Original Research Article

FASTING BLOOD SUGAR (FBS) IN THE FIRST TRIMESTER: PREDICTIVE VALUE FOR GESTATIONAL DIABETES MELLITUS AND IMPACT ON PREGNANCY-RELATED OUTCOMES

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Abstract: *Gestational diabetes mellitus (GDM) is a significant health concern in pregnancy, affecting maternal and neonatal outcomes. Early detection of GDM through fasting blood glucose (FBS) screening may help in timely management to prevent complications.* **Objective:** *To determine the fasting blood glucose threshold that accurately predicts the onset of gestational diabetes mellitus (GDM) and its impact on pregnancy outcomes.* **Methods**: *A prospective cohort study was conducted at the Obstetrics and Gynecology Department of Jinnah Postgraduate Medical Centre (JPMC), Karachi, from August 2023 to May 2024, involving 405 pregnant women selected through systematic random sampling. Inclusion criteria included singleton pregnancies, excluding women with pregestational diabetes or baseline fasting glucose levels of 126 mg/dL or higher. Baseline data on age, BMI, gestational age, and family history of diabetes were collected, and FBS levels were measured at the initial visit. Oral Glucose Tolerance Tests (OGTT) were conducted between 24 to 28 weeks of gestation to diagnose GDM. Maternal and fetal outcomes were monitored until delivery. Statistical analyses, including logistic regression and ROC curve analysis, were performed using IBM SPSS version 20.* **Results:** *Among the 405 participants, with a mean age of 28 ±6.49 years, the mean fasting blood sugar (FBS) was 89.5 mg/dL (±12.3). Impaired FBS (≥92 mg/dL) was noted in 24.70% of participants, and 18.27% were diagnosed with GDM following OGTT. A fasting glucose level of 127.4 mg/dL (±22.1) was observed among women diagnosed with GDM. Logistic regression showed a significant association between FBS ≥92 mg/dL and GDM risk (OR 1.08, CI 1.02-1.14, p=0.011). ROC analysis revealed an FBS cutoff of 92 mg/dL with 73% sensitivity and 68% specificity for predicting GDM. Gestational hypertension was observed in 8.64% of participants, and preeclampsia in 6.67%. Vaginal deliveries occurred in 72.1% of cases, while 27.9% required cesarean sections. Neonatal outcomes showed an 11% macrosomia rate, with 12% requiring NICU admission.* **Conclusion:** *Fasting blood glucose levels ≥92 mg/dL in early pregnancy are strongly predictive of gestational diabetes mellitus (GDM). Early FBS screening allows for timely intervention, potentially improving maternal and neonatal outcomes. This study underscores the importance of incorporating FBS screening in routine antenatal care for better pregnancy management.*

Keywords: Gestational Diabetes Mellitus (GDM), Fasting Blood Sugar (FBS), First Trimester, Pregnancy, Maternal Outcomes, Neonatal Outcomes

Introduction

Gestational diabetes mellitus (GDM) represents a significant health issue, manifesting as hyperglycemia during pregnancy in women who previously showed no signs of diabetes (1). The impact of GDM on perinatal outcomes can be profound, underscoring the importance of early diagnosis and intervention to enhance both maternal and fetal prognosis (2). Although widespread screening for GDM might not be deemed economical in high-income nations, its application is particularly valuable in low- and middle-income countries where the burden of undiagnosed diabetes can be substantial (3).

When diagnosing gestational diabetes mellitus (GDM), the gold standard is the 75g 2-hour oral glucose tolerance test (OGTT), which is usually given between weeks 24 and 28 of pregnancy (4). The World Health Organization (WHO),

the American Diabetes Association (ADA), and the International Association of Diabetes and Pregnancy Study Groups (IADPSG) have established guidelines that if followed, can diagnose GDM if fasting glucose levels are 92 mg/dl or higher if levels are 180 mg/dl or higher after one hour, and if levels are 153 mg/dl or higher after two hours. Despite these established guidelines, various other screening tools and criteria are also utilized in practice(5-7). In Pakistan, over the past twenty years, numerous studies have delved into the prevalence of GDM, employing different screening methods and diagnostic tools. These studies have reported a wide range of GDM prevalence, from as low as 4.41% to as high as 57.90%, reflecting the variability in diagnostic approaches. However, comprehensive, multi-centric studies and community

surveys providing pooled evidence on GDM prevalence are notably absent in the country (8-10).

In light of this, the purpose of this study is to close these gaps by examining Pakistan's both general and subgroups pooled estimations of GDM prevalence. We aim to scrutinize the methodological variations across existing studies to address any inconsistencies. This research is pivotal in formulating a pragmatic, feasible, convenient, and cost-effective strategy for GDM screening, especially tailored for low- and middle-income countries. By focusing on fasting blood sugar (FBS) levels in the first trimester, our goal is to establish an early screening method that can predict the onset of GDM, thereby enabling timely interventions to improve pregnancy outcomes.

To determine the fasting blood glucose (FBS) threshold that may be used to accurately predict when Gestational Diabetes Mellitus (GDM) will manifest and to outline its impact on pregnancy outcomes.

Methodology

This prospective cohort study was conducted at the Obstetrics and Gynecology Department of Jinnah Postgraduate Medical Centre (JPMC), Karachi, over 10 months from August 2023 to May 2024. A total of 405 pregnant women were determined using opine with a 99% confidence level. Systematic random sampling was employed. A sampling interval of three was used, selecting every third pregnant woman visiting the antenatal care clinic at JPMC, provided they met the inclusion criteria and provided consent. If a selected woman did not consent, the next eligible pregnant woman was approached. Singleton pregnancies and pregnant women attending antenatal care at JPMC, Karachi. Excluded from the study were women diagnosed with pregestational diabetes mellitus and those whose baseline fasting glucose level was 126 mg/dl or above. We conducted a comprehensive baseline assessment for all participants, collecting data on age, BMI, gestational age, family history of diabetes, previous pregnancies, and any history of pregnancy complications. Laboratory tests included measuring fasting blood sugar (FBS) levels at the initial visit to establish baseline glucose levels. Between 24 to 28 weeks of gestation, participants underwent the Oral Glucose Tolerance Test (OGTT) to diagnose gestational diabetes mellitus (GDM) and to correlate the diagnosis with the FBS levels measured during the first antenatal visit. Participants were followed up until delivery to monitor maternal and fetal outcomes. Medical records were reviewed to collect data on pregnancy complications, mode of delivery, neonatal outcomes, and maternal outcomes. The participants' basic attributes were compiled using descriptive statistics. After accounting for any confounding variables, the relationship between initial FBS levels and the onset of GDM was examined using logistic regression analysis. Using a Receiver Operating Characteristic (ROC) curve analysis, the best FBS cutoff value for GDM prediction was found. IBM SPSS version 20 was utilised for the entire analysis process. The Institutional Ethical Board gave their approval to the study protocol. Before registration, all individuals provided their informed consent.

Results

The study included 405 pregnant women with a mean age of 28 ±6.49 years. Most were urban residents (59.01%), with a mean BMI of 24.5 kg/m² (±3.2), and 57.53% had a normal weight. First-time pregnancies accounted for 37.04%. Educational levels varied: 9.9% had primary education, 19.8% had matriculation, 24.9% had intermediate, 29.9% had bachelor's, and 15.5% had master's degrees. The mean fasting blood sugar (FBS) was 89.5 mg/dL ($\pm$12.3), with 75.30% showing normal FBS (<92 mg/dL) and 24.70% impaired FBS ($\geq$92 mg/dL). Table-1

OGTT performed between 24-28 weeks revealed that 18.27% of participants had gestational diabetes mellitus (GDM), with a mean fasting glucose of 127.4 mg/dL ($\pm$22.1). Table-2

Gestational hypertension was observed in 8.64% of women, and 6.67% developed preeclampsia. Delivery mode included 72.1% vaginal births and 27.9% cesarean sections. Table-3

Neonatal outcomes showed an average birth weight of 3,150 ±410 grams, with 11% of babies being macrosomic and 12% requiring NICU care, mainly due to preterm birth (7.41%). Table-4

Logistic regression showed FBS $\geq$92 mg/dL increased the risk of GDM (OR 1.08, CI 1.02-1.14, p = 0.011). ROC analysis indicated FBS $\geq$92 mg/dL had a sensitivity of 73% and specificity of 68% for diagnosing GDM. Figure-1 below.

Table 1: Patient characteristics

Characteristic		Value
Total Participants, n		405
Mean Age (years), Mean ± SD		28 ±6.49
Urban Residents, n (%)		239 (59.01%)
Rural Residents, n (%)		166 (40.98%)
Mean BMI (kg/m²), Mean ± SD		24.5 ±3.2
Normal Weight, n (%)		233 (57.53%)
First pregnancy, n (%)		150 (37.04%)
Education Level, n (%)	Primary School	40 (9.9%)
	Matriculation	80 (19.8%)
	Intermediate	101 (24.9%)
	Bachelor	121 (29.9%)
	Masters	63 (15.5%)
Mean Fasting Blood Sugar level (mg/dL), Mean ± SD		89.5 ±12.3
Baseline Fasting Blood Sugar level (mg/dL)	<92 (Normal)	305 (75.30%)
	$\geq$92 (Impaired)	100 (24.70)

Table 2: Gestational Diabetes Diagnosis Statistics

GDM Diagnosis	Frequency, n (%) / Mean ± SD
Diagnosed with GDM	74 (18.27%)
Mean Fasting Glucose (in GDM patients)	127.4 ±22.1 mg/dl

Table 3: Maternal Outcomes

Outcome	Frequency, n (%)
Gestational Hypertension	35 (8.64%)
Preeclampsia	27 (6.67%)
Vaginal Delivery	292 (72.1%)
Cesarean Section	113 (27.9%)

Table 4: Neonatal Outcomes

Outcome	Frequency, n (%) / Mean ± SD
Mean Birth Weight	3,150 ±410 grams
Macrosomic (>4,000 grams)	43 (10.62%)
NICU Admission (%)	49 (12.09%)
- Due to Prematurity	30 (7.41%)
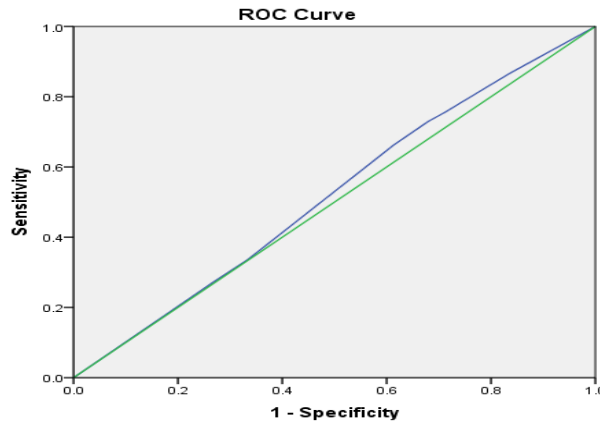
☐ *ROC Curve analysis: Sensitivity 73%, Specificity 68%, FBS cutoff 92 mg/dl*

Figure-1: ROC Curve for FBS threshold to diagnose GDM

Discussion

In our study involving 405 pregnant women, we delved into how early pregnancy fasting blood sugar (FBS) levels can forecast the likelihood of developing gestational diabetes mellitus (GDM). The participants, averaging 28 years of age with varying educational backgrounds, showed a mean FBS of 89.5 mg/dL. Notably, about a quarter of them exhibited higher FBS levels, marking them at risk for GDM.

Our findings divulged a significant link between elevated first-trimester FBS and increased GDM risk. Specifically, an FBS level of 92 mg/dL or above correlated with higher odds of developing GDM, reinforcing similar observations in studies by Riskin et al. and Min Hao et al (11-12). These studies, like ours, emphasized how early FBS screening can serve as a crucial predictor, albeit with varying degrees of sensitivity and specificity depending on the population studied.

Moreover, our ROC analysis revealed that using an FBS cutoff of 92 mg/dL achieved moderate sensitivity (73%) and specificity (68%) in diagnosing GDM. This diagnostic capability aligns with trends observed by Li et al. and Aravind et al., highlighting the utility of FBS in initial screening for GDM (13-14).

Beyond diagnosis, our study illuminated the broader implications of elevated FBS levels on pregnancy outcomes. We observed heightened incidences of macrosomia and NICU admissions, primarily due to prematurity, among women with elevated FBS. These findings mirror previous research by Riskin et al. and Hénoch et al., emphasizing the critical role of early metabolic assessment in identifying at-risk pregnancies and guiding timely interventions to enhance maternal and neonatal health (11-15) For GDM and associated.

Complications. This approach could potentially mitigate adverse outcomes through early intervention strategies tailored to individual metabolic profiles.

Looking forward, future research should refine FBS cutoff thresholds tailored to specific demographic and clinical contexts. By further exploring personalized management approaches based on early pregnancy metabolic profiles, we can optimize maternal-fetal health strategies and improve outcomes for both mothers and babies.

In conclusion, our study contributes valuable insights into the predictive power of first-trimester FBS levels in anticipating GDM and its impact on pregnancy outcomes. By synthesizing our findings with existing literature, we advocate for enhanced metabolic screening practices to support maternal and neonatal well-being during pregnancy. Potential limitations included the follow-up compliance and single-centre nature of the study, which may limit generalizability to other settings. Therefore, future research with a larger population size and multi-centred study design around the country may lead to more favourable and generalized results.

Conclusion

This study demonstrates that gestational diabetes mellitus (GDM) C is predicted by elevated fasting blood sugar levels in the early stages of pregnancy, particularly ≥92 mg/dL. This emphasises how crucial early screening is for identifying pregnancies at risk and starting interventions on time to promote the health of the mother and the newborn. To maximize prenatal care practices, future research should concentrate on improving screening criteria and tailored management approaches.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-JPDHKHR-091/22)
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Coordination of collaborative efforts.
Study Design, Review of Literature.
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Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.
Conception of Study, Final approval of manuscript.
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Conception of Study, Final approval of manuscript.
Data entry and Data analysis, drafting article.

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