 2019–2021 were pregnant, of whom 180

women in 2014–2015 and 247 women in 2019–2021 had diabetes during their gestational periods, allowing the percentage prevalence calculation of GDM.² According to the International diabetes federation (IDF) Diabetes Atlas 2025, approximately 1 out of 6 live births are affected specifically by GDM. Prevalence of gestational diabetes mellitus is 26.1% in India. The 2025 ADA standards of care have been "completely updated" to provide more actionable guidance on various screening approaches, reflecting a shift toward addressing social determinants of health and disparities in care access. Globally, about 16.7% of births in women aged 20–49 is affected by hyperglycaemia during pregnancy, with GDM

contributing to the majority of these cases.³ Approximately, 22.4% of pregnant women in India have GDM, according to the ICMR-INDIAB National study 2025. the study reports a high rate of 'Early GDM' (diagnosed before 20 weeks) at 19.2% while 'Late GDM' (diagnosed after 20 weeks) stands at 23.4%.⁴

There is a strong initiative in the National Health Mission to improve screening and treatment for GDM across India. Along with improving screening and treatment for this condition, focusing on the wider need of more available phlebotomy and lab services, access to medications, training for doctors and healthcare infrastructure as a whole remains important. Hence, the present case control study was carried out to study the factors effecting the disease pattern in pregnant women.

METHODS

Study design and settings

A hospital-based case control study was conducted to study the risk factors of gestational diabetes mellitus among pregnant women attending tertiary care centre and to study their strength of association from March 2024 to October 2025. The study was approved by the institutional ethics committee.

Study population

Cases

Pregnant women having plasma glucose levels above 140 mg/dl attending tertiary care centre.

Controls

Women with glucose levels less than 140 mg/dl were selected as control matched with age (± 2 years).

Sample size

The sample size for the study was calculated using the sample size formula of the Case-control studies using Open Epi, Version 3, open-source calculator--SSCC. The calculations were based on the assumption that anticipated probability of exposure (Infertility) 1 in the control group is around 5.3 % with odds ratio of 4.1; 1:1 ratio of cases to control, power of 80% and confidence level of 95%, the calculated sample size is 184 i.e., 92 cases and 92 controls.

Cases

Inclusion criteria

Pregnant women with plasma glucose levels >140 mg/dl attending tertiary care centre.

Exclusion criteria

Participants not giving consent for the study.

Controls

Inclusion criteria

Pregnant women with plasma glucose levels <140 mg/dl attending tertiary care centre. Controls are matched with age ± 2 years with cases.

Exclusion criteria

Participants not giving consent for the study.

Data collection

A predesigned, prestructured questionnaire was used to collect information on sociodemographic characteristics (age, residence, religion, education, occupation, family type, socioeconomic status), reproductive history (marriage duration, age at marriage, age at menarche, menstrual cycles), obstetric history (gravidity, parity, antenatal visits, mode of delivery), family history of chronic diseases, history of infertility treatment, complications in previous pregnancy like GDM or gestational hypertension, if previous pregnancy was associated with any infections.

Operational definitions

GDM

It is defined as carbohydrate intolerance of variable severity with onset or first recognition during the present pregnancy.

Socioeconomic status

Based on modified BG Prasad classification 2024.

Statistical analysis

Data were analysed using SPSS software. Univariate analysis was performed using chi-square tests and Fisher's exact test. Variables with $p < 0.05$ in univariate analysis were included in multivariate logistic regression to identify independent determinants. Results were presented as odds ratios with 95% confidence intervals.

RESULTS

Sociodemographic characteristics

The study included 184 participants (92 cases and 92 controls). The mean age among cases was 25.06 ± 3.87 years and 24.81 ± 3.81 years among controls. Most participants were from urban areas (77.7%), Muslim

(62.0 %) and belonged to class II socioeconomic status (34.2%).

Significant determinants in univariate analysis.

Educational factors

Compared to illiterate women, those with high school education had 4.11 times higher odds (OR: 4.11, 95% CI: 1.80–21.08, $p=0.05$) and women with intermediate/diploma education had 7 times higher odds (OR: 7.00, 95% CI: 1.22–40.31, $p=0.02$) of having knowledge regarding the disease and its complications.

Reproductive factors

Women married at age ≥ 18 years had 9.87 times higher odds of developing GDM (OR: 9.87, 95% CI: 1.20 – 45.3, $p=0.02$). women married for duration more than five years had higher odds of developing the disease (OR: 2.01, 95% CI: 1.07 – 3.78; $p=0.02$). Multigravida women (≥ 2 pregnancies) were 2.77 times higher odds (OR: 2.77, 95% CI: 1.45–5.28, $p<0.001$). Similarly, multiparous women had also 2.77 times higher odds (OR: 2.77, 95% CI: 1.45– 5.28; $p<0.001$) of developing the disease (Table 2).

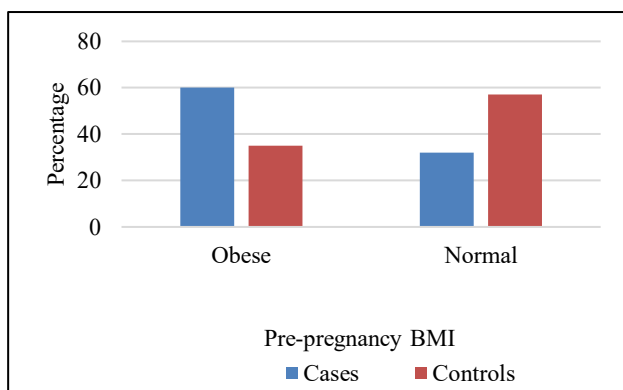


Figure 1: Distribution of study participants according to their pre-pregnancy BMI.

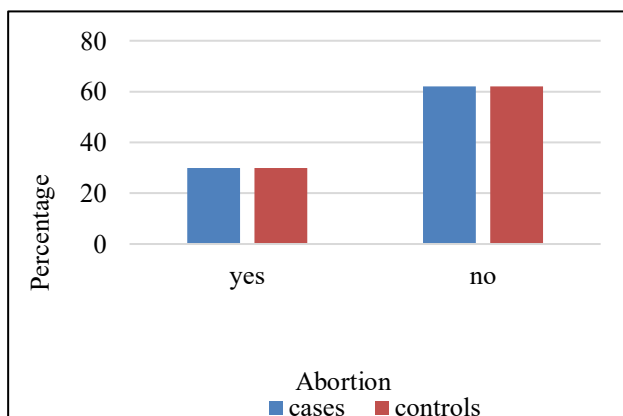


Figure 2: Distribution of study participants according to history of abortion.

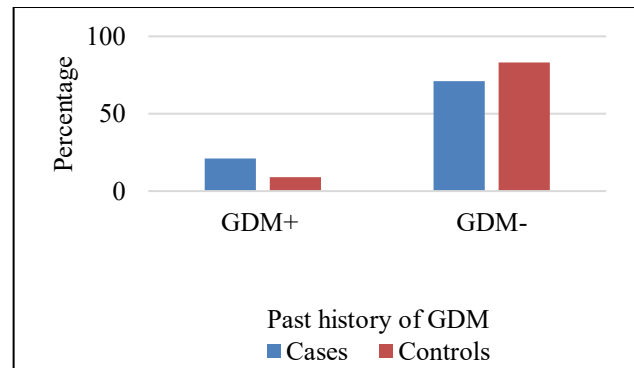


Figure 3: Distribution of study participants according to past history of GDM.

Other risk factors associated with GDM.

Past history of GDM

Participants with history of GDM in the previous pregnancies had 2.57 times higher odds of developing GDM in the further conceptions. (OR=2.57;95% CI:1.14–5.80; p value=0.02) (Table 3).

Pre-pregnancy BMI

Study showed that obese women were having 3.054 times higher odds of developing GDM (OR=3.054;95% CI:1.67–5.57; p value=0.0001) which showed statistically higher significant association (Table 3).

Multivariate analysis

Five factors remained significant predictors in the final multivariate model.

Education of participant

Illiterate females were having 1.51 times higher chances of developing the disease (OR=1.509 ;95% CI: 1.041–2.188; p value=0.03).

Pre-pregnancy BMI

Women with higher BMI values had 3.180 times higher risk of developing GDM (OR=3.180; 95% CI: 1.547–6.537; p value=0.002).

Parity

Multiparous women were having 3.32 times higher risk of developing the disease (OR=3.320; 95% CI: 1.339–8.233; p value=0.01).

History of abortion

Women who had history of abortion were at 2.873 times more risk of GDM (OR=2.873; 95% CI: 1.401–5.894; p value=0.004).

Duration of marriage

risk (OR=2.539; 95% CI: 1.016-6.346; p value=0.04) (Table 4).

It was observed that women married for more than five years duration had significantly higher chance of GDM

Table 1: Distribution of study participants according to sociodemographic details.

Variables	Categories	Cases N (%)	Controls N (%)	Total N (%)	P value	Odds ratio (95% CI)
Age (in years)	18-23	37 (40.2)	37 (40.2)	74 (40.2)	1	1
	24-29	42 (45.7)	41 (44.6)	83 (45.1)	0.94	1.02 (0.56,1.92)
	30-35	13 (14.1)	14 (15.2)	27 (14.7)	0.87	0.93 (0.39,2.24)
Residence	Urban	68 (73.9)	75 (81.5)	143 (77.7)	1	1
	Rural	24 (26.1)	17 (18.5)	41 (22.3)	0.24	1.56 (0.77,3.25)
Education of participant	Illiterate	2 (2.8)	8 (8.2)	10 (5.4)	1	1
	Middle school	25 (27.1)	29 (32.5)	54 (29.3)	0.14	3.45 (0.66,18.1)
	High school	36 (39.1)	35 (38.1)	71 (38.7)	0.05*	4.11 (1.80,21.0)
	Intermediate/diploma	21 (22.8)	12 (13.0)	33 (17.9)	0.02*	7.00 (1.22,40.3)
	Graduate/professional	8 (8.2)	8 (8.2)	16 (8.7)	0.13	4.00 (0.60,26.6)
Occupation of husband	Unskilled	11 (11.9)	18 (19.6)	29 (15.8)	1	1
	semiskilled	6 (6.5)	4 (4.3)	10 (5.4)	0.23	2.45 (0.57,10.68)
	skilled	35 (38.1)	24 (26.1)	59 (32.1)	0.04*	2.39 (1.96,5.94)
	Clerical /shop/farm	33 (35.9)	39 (42.4)	72 (39.1)	0.47	1.38 (0.57,3.35)
	Semi-professional/professional	7 (7.6)	7 (7.6)	14 (7.6)	0.45	1.64 (0.45,5.93)
Total		92 (100.0)	92 (100.0)	184 (100.0)	-	-

(*denotes statistically significant p value <0.05).

Table 2: Distribution of study participants according to obstetric characteristics.

Variables	Categories	Cases N (%)	Controls N (%)	Total N (%)	P value	Odds ratio (95%CI)
Age at marriage (years)	>18	83 (90.2)	91 (98.9)	174 (95.0)	0.02*	9.87 (1.20,80.3)
	<18	9 (9.8)	1 (1.1)	10 (5.0)	-	-
No of living children	Not yet delivered	22 (23.9)	34 (36.9)	56 (30.7)	-	-
	≥ 2	27 (29.4)	19 (20.6)	46 (25.0)	0.24	1.29 (0.62,2.67)
	1	43 (46.7)	39 (42.5)	82 (44.6)	-	-
Gravidity	≥2	72 (78.3)	52 (56.5)	124 (67.4)	<0.001*	2.77 (1.45,5.28)
	1	20 (21.7)	40 (43.5)	60 (32.6)	-	-
Parity	≥2	72 (78.3)	52 (56.5)	124 (67.4)	<0.001*	2.77 (1.45,5.28)
	1	20 (21.7)	40 (43.5)	60 (32.6)	-	-
Antenatal visits in pregnancy	< 4 visits	36 (39.2)	41 (44.6)	77 (41.8)	0.45	0.80 (0.44,1.44)
	≥ 4 visits	56 (60.8)	51 (55.4)	107 (58.2)	-	-
Total		92 (100.0)	92 (100.0)	184 (100.0)	-	-

(*denotes statistically significant p value <0.05).

Table 3: Distribution of study participants based on other risk factors of GDM.

Variables	Categories	Cases N (%)	Controls N (%)	Total N (%)	P value	Odds ratio (95% CI)
Past history	Yes	22 (22.8)	10 (9.8)	32 (16.3)	0.02*	2.57 (1.14,5.80)

Continued.

Variables	Categories	Cases N (%)	Controls N (%)	Total N (%)	P value	Odds ratio (95% CI)
of GDM	No	70 (77.2)	82 (90.2)	152 (83.7)		
Pre-pregnancy BMI	Obese	60 (65.3)	35 (38.0)	95 (51.6)	0.0001*	3.05 (1.67,5.57)
	Normal BMI	32 (34.7)	57 (62.0)	89 (48.4)	-	-
History of abortion	Yes	61 (66.3)	31 (33.7)	92 (50.0)	< 0.001*	3.69 (2.01,6.78)
	No	32 (33.7)	60 (66.3)	92 (50.0)	-	-
Duration of marriage	>5 years	37 (40.2)	23 (25.0)	60 (32.6)	0.02*	2.01 (1.07,3.78)
	<5 years	55 (59.8)	69 (75.0)	124 (67.4)	-	-
Total		92 (100.0)	92 (100.0)	184 (100.0)	-	-

(*denotes statistically significant p value <0.05).

Table 4: Binary Logistic regression analysis for determinants of GDM.

Variables	Odds ratio	95% CI		P value
		Lower	Upper	
Education of participant	1.509	1.041	2.188	0.03
Duration of marriage	2.539	1.016	6.346	0.04
Pre-pregnancy BMI	3.18	1.547	6.537	0.002
Parity	3.32	1.339	8.233	0.01
History of abortion	2.873	1.401	5.894	0.004

DISCUSSION

GDM is a pregnancy-related metabolic disorder characterized by elevated blood glucose levels first detected during pregnancy. It poses considerable risks to both maternal and fetal health and has become increasingly prevalent worldwide. Early diagnosis and appropriate management are crucial to reducing adverse pregnancy complications and improving long-term health for both mother and child. The present case-control study was undertaken to study the determinants and the risk factors associated with Gestational diabetes in antenatal women attending tertiary care centre.

Age

In the present study, 40.2% of cases and controls were aged 18-23 years and 45.7% of cases and 44.6% of controls were in 24-29 years age group. The mean age was 25.06±3.87 among cases and 24.8±3.81 years among controls. There was no significant difference in the age.

These results were consistent with Rathi et al, with mean age of GDM subjects (29.30±4.37) years and controls (29.09±4.01) years.⁵ Mamta et al, observed mean age among cases (26.63±4.5) and S Mishra et al.^{6,9}

Residence

In the present study, 73.9% of cases and 81.5% of controls resided in the urban areas. The difference was not statistically significant. Arora et al and Rathi et al showed more urban population.⁵

Religion

Religious distribution had no significant difference. majority of our cases were Muslims (67%) than Hindus. While, Mishra et al, showed GDM was higher among Christians compared to Hindus (Crude OR 4.7, p=0.002).⁹ It may reflect cultural and geographic differences.

Education of participant

Education was a significant determinant in our study. High school (OR=4.11) and Intermediate/diploma (OR=7.0) compared with illiterate. Innes et al and Swaminathan et al, showed similar pattern.^{7,8}

Occupation of participant

Most of women were unemployed. Vishwanathan et al, 10 showed majority women being skilled workers. But there is no statistical association among the groups.

Education of husband

In this study, spouse of 33 (35.9%) of both groups had up to high school and Intermediate/diploma level education and 8 (8.7%) were graduates. but this had no significant difference.

Occupation of husband

In this study, among the husbands of cases, 38.1% were skilled workers and 26.1 % among those of the controls. occupation status of the spouse did not show any association, aligned with John et al.¹⁰

Type of family

There is no significant difference in the type of family. Seshiah et al had most of study subjects from joint families (57%).¹² Lee et al study had women belonged to nuclear family.

Socioeconomic status

No significant difference seen in the study. Swaminathan et al study showed that risk was more in higher socioeconomic class.⁵ While Unnikrishnan et al showed that risk was higher in the lower socioeconomic group.⁵

Duration of marriage

In this study, most of cases were women who had married for more than five years duration. Ahmed et al study showed similar results with cases (54%) compared to the non-GDM group.⁷

Age at marriage

The mean age at marriage among cases was 18.4±2.3. the odds of developing GDM were significantly higher (OR=9.87) among the women married above 18 years of age than married younger than 18 years ($p=0.02$; 95% CI: 1.20-80.3). Similar findings shown by Shamsad et al and Avinash et al.^{9,13}

Number of living children

This study shows more chances of GDM in women having more than two children compared to those who had one child. These findings align with Vijayalakshmi et al, but did not show any statistical difference.⁸

Mode of delivery

Most of the participants had spontaneous vaginal delivery constituting 64.1% of the cases and 57.6% of controls. similar findings seen in study by Suseela et al and Yadav et al.^{11,14}

Past history of GDM

Being a significant factor (OR=2.57) in this study, aligned with P Rathi et al, reported higher odds of developing GDM in women with history of GDM in previous pregnancy (OR=1.95). consistent with Mishra et al.^{5,9}

Regularity in menstrual cycles

A patient's menstrual history relates to underlying Insulin resistance and predicts the risk of developing GDM. Chakraborty and Yadav et al and Ganapathy et al also reported the significance of irregular menstrual cycles as the risk factor for GDM.^{14,15}

Pre-pregnancy BMI

A higher pre-pregnancy BMI is one of the most significant factors for developing GDM. S Mishra et al, Ashraf et al, Suseela et al and Rathi et al, Chaudhary R et al studies showed significant association.^{5,9,11,16}

Gravidity

In this study, higher proportion of women were multigravida (OR=2.76) has statistically significant association with developing GDM. Similar findings seen with S Mishra et al, Neeraja et al, Taneja et al and Hussain et al.^{9,11,14,16}

Parity

It also showed statistical significance (OR= 2.77) aligned with Hussain et al, Kumar et al, and S Mishra et al, with multiparous women had greater risk of developing GDM.^{9,11,14}

History of abortion

History of abortions or miscarriages is a significant risk factor in this study (OR=3.69). Similar findings seen in Unnikrishnan et al and Mishra et al studies.^{5,9}

Antenatal visits during pregnancy

In the current study, 60.8% of cases and 55.4% of controls had more than four ANC visits. Goldberg et al, and Mohan V et al and Gupta V et al, studies showed that women who had more than four ANC visits had lesser chance of GDM.^{10,20}

Limitations

As this is a hospital-based case-control study on determinants of gestational diabetes mellitus (GDM) it may be subject to selection bias, as cases and controls are recruited from a single healthcare facility and may not represent the general population. Recall bias can occur because participants may inaccurately report past exposures or risk factors. The temporal relationship between exposure and outcome is difficult to establish, limiting causal inference. Additionally, findings may have limited generalizability to pregnant women in other settings or communities

CONCLUSION

Education status of participant, duration of marriage, pre-pregnancy BMI, history of abortion and parity are independently associated with increased odds of developing GDM. Early screening and targeted counselling for women with these risk factors, especially those with low education, high BMI or prior obstetric complications, can help in timely detection and

management of GDM, thereby improving maternal and foetal outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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