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Original Research Article

Demographic and clinical predictors of gestational diabetes mellitus in early pregnancy: a prospective observational study

Pooja Agarwal[1]*, Nisha Thakur[2], Sunita Agrawal[2]

[1]Department of Obstetrics and Gynecology, Maharaja Agrasen Hospital, Jaipur, Rajasthan, India
[2]Department of Obstetrics and Gynecology, JLN Hospital and Research Center, Bhilai, Chhattisgarh, India

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***Correspondence:**
Dr. Pooja Agarwal,
E-mail: drpooja106@gmail.com

ABSTRACT

Background: Gestational diabetes mellitus (GDM) poses significant health risks to both the mother and fetus. Identifying predictors of GDM early in pregnancy can facilitate timely intervention and reduce associated morbidity. To evaluate demographic and clinical parameters as predictors of GDM in pregnant women attending antenatal care before 20 weeks of gestation.
Methods: A prospective observational study was conducted on 200 pregnant women attending antenatal outpatient department at J.L.N. Hospital and Research Centre, Bhilai, Chhattisgarh. Relevant demographic and clinical data were recorded. DIPSI tests were conducted at <20 weeks, 24-28 weeks and 32-34 weeks of gestation. Associations between GDM and factors such as age, BMI, family history of diabetes, gravidity, haemoglobin and socioeconomic status were analysed using chi-square and t-tests.
Results: GDM was diagnosed in 34 participants (17%). Significant predictors of GDM included advanced maternal age ($p<0.01$), higher BMI ($p=0.02$) and positive family history of diabetes ($p<0.001$). Gravidity, hemoglobin and socioeconomic status did not show any associations.
Conclusions: Maternal age, BMI and family history of diabetes are strong predictors of GDM. Routine screening and early risk stratification based on these predictors can guide targeted interventions, particularly in resource-limited settings.

Keywords: BMI, Demographics, Early pregnancy, Gestational diabetes mellitus, Predictors

INTRODUCTION

GDM is defined as glucose intolerance with onset or first recognition during pregnancy and represents one of the most common metabolic complications of gestation.[1] The global prevalence of GDM continues to rise, largely driven by increasing maternal age, obesity, urbanization and sedentary lifestyle patterns.[2]

According to the International Diabetes Federation, approximately 14–16% of pregnancies worldwide are affected by hyperglycemia, with South Asian populations demonstrating particularly high susceptibility.[3] In India, the burden of GDM is substantial due to genetic predisposition toward insulin resistance, higher body fat percentage at lower BMI thresholds and rapid nutritional transition.[4] The clinical significance of GDM extends beyond pregnancy, as it is associated with fetal macrosomia, neonatal hypoglycemia, hypertensive disorders, cesarean delivery and increased long-term risk of type 2 diabetes mellitus in both mother and offspring.[5,6]

Current guidelines recommend screening for GDM at 24–28 weeks of gestation.[7] However, metabolic alterations and insulin resistance begin much earlier in pregnancy and hyperglycemia may be present before routine screening.[8]

Delayed diagnosis can result in prolonged fetal exposure to elevated glucose levels. Therefore, identification of high-risk women in early pregnancy using simple demographic and clinical markers may facilitate timely intervention and improved perinatal outcomes, particularly in resource-limited settings where universal repeated OGTT may not be feasible.[9]

Several demographic and clinical factors such as advanced maternal age, increased body mass index (BMI), family history of diabetes and parity have been associated with increased risk of GDM.[10,11]

However, prospective data evaluating these predictors before 20 weeks of gestation using DIPSI criteria remain limited, particularly from central India. Hence, the present study was undertaken to evaluate demographic and clinical predictors of GDM among women presenting before 20 weeks of gestation.

METHODS

Study design and setting

This prospective observational study was conducted at the Department of Obstetrics and Gynecology, J.L.N. Hospital and Research Centre, Bhilai, Chhattisgarh, from November 2020 to May 2022. The hospital is a tertiary care center catering to a diverse patient population.

Study population

A total of 200 pregnant women with a gestational age of less than 20 weeks were enrolled after providing informed written consent. Inclusion criteria included women attending their first antenatal check-up in the first or early second trimester (<20 weeks). Exclusion criteria included known cases of pre-gestational diabetes, HbA1c levels >6.5% at baseline (indicative of overt diabetes) and other known endocrinopathies.

Data collection

Demographic information such as age, education level, socioeconomic status (as per modified Kuppuswamy scale), gravidity and family history of diabetes was collected using a structured questionnaire. Clinical parameters including BMI and hemoglobin level were measured at the time of recruitment. BMI was calculated using measured weight and height and categorized based on WHO criteria.

Screening and diagnosis of gestational diabetes mellitus

All participants underwent the DIPSI (Diabetes in Pregnancy Study Group India) test at three time points: initial visit (<20 weeks), 24–28 weeks and 32–34 weeks of gestation. A 75 g oral glucose load was administered regardless of fasting status and plasma glucose levels were measured 2 hours later. A value >140 mg/dl was considered diagnostic for GDM.

Statistical analysis

Data were analyzed using SPSS version 20.0. Descriptive statistics were used for baseline characteristics. Associations between GDM and potential predictors were assessed using chi-square tests for categorical variables and independent t-tests for continuous variables. A p value<0.05 was considered statistically significant.

Ethical considerations

The study was approved by the Institutional Ethics Committee of J.L.N. Hospital and Research Centre, Bhilai. All participants provided informed consent prior to inclusion.

RESULTS

Demographic predictors of gestational diabetes mellitus

The proportion of GDM was significantly higher in the older age group (31–41 years) compared to the younger group (Table 1). A Chi-square test revealed a statistically significant association between maternal age and the development of GDM (p=0.005). This signifies that, conception at greater age increases the chance of developing GDM. The p value was >0.05, indicating that the observed association between socio economic status and GDM was not statistically significant in this sample (Table 2). This could be due to sample size limitations or the influence of confounding variables such as education, occupation or access to antenatal care. Primigravida (first-time pregnant women) accounted for 46% of the sample and contributed to a lower proportion of GDM cases. Multigravida (women with two or more pregnancies) comprised 54% of the sample and exhibited a slightly higher GDM incidence. Despite this trend, the p-value exceeded 0.05, indicating that the observed difference was not statistically significant. Therefore, no definitive association between gravidity and GDM can be concluded from this study (Table 3).

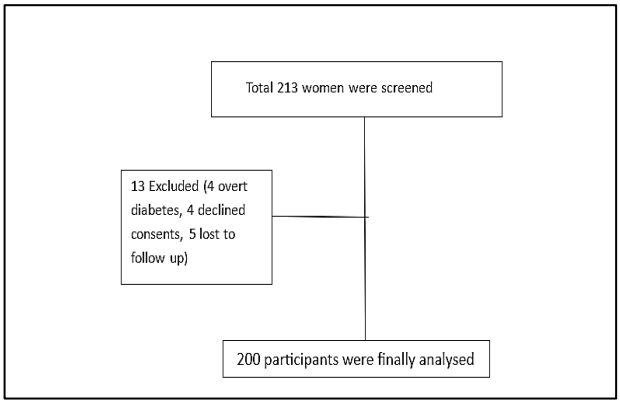

Figure 1: Study population.

Table 1: Association between Age and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
Age (in years)	20-30	111 (66.87)	14 (41.18)	125 (62.5)	0.005	Significant
	31-41	55 (33.13)	20 (58.82)	75 (37.5)		
Total		166 (100)	34 (100)	200 (100)		

Table 2: Association between Socio economic status and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
Socio economic status	Low	27 (16.27)	2 (5.88)	29 (14.5)	0.057	Not Significant
	Medium	118 (71.08)	23 (67.65)	141 (70.5)		
	High	21 (12.65)	9 (26.47)	30 (15)		
Total		66 (100)	34 (100)	200 (100)		

Table 3: Association between Gravidity and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
Gravidity	Primi	78 (46.99)	14 (41.18)	92 (46)	0.536	Not significant
	≥G2	88 (53.01)	20 (58.82)	108 (54)		
Total		166 (100)	34 (100)	200 (100)		

Table 4: Association between Family history of DM and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
Family history of DM	No	123 (74.1)	12 (35.29)	135 (67.5)	<0.001	Significant
	Yes	43 (25.9)	22 (64.71)	65 (32.5)		
Total		166 (100)	34 (100)	200 (100)		

Table 5: Association between BMI and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
BMI	Underweight	2 (1.2)	0 (0)	2 (1)	<0.001	Significant
	Normal	151 (90.96)	14 (41.18)	165 (82.5)		
	Overweight	13 (7.83)	20 (58.82)	33 (16.5)		
	Obese	0 (0)	0 (0)	0 (0)		
Total		166 (100)	34 (100)	200 (100)		

Table 6: Association between Hb and GDM developed or not.

		GDM developed or not		Total	P value	Significance
		No	Yes			
Hb	8.0-8.9	12 (7.23)	0 (0)	12 (6)	0.133	Not significant
	9.0-9.9	26 (15.66)	6 (17.65)	32 (16)		
	10.0-10.9	36 (21.69)	12 (35.29)	48 (24)		
	11.0-11.9	42 (25.3)	11 (32.35)	53 (26.5)		
	12.0-12.9	47 (28.31)	4 (11.76)	51 (25.5)		
	13.0-13.9	3 (1.81)	1 (2.94)	4 (2)		
Total		166 (100)	34 (100)	200 (100)		

Table 7: Multivariate logistic regression analysis of predictors of GDM.

Variable	Adjusted odds ratio (AOR)	95% Confidence interval	P value
Age ≥31 years	2.18	1.15–4.12	0.017
BMI ≥25 kg/m²	4.76	2.32–9.77	<0.001
Family history of DM	5.42	2.63–11.18	<0.001
Multigravida	1.21	0.63–2.34	0.56
Socioeconomic status	1.34	0.72–2.48	0.34
Hemoglobin level	0.94	0.78–1.14	0.51

Among the 65 women with a family history of diabetes, 22 (33.85%) developed GDM. In contrast, only 12 out of 135 women (8.89%) without a family history developed GDM. The p value was <0.001, indicating a statistically significant association (Table 4). This finding strongly suggests that a positive family history of diabetes is a major demographic risk factor for GDM.

Clinical predictors of gestational diabetes mellitus

Among the 33 overweight women (BMI>25), 20 (60.60%) developed GDM. In contrast, among the 165 women with normal BMI, only 14 (8.48%) developed GDM. The p value was <0.001, indicating that this association is statistically significant (Table 5). These findings suggest that, overweight women were more than twice as likely to develop GDM compared to their normal-weight counterparts. The association between maternal hemoglobin (Hb) levels in early pregnancy and the development of gestational diabetes mellitus (GDM) in this study revealed a non-significant trend (Table 6). On multivariate logistic regression analysis, maternal age ≥31 years, BMI ≥25 kg/m² and positive family history of diabetes remained independent predictors of GDM.

DISCUSSION

This prospective observational study assessed early pregnancy predictors of GDM using DIPSI criteria and observed an overall incidence of 17%, which aligns with previously reported Indian prevalence ranging between 10–18% depending on population characteristics and diagnostic criteria.[12]

Maternal age

Advanced maternal age (≥31 years) was significantly associated with GDM (p=0.005) and remained an independent predictor on multivariate analysis. Similar findings have been reported in large cohort studies demonstrating that increasing maternal age is associated with progressive decline in insulin sensitivity and impaired β-cell compensation.[13,14]

Age-related metabolic changes may amplify pregnancy-induced insulin resistance, thereby increasing susceptibility to glucose intolerance. These findings support targeted early screening in women above 30 years of age.

Body mass index

BMI ≥25 kg/m² showed a strong and independent association with GDM (AOR 4.76, p<0.001). Adiposity is known to increase circulating inflammatory cytokines, free fatty acids and insulin resistance, which contribute to impaired glucose metabolism during pregnancy.[11,15]

Meta-analyses have consistently demonstrated that overweight and obese women are at significantly higher risk of developing GDM compared to normal-weight women[16]. Given that BMI is a modifiable risk factor, preconception counselling and early antenatal weight optimization may reduce GDM burden.

Family history of diabetes

A positive family history of diabetes emerged as a significant independent predictor (AOR 5.42, p<0.001). Genetic susceptibility to β-cell dysfunction and shared lifestyle behaviors contribute to increased risk among women with affected first-degree relatives.[16,17] Similar associations have been reported in both Indian and international studies.[10,18] Early identification and closer glucose monitoring in such women may improve maternal outcomes.

Gravidity

Although multigravida women showed a slightly higher frequency of GDM, the association was not statistically significant. Previous studies have reported inconsistent findings regarding gravidity as an independent predictor.[10,19] Gravidity may act as a confounding factor mediated by increasing maternal age rather than functioning as an independent determinant.

Socioeconomic status

Socioeconomic status did not demonstrate a statistically significant association in our study. While lower socioeconomic groups may experience nutritional imbalance and limited access to healthcare, its independent predictive role remains variable across populations.[12]

Hemoglobin levels

No significant association was observed between early pregnancy hemoglobin levels and GDM. Although some studies have suggested that higher hemoglobin concentrations may correlate with increased iron stores and insulin resistance, the evidence remains inconclusive.[20] In our cohort, hemoglobin levels did not independently predict GDM development.

Clinical implications

The findings of this study indicate that simple, readily measurable parameters at the first antenatal visit namely maternal age, BMI and family history of diabetes can effectively stratify GDM risk before 20 weeks of gestation. Early risk-based screening strategies may be particularly valuable in resource-constrained settings where repeated OGTT testing is logistically challenging.[9]

Limitations

This study was conducted at a single tertiary care center with a moderate sample size of 200 participants, which may limit generalizability. Future multicentric studies with larger samples and biochemical markers may further refine early prediction models.

CONCLUSION

Maternal age ≥31 years, BMI ≥25 kg/m² and positive family history of diabetes are significant independent predictors of GDM in early pregnancy. Early identification using these readily available demographic and clinical parameters may facilitate timely intervention and improve maternal and fetal outcomes, particularly in resource-constrained settings.

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