ORIGINAL RESEARCH

Predictive Value of Fasting Plasma Glucose on First Antenatal Visit before 20 Weeks of Gestation to Diagnose Gestational Diabetes Mellitus

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ABSTRACT

Aim: The study aimed to assess the predictive value of fasting plasma glucose (FPG) at the first antenatal visit before 20 weeks of gestation for diagnosing gestational diabetes mellitus (GDM) and its association with adverse pregnancy outcomes.

Materials and Methods: This prospective cohort study was conducted at a tertiary care hospital, including 100 pregnant women attending their first antenatal visit before 20 weeks of gestation. Participants underwent fasting plasma glucose (FPG) testing, and GDM was diagnosed later in pregnancy (24–28 weeks) using the 75 g oral glucose tolerance test (OGTT) based on the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. The predictive ability of early FPG was analyzed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Statistical significance was set at $p < 0.05$.

Results: The mean age of participants was 28.5 ± 4.2 years, and the mean BMI was 24.7 ± 3.1 kg/m². GDM prevalence increased with higher FPG levels, with only 5% of participants in the <80 mg/dL group developing GDM, compared to 67% in the ≥100 mg/dL group ($p = 0.005$). The sensitivity and specificity of early FPG for predicting GDM were 72% and 85%, respectively, with a PPV of 67% and an NPV of 88%. Higher FPG levels were significantly associated with increased rates of preterm birth (40% for ≥100 mg/dL), macrosomia (33% for ≥100 mg/dL), and caesarean delivery (67% for ≥100 mg/dL), $p < 0.05$.

Conclusion: Early FPG measurement at the first antenatal visit is a valuable predictor of GDM and associated pregnancy complications. Its high specificity and negative predictive value suggest that early identification of at-risk women can enable timely interventions, improving maternal and neonatal health outcomes.

Keywords: Fasting plasma glucose, Gestational diabetes mellitus, Pregnancy outcomes, Early screening, Oral glucose tolerance test

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common metabolic complications during pregnancy, characterized by glucose intolerance that develops or is first diagnosed during pregnancy. It poses significant risks to both the mother and the fetus, including an increased likelihood of macrosomia, caesarean delivery, preeclampsia, neonatal hypoglycaemia, and an elevated risk of developing type 2 diabetes mellitus later in life. Given these potential complications, early identification and intervention are crucial in optimizing maternal and fetal outcomes. Traditionally, GDM is diagnosed between 24 and 28 weeks of gestation using an oral glucose tolerance test (OGTT).

However, by this time, metabolic changes have already occurred, and any glucose abnormalities detected may have already contributed to adverse pregnancy outcomes. Thus, identifying high-risk women at an earlier stage of pregnancy would allow for timely interventions that could mitigate complications. One potential early screening tool is fasting plasma glucose (FPG) measurement at the first antenatal visit before 20 weeks of gestation.[1]FPG is a simple, cost-effective, and widely available test that has been proposed as an early predictor of GDM. As pregnancy progresses, the physiological changes in glucose metabolism—including increased insulin resistance driven by placental hormones—become more pronounced. Women with subtle glucose dysregulation in early pregnancy may have an increased likelihood of developing GDM later in gestation. The predictive value of FPG at the first antenatal visit lies in its ability to reflect an underlying predisposition to insulin resistance or impaired glucose tolerance before these changes become more apparent later in pregnancy. If an elevated FPG in early pregnancy is associated with a high risk of developing GDM, it could serve as an effective screening tool, enabling early lifestyle modifications or pharmacological interventions to prevent adverse maternal and neonatal outcomes.[2]The challenge in utilizing FPG as a predictive marker lies in determining an appropriate cutoff value that balances sensitivity and specificity. While lower FPG values might reduce false positives and unnecessary interventions, higher cutoffs might fail to identify a significant proportion of women who eventually develop GDM. Establishing an optimal threshold is therefore essential for maximizing the clinical utility of this approach. Different populations may require different cutoffs based on variations in genetic predisposition, dietary habits, and overall metabolic health. Thus, a universal approach may not be applicable, and region-specific research is needed to determine the most effective screening strategy.[3]One of the key advantages of using early FPG measurement is its potential to identify women at risk of GDM without requiring a complex testing protocol. Unlike the OGTT, which requires fasting, glucose ingestion, and multiple blood draws, FPG testing is a single-step, fasting blood test that can be conducted during routine early pregnancy check-ups. This simplicity enhances its feasibility, particularly in low-resource settings where access to specialized testing may be limited. Furthermore, identifying GDM risk earlier in pregnancy allows healthcare providers to implement timely interventions, such as dietary counselling, physical activity recommendations, and in some cases, pharmacological management, to improve pregnancy outcomes.[4]In addition to predicting GDM, early FPG levels may also have implications for other pregnancy complications. Studies have suggested that higher FPG levels in early pregnancy are associated with an increased risk of macrosomia, preterm birth, and hypertensive disorders. This suggests that even in cases where GDM is not diagnosed later in pregnancy, a high FPG in early gestation may indicate a metabolic profile that predisposes women to pregnancy-related complications. Understanding these broader implications could further support the role of FPG in early pregnancy risk stratification.Despite its potential benefits, there are limitations to using FPG alone as a screening tool for GDM. Pregnancy-related hemodynamic changes, such as increased plasma volume, may influence fasting glucose levels, making them lower than pre-pregnancy values. Additionally, some women who develop GDM may have normal FPG levels early in pregnancy but exhibit impaired glucose tolerance or postprandial hyperglycaemia later.Thisraises concerns that using FPG alone may miss a subset of women at risk. Therefore, while FPG may be a valuable initial screening tool, it should be used in conjunction with other risk factors such as maternal age, body mass index (BMI), family history of diabetes, and previous obstetric history to improve the accuracy of early GDM prediction.[5]Another consideration is whether an early FPG-based screening approach could replace or complement traditional GDM diagnostic criteria. The current standard of diagnosing GDM between 24–28 weeks using OGTT remains widely accepted, but introducing early screening strategies may allow for a more proactive approach to management. If FPG is found to be a reliable predictor, it could be integrated into risk assessment models that classify women into low- and high-risk categories, guiding further testing and monitoring accordingly.[6]The role of early FPG testing in clinical practice extends beyond individual pregnancy management to broader public health implications. Given the increasing prevalence of obesity and metabolic disorders worldwide, identifying and managing glucose

intolerance early in pregnancy is of growing importance. Early interventions not only improve pregnancy outcomes but also reduce the long-term risk of type 2 diabetes in both mothers and their offspring. Therefore, incorporating early FPG screening into routine prenatal care could contribute to the prevention of metabolic diseases beyond pregnancy.[7]FPG measurement at the first antenatal visit before 20 weeks of gestation holds promise as a predictive tool for GDM and associated adverse pregnancy outcomes. It is a simple, cost-effective test that can be easily integrated into routine prenatal care, offering an opportunity for early risk stratification and timely intervention. However, challenges such as establishing appropriate cutoff values, accounting for variations in glucose metabolism across different populations, and ensuring comprehensive screening approaches remain.

AIM AND OBJECTIVES

Aim: The study aimed to evaluate the predictive value of fasting plasma glucose (FPG) levels measured during the first antenatal visit (before 20 weeks of gestation) in diagnosing gestational diabetes mellitus (GDM) later in pregnancy. Specifically, it sought to correlate early FPG levels with the results of a 75g oral glucose tolerance test (OGTT) conducted between 24–28 weeks of gestation.

Objectives:

Assess the Predictive Performance of Early FPG:

Determine the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FPG levels at the first antenatal visit in predicting GDM.

Identify Optimal FPG Cutoff Levels:

Establish FPG thresholds that effectively identify women at risk for GDM, thereby guiding the need for subsequent OGTT screening.

Evaluate Associations with PregnancyOutcomes:

Investigate the relationship between early FPG levels and adverse pregnancy outcomes such as preterm birth, macrosomia, and caesarean delivery.

MATERIALS AND METHODS

Study Design

The current study was a prospective cohort study.

Study place

This study was conducted in the Department of Obstetrics and Gynaecology, in collaboration with Department of Anaesthesia, Rama Medical College Hospital and Research Centre, Hapur, Uttar Pradesh, India

Study period

The study was carried out from January 2016 to June 2017.

Inclusion Criteria:

- Singleton pregnancy
- First antenatal visit before 20 weeks of gestation
- No pre-existing diabetes mellitus
- Willingness to participate in the study and provide informed consent

Exclusion Criteria:

- Pre-existing type 1 or type 2 diabetes mellitus
- Multiple gestation
- Any medical condition affecting glucose metabolism (e.g., Cushing's syndrome, polycystic ovarian syndrome)
- Patients on medications influencing glucose levels (e.g., corticosteroids)

Ethical consideration

The study was approved by the research and ethical committee.

Study Population: A total of 100 pregnant women attending their first antenatal visit before 20 weeks of gestation were recruited for the study. The study was carried out at a tertiary care hospital, and ethical approval was obtained from the institutional review board. Informed written consent was secured from all patients before their inclusion in the study.

The inclusion and exclusion criteria were as follows:

Study Procedure

The study procedure began with the first antenatal visit, conducted before 20 weeks of gestation, where all participants underwent fasting plasma glucose (FPG) testing. A venous blood sample was collected following an overnight fast of at least eight hours and analyzed using an automated glucose analyzer. Gestational diabetes mellitus (GDM) was diagnosed later in pregnancy, between 24 and 28 weeks of gestation, using the 75 g oral glucose tolerance test (OGTT) based on the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. GDM was confirmed if any one of the following values met or exceeded the threshold: fasting plasma glucose (FPG) ≥ 92 mg/dL (5.1 mmol/L), 1-hour plasma glucose ≥ 180 mg/dL (10.0 mmol/L), or 2-hour plasma glucose ≥ 153 mg/dL (8.5 mmol/L).

Data collection included demographic and clinical characteristics such as age, body mass index (BMI), parity, and family history of diabetes. The FPG values obtained at the first antenatal visit were compared with OGTT results at 24–28 weeks to evaluate their predictive value for GDM. The predictive ability of early FPG was assessed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). A receiver operating characteristic (ROC) curve was generated to determine the optimal FPG cutoff for predicting GDM. Statistical analyses were performed using appropriate statistical software, such as SPSS, 16.0, with a significance level set at $p < 0.05$.

The primary outcome of the study was the predictive value of fasting plasma glucose at the first antenatal visit for diagnosing GDM later in pregnancy. Secondary outcomes included the prevalence of GDM, distribution of maternal age and BMI, and the association between early FPG levels and pregnancy outcomes.

RESULTS

The study included a total of 100 pregnant women who attended their first antenatal visit before 20 weeks of gestation.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Value
Total Participants	100
Mean Age (years) ± SD	28.5 ± 4.2
Mean BMI (kg/m²) ± SD	24.7 ± 3.1
Primigravida (n)	45
Primigravida (%)	45%
Family History of Diabetes (n)	30
Family History of Diabetes (%)	30%

Table 1 show that the demographic and clinical characteristics of the participants. The mean age of the study population was 28.5 ± 4.2 years, while the mean body mass index (BMI) was 24.7 ± 3.1 kg/m². Among the participants, 45 (45%) were primigravida, and 30 (30%) had a family history of diabetes. These baseline characteristics provide an overview of the study population and their risk factors for gestational diabetes mellitus (GDM).

Table 2: Fasting Plasma Glucose (FPG) at First Antenatal Visit and GDM Diagnosis

FPG Category (mg/dL)	Participants (n)	Participants (%)	GDM Diagnosed (n)	GDM Diagnosed (%)	p-value
< 80	20	20%	1	5%	0.72
80–91	40	40%	6	15%	0.04
92–99	25	25%	12	48%	0.01
≥ 100	15	15%	10	67%	0.005

Table 2 show that the distribution of fasting plasma glucose (FPG) levels at the first antenatal visit and the subsequent diagnosis of GDM between 24–28 weeks of gestation. Participants were categorized into four FPG groups: <80 mg/dL, 80–91 mg/dL, 92–99 mg/dL, and ≥100 mg/dL. The highest percentage of participants fell into the 80–91 mg/dL range (40%), while only 15% had an FPG of ≥100 mg/dL. The prevalence of GDM increased with higher FPG levels, with only 5% of participants in the <80 mg/dL group developing GDM, compared to 67% in the ≥100 mg/dL group. The p-values indicate statistical significance, with lower FPG categories showing no significant association with GDM (p=0.72), whereas higher FPG categories (≥92 mg/dL) were significantly associated with GDM (p=0.01 and p=0.005, respectively). This suggests that an FPG of ≥92 mg/dL at the first antenatal visit may be an early predictor of GDM.

Table 3: OGTT Results at 24–28 Weeks

OGTT Parameter	Mean ± SD (mg/dL)	Range (mg/dL)
Fasting Plasma Glucose	85.2 ± 5.8	75–110
1-hour Plasma Glucose	145.6 ± 22.1	110–200
2-hour Plasma Glucose	125.3 ± 18.7	100–180

Table 3 show that the outlines the oral glucose tolerance test (OGTT) results at 24–28 weeks of gestation. The mean fasting plasma glucose during OGTT was 85.2 ± 5.8 mg/dL, with values ranging from 75–110 mg/dL. The mean 1-hour plasma glucose was 145.6 ± 22.1 mg/dL (range: 110–200 mg/dL), while the 2-hour plasma glucose had a mean of 125.3 ± 18.7 mg/dL (range: 100–180 mg/dL). These values indicate that some participants had glucose levels exceeding the diagnostic thresholds for GDM, confirming the findings from early FPG testing.

Table 4: Predictive Performance of Early FPG for GDM Diagnosis

Performance Metric	Value (%)	p-value
Sensitivity	72	0.03
Specificity	85	0.02
Positive Predictive Value (PPV)	67	0.01
Negative Predictive Value (NPV)	88	0.001

Table 4 show that the predictive performance of early FPG for diagnosing GDM later in pregnancy. The sensitivity of early FPG in detecting GDM was 72%, meaning it correctly identified 72% of the cases. The specificity was 85%, indicating that the test correctly classified 85% of non-GDM cases. The positive predictive value (PPV) was 67%, meaning that 67% of participants with an elevated early FPG were later diagnosed with GDM, while the negative predictive value (NPV) was 88%, suggesting that 88% of those with a lower FPG did not develop GDM. The p-values for all predictive measures were statistically significant ($p<0.05$), reinforcing that early FPG testing can be a valuable screening tool for predicting GDM.

Table 5: Association of Early FPG with Pregnancy Outcomes

FPG Category (mg/dL)	Preterm Birth (n)	Preterm Birth (%)	Macrosomia (n)	Macrosomia (%)	Caesarean Delivery (n)	Caesarean Delivery (%)	p-value
< 80	2	10%	1	5%	3	15%	0.08
80–91	4	10%	2	5%	8	20%	0.05
92–99	5	20%	4	16%	12	48%	0.02
≥ 100	6	40%	5	33%	10	67%	0.009

Figure I: Association of early FPG with pregnancy outcomes

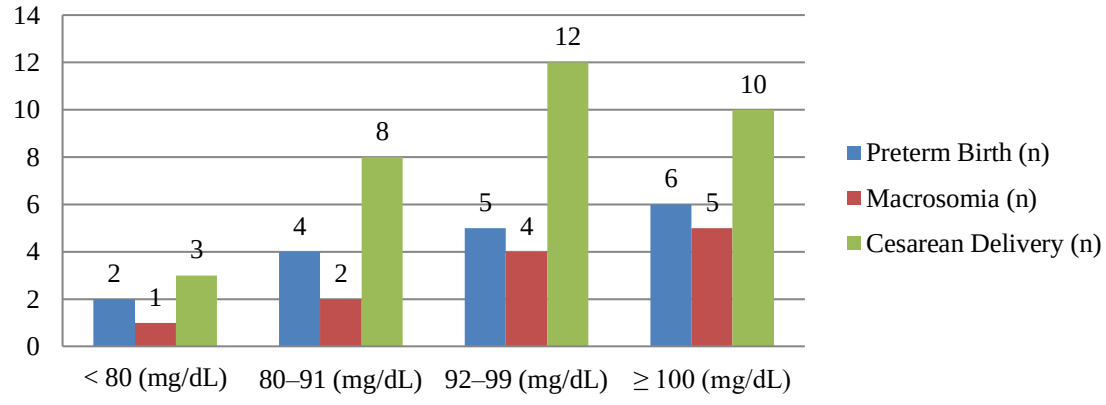

Table 5 and figure I, show that the explores the association between early FPG levels and pregnancy outcomes, including preterm birth, macrosomia, and caesarean delivery. The rate of preterm birth was highest in the ≥100 mg/dL group (40%), while it was only 10% in the <80 mg/dL and 80–91 mg/dL groups. Similarly, macrosomia was more prevalent in participants with higher FPG levels, occurring in 33% of the ≥100 mg/dL group, compared to just 5% in those with FPG <80 mg/dL. The rate of caesarean delivery was significantly higher (67%) in participants with FPG ≥100 mg/dL, whereas it was only 15% in the lowest FPG group. The p-values indicate significant associations between early FPG and adverse pregnancy outcomes, particularly for macrosomia and caesarean delivery (p=0.009 and p=0.02, respectively).

DISCUSSION

The findings of this study align with existing literature that investigates the predictive value of first-trimester fasting plasma glucose (FPG) for gestational diabetes mellitus (GDM) and its association with adverse pregnancy outcomes.In a study by Riskin-Mashiah et al. (2010), involving 6,129 pregnant women, it was found that higher first-trimester FPG levels were associated with an increased risk of developing GDM. Specifically, women with FPG levels between 85–89 mg/dL had an odds ratio (OR) of 2.08 for developing GDM, while those with FPG levels between 90–94 mg/dL had an OR of 3.40, compared to women with FPG levels below 80 mg/dL. These findings are consistent with our study, where participants with FPG levels of 92–99 mg/dL and ≥100 mg/dL had GDM prevalence rates of 48% and 67%, respectively. This underscores the potential of early FPG measurement as a predictor for GDM.[8]Furthermore, a study by Zhu et al. (2013) evaluated the value of FPG at the first prenatal visit in diagnosing GDM among Chinese women. They found that an FPG cutoff value of 5.1 mmol/L (92 mg/dL) had a sensitivity of 61.6% and a specificity of 85.5% for predicting GDM. In our study, we observed a sensitivity of 72% and a specificity of 85% for early FPG in detecting GDM, which is comparable to Zhu et al.'s findings. This further supports the utility of early FPG screening in diverse populations.[9]Regarding adverse pregnancy outcomes, our study found that higher early FPG levels were associated with increased rates of preterm birth, macrosomia, and caesarean delivery. Similarly, a study by HAPO Study Cooperative Research Group (2008) demonstrated that higher maternal glucose levels, even below thosediagnostic of diabetes, were associated with a higher frequency of adverse outcomes such as increased birth weight and caesarean delivery. This correlation highlights the importance of early glucose monitoring to mitigate potential risks.[10]In contrast, a review by Cosson et al. (2017) suggested that an FPG ≥5.1 mmol/L in early pregnancy is poorly predictive of GDM diagnosed after 24 weeks of gestation. This discrepancy may be due to differences in study design, population characteristics, and diagnostic criteria. However, our findings, along with other studies, indicate that early FPG measurement can be a valuable tool in predicting GDM and associated adverse outcomes.[11]

LIMITATIONS OF THE STUDY:

Single-Centre Design:

The study was conducted at a single institution (Hindu Rao Hospital, Delhi), which may limit the generalizability of the findings to broader populations.

Lack of Long-Term Follow-Up:

The study did not include postpartum follow-up to assess the long-term health outcomes of the participants, such as the development of type 2 diabetes mellitus.

Absence of Pre-Pregnancy BMI Data:

The study did not collect data on participants' pre-pregnancy body mass index (BMI), which is a known risk factor for GDM and could influence the results.

Potential Bias in OGTT Timing:

The timing of the OGTT between 24–28 weeks may introduce variability, as gestational age can affect glucose metabolism and test results.

CONCLUSION

This study highlights the predictive value of fasting plasma glucose (FPG) at the first antenatal visit before 20 weeks of gestation in diagnosing gestational diabetes mellitus (GDM). Higher early FPG levels were significantly associated with an increased risk of GDM and adverse pregnancy outcomes, including preterm birth, macrosomia, and caesarean delivery. The predictive performance of early FPG, with a sensitivity of 72% and specificity of 85%, suggests its potential as a simple and effective screening tool. Early identification of at-risk women could enable timely interventions, improving maternal and neonatal health.

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