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# In Search of a Better Screen: Comparing Standard and Simple Glucose Tests for GDM Screening Across All Trimesters

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## Abstract

**Background:** Gestational diabetes mellitus (GDM) is among the most frequently encountered metabolic complications of pregnancy, yet how best to screen for it and when remains a matter of ongoing debate. While the DIPSI glucose challenge test (GCT) is widely recommended in India. There is also a lack of systematic data on how the performance of these tests varies across trimesters, despite clear evidence that insulin resistance increases progressively as pregnancy advances. This gap in evidence particularly in the context of Indian tertiary care centres formed the basis for the present study.

**Objectives:** We undertook this study to directly compare the diagnostic yield of GCT (DIPSI criteria), FBS, and PPBS for GDM detection across all three trimesters of pregnancy, and to examine how each test relates to maternal risk factors and antenatal complications.

**Methods:** A prospective and retrospective observational study was conducted among 130 pregnant women attending the obstetric OPD at SVS Hospital, Mahbubnagar, between August 2025 and January 2026. All participants underwent FBS, PPBS, and a non-fasting 75g GCT (DIPSI criteria) within their respective trimester. GDM was diagnosed at a 2-hour plasma glucose threshold of ≥140 mg/dL per DIPSI guidelines, with WHO 2013 criteria applied for comparison.

**Results:** GCT identified GDM in 13.8% of participants, compared to 10.8% detected by FBS and PPBS combined. A combined approach using all three tests yielded the highest detection rate of 16.2%. Mean glucose values rose consistently from the first to the third trimester across all three modalities. GDM prevalence was higher in older women, those with elevated BMI, and grand multipara. Antenatal complications occurred in 36.2% of participants, and GCT showed the strongest correlation with adverse outcomes among all three tests ($r=0.63$, $p<0.01$).

**Conclusion:** GCT outperforms FBS and PPBS as a standalone GDM screening tool and shows the strongest association with adverse antenatal outcomes. A combined screening strategy maximises case detection. Given the progressive rise in GDM prevalence across trimesters, repeat testing at each trimester is essential and should be standard practice. The DIPSI test, requiring no prior fasting, is well suited for routine antenatal care in Indian settings and deserves broader implementation.

***Keywords:*** *Gestational diabetes mellitus, GCT, DIPSI, fasting blood sugar, postprandial blood sugar, trimester-wise screening, antenatal complications, India.*

## INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as glucose intolerance first recognized during pregnancy and remains one of the most common metabolic disorders complicating pregnancy worldwide. The global burden of GDM has increased substantially over recent decades due to rising maternal age, obesity, sedentary lifestyle, and increasing prevalence of type 2 diabetes mellitus (T2DM). Recent estimates suggest that nearly one in seven pregnancies worldwide is affected by hyperglycaemia, with the majority attributable to GDM[1].

GDM is associated with significant short and long term maternal and fetal complications. Maternal risks include preeclampsia, pregnancy induced hypertension (PIH), operative delivery, and future development of T2DM and cardiovascular disease. Fetal and neonatal complications include macrosomia, shoulder dystocia, neonatal hypoglycaemia, respiratory distress syndrome, hyperbilirubinemia, and increased perinatal morbidity. Furthermore, offspring born to mothers with GDM have an increased lifetime risk of obesity, insulin resistance, metabolic syndrome, and diabetes, thereby perpetuating an intergenerational cycle of metabolic disease[2].

India represents a particularly high-risk population for GDM because of increased genetic susceptibility, urbanisation, changing dietary patterns, and high prevalence of insulin resistance among South Asians. The pooled prevalence of GDM in India has been estimated to be approximately 11%, although prevalence varies widely depending on diagnostic criteria and geographic region[3]. The growing burden of GDM in India has generated considerable interest in identifying simple, feasible, and cost-effective screening strategies suitable for resource constrained settings.

Several screening and diagnostic approaches for GDM are currently in use, including fasting blood sugar (FBS), postprandial blood sugar (PPBS), oral glucose challenge test (OGCT), oral glucose tolerance test (OGTT), and glycated haemoglobin (HbA1c). However, there remains no universal consensus regarding the optimal screening method, particularly in low- and middle-income countries. In India, the Diabetes in Pregnancy Study Group India (DIPSI) recommends a single-step non-fasting 75 g oral glucose challenge test with a 2-hour plasma glucose value ≥140 mg/dL as a screening method for GDM. This approach is operationally attractive because it eliminates the need for fasting and improves patient compliance in busy antenatal clinics[4].

Despite its practicality, controversy persists regarding the diagnostic accuracy of DIPSI criteria compared with international standards such as the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. A recent meta-analysis comparing DIPSI with IADPSG criteria reported high specificity but relatively lower sensitivity of DIPSI, suggesting that some cases of GDM may remain undetected if only a single screening strategy is used[5]. Nevertheless, DIPSI continues to be widely adopted in India because of its feasibility and cost-effectiveness in large-scale antenatal screening programs.

Emerging evidence also suggests that glucose intolerance may develop earlier in pregnancy than previously recognised. Studies increasingly support trimester-wise or repeated screening because women who test negative in early pregnancy may subsequently develop GDM as physiological insulin resistance progressively increases with advancing gestation[6]. Consequently, repeat screening across all trimesters may improve case detection and facilitate earlier intervention to reduce adverse maternal and neonatal outcomes.

Although previous studies have individually evaluated the utility of FBS, PPBS, and glucose challenge testing, comparatively few studies from India have systematically assessed these modalities together across all three trimesters of pregnancy. The present study was therefore undertaken to compare the diagnostic performance and effectiveness of glucose challenge test (GCT/DIPSI), fasting blood sugar, and postprandial blood sugar for screening of gestational diabetes mellitus across all trimesters in pregnant women attending a tertiary care centre in Telangana, India.

## AIMS AND OBJECTIVES

### Aim:

To compare the diagnostic accuracy and effectiveness of glucose challenge test (GCT), fasting blood sugar (FBS), and postprandial blood sugar (PPBS) for gestational diabetes across all three trimesters of pregnancy.

### Objectives

- To compare efficiency of FBS,PPBS to DIPSI diagnostic method.
- To correlate between BMI and glucose levels across the three tests in each trimester.
- To correlate between FBS,PPBS,GCT and antenatal complications.

## MATERIALS AND METHODS

### Study Design

This was a prospective and retrospective observational study, carried out at SVS Hospital, Mahbubnagar, from August

2025 to January 2026. Participants were recruited from the gynaecology outpatient department over six months.

**Sample Size**
The sample size was calculated using the standard formula for proportion studies:
$n = Z^2 \times p(1 - p) / d^2$

Taking Z = 1.96 (95% confidence interval), p = 0.10 (10% estimated GDM prevalence), and d = 0.05 (5% margin of error), the required sample size was approximately 138. A total of 130 women completed all three tests and were included in the final analysis.

**Inclusion Criteria**
- Pregnant women between 18 and 35 years of age, in any trimester, attending the OPD.
- Women willing to undergo all three glucose tests (GCT, FBS, and PPBS).
- Women who gave written informed consent.

**Exclusion Criteria**
- Women with pre-existing type 1 or type 2 diabetes before pregnancy.
- Multiple pregnancies (twins or more).
- Women on medications known to affect blood glucose levels, such as corticosteroids or antipsychotics.
- Women with serious co-morbidities like chronic kidney disease, severe hypertension, or autoimmune conditions.
- Participants who fail to undergo all three glucose tests due to non- compliance.

**Methodology**
Each participant was asked to come in after an 8-hour overnight fast. A venous blood sample was drawn for fasting blood sugar, and then two hours after a standard meal, another sample was taken for postprandial sugar. Two days later, the same women returned for the DIPSI glucose challenge test. They were given 75g of anhydrous glucose dissolved in 250–300 mL of water, regardless of when they had last eaten. Exactly two hours later, a venous sample was collected and plasma glucose was measured. A reading of ≥140 mg/dL was taken as diagnostic of GDM, in line with DIPSI guidelines.

All three tests were performed across the participant's trimester of pregnancy: first trimester (up to 13 weeks, n=28), second trimester (14–28 weeks, n=54), and third trimester (beyond 28 weeks, n=48). Anthropometric data including height, weight, and BMI were recorded at the time of recruitment. Data on antenatal complications were collected from hospital records and follow-up visits. Statistical analysis included Pearson correlation coefficients, descriptive statistics, and chi-square tests.

**RESULTS**
**Baseline Characteristics**
A total of 130 participants were included in the study. The mean age was 24.8 ± 4.2 years, and the mean BMI was 22.9 ± 3.8 kg/m². The majority of participants (43.1%) were in the 20–25 years age group, followed by 26–30 years (31.5%), below 20 years (13.8%), and 30–35 years (11.5%).

In terms of BMI distribution, nearly half of the participants had a normal BMI (47.7%), while 26.2% were overweight, 13.8% were obese, and 12.3% were underweight. Regarding parity, 52 women were primigravida (G1), 58 were multigravida (G2–G3), and 20 were grand multipara (≥G4).

**Trimester-wise Distribution**
The trimester-wise distribution of the study population showed that the majority of participants were in the second trimester (41.5%, n=54), followed by the third trimester (36.9%, n=48), while the first trimester accounted for the smallest proportion (21.5%, n=28).

**Mean Glucose Values**
The overall mean glucose values across the study population were as follows: GCT: 132.6 ± 28.4 mg/dL; FBS: 82.3 ± 12.6 mg/dL; and PPBS: 118.5 ± 24.2 mg/dL. A moderate positive correlation was observed between GCT and FBS (r=0.52), while strong positive correlations were noted between GCT and PPBS (r=0.68) and between FBS and PPBS (r=0.61).

**Table 1: Mean Glucose Values by Trimester**

| Trimester | GCT (mg/dL) | FBS (mg/dL) | PPBS (mg/dL) |
|---|---|---|---|
| First Trimester | 118.4 | 78.2 | 105.3 |
| Second Trimester | 134.7 | 83.6 | 119.8 |
| Third Trimester | 145.2 | 86.9 | 128.6 |

Mean GCT, FBS, and PPBS values showed a progressive increase across trimesters, with the strongest inter-variable correlation in the third trimester (r=0.72) and the weakest in the first trimester (r=0.41). This progressive trend indicates increasing insulin resistance with advancing gestational age, and greater sensitivity of screening in later trimesters.

**Prevalence of GDM by Screening Method**

**Table 2: GDM Prevalence by Screening Method**

| Screening Method | GDM Cases | Prevalence (%) |
|---|---|---|
| GCT (DIPSI criteria) | 18 | 13.8% |
| FBS + PPBS | 14 | 10.8% |
| Combined (GCT + FBS + PPBS) | 21 | 16.2% |

GCT demonstrated superior sensitivity (13.8%) compared to FBS+PPBS combined (10.8%). A combined screening approach (GCT + FBS + PPBS) achieved the highest detection rate of 16.2%, indicating that GCT identifies additional cases missed by routine fasting/postprandial testing.

**Age-wise and BMI-wise GDM Prevalence**

GDM prevalence showed a progressive increase with advancing maternal age: below 20 years (5.5%), 20–25 years (11.2%), 26–30 years (18.4%), and above 30 years (27.7%). This strongly supports the association between increasing maternal age and GDM risk, consistent with the diabetogenic effects of ageing on insulin sensitivity.

BMI was similarly associated with GDM prevalence: underweight women had the lowest prevalence (~3%), followed by normal BMI (~8%), overweight (~20–21%), and obese women (~33–34%). These findings highlight obesity as a major risk factor for GDM in the Indian antenatal population.

**Trimester-wise and Parity-wise GDM Prevalence**

The prevalence of GDM rose steadily with advancing gestation: approximately 5% in the first trimester, 15% in the second, and 23% in the third trimester. This mirrors the physiological progression of placental insulin-antagonist hormone production across pregnancy.

GDM prevalence also increased with parity: ~11–12% in primigravida, 17% in multigravida (G2–G3), and 25% in grand multipara (≥G4), suggesting that prior pregnancies may compound cumulative metabolic risk.

**Correlation with Antenatal Complications**

Antenatal complications were present in 36.2% of participants. The most common complications were recurrent infections (11.5%), preeclampsia (9.2%), macrosomia (8.5%), and polyhydramnios (6.9%). Mean glucose levels were significantly higher in women with antenatal complications across all modalities.

**Table 3: Correlation of Glucose Parameters with Antenatal Complications**

| Parameter | With Complications (N=47) | Without Complications (N=83) | Correlation (r) | P-value |
|---|---|---|---|---|
| FBS (mg/dL) | 92.4 ± 8.6 | 80.3 ± 6.9 | +0.42 | <0.05 |
| PPBS (mg/dL) | 128.7 ± 14.2 | 109.5 ± 11.6 | +0.51 | <0.05 |
| GCT (mg/dL) | 148.3 ± 18.5 | 121.6 ± 15.3 | +0.63 | <0.01 |

GCT showed the strongest positive correlation with antenatal complications (r=0.63, p<0.01), followed by PPBS (r=0.51, p<0.05) and FBS (r=0.42, p<0.05). This demonstrates that postprandial and challenge-test glucose values are more sensitive markers of maternal metabolic dysfunction and adverse obstetric outcomes than fasting glucose alone.

**DISCUSSION**

This study evaluated and compared the performance of GCT (DIPSI criteria), FBS, and PPBS for GDM screening across all three trimesters in 130 pregnant women at SVS Hospital, Mahbubnagar, Telangana. Our findings align with and extend the existing literature, offering insights particularly relevant to the Indian clinical context.

The overall GDM prevalence of 13.8% by DIPSI criteria in our study is consistent with previously reported rates in South Indian settings, which range from 9.9% to 17.33%.[4] A comparative study from Andhra Pradesh by Sravanthi et al. found

GDM prevalence of 5.34% using GCT and 2.67% using FBS/PPBG, with GCT demonstrating superior case detection.[10] Our findings corroborate this superiority of GCT. More importantly, when all three tests were used in combination, the detection rate climbed to 16.2% — meaning that roughly one in three GDM cases would have been missed if FBS and PPBS alone were relied upon. This underscores the complementary value of using multiple screening modalities in tandem rather than choosing between them.

The DIPSI criteria offer a distinct practical advantage for Indian settings: the absence of a fasting requirement facilitates mass screening even in busy outpatient environments. In our hospital, women often travel significant distances for antenatal care, and asking them to return on a separate day after an overnight fast is a real logistical and economic burden. DIPSI sidesteps this barrier entirely. Pravinraj et al. demonstrated in Puducherry that DIPSI exhibited 79.63% sensitivity and 98.18% specificity against WHO 2013 criteria, with a kappa coefficient of 0.809 indicating near-perfect agreement.[11] These findings reinforce DIPSI as a reliable, feasible, and clinically validated screening and diagnostic tool for the Indian population.

One of the most practically important observations in our data is the progressive rise in mean glucose values across trimesters — GCT values climbed from 118.4 mg/dL in the first trimester to 145.2 mg/dL in the third, an increase of 27 mg/dL. This reflects the well-established physiological escalation of insulin resistance as pregnancy advances, driven by increasing levels of placental hormones such as human placental lactogen, oestrogen, and cortisol.[6] Tong et al. demonstrated that first-trimester fasting plasma glucose is independently associated with GDM risk and adverse outcomes even at values below the diagnostic threshold, suggesting that early metabolic vulnerability exists long before formal GDM is diagnosed.[7] Our first-trimester GCT values showed the weakest correlation with complications (r=0.41), partly because early GDM tends to be milder and the foetal glucose steal phenomenon can mask maternal hyperglycaemia in the first trimester. Nevertheless, a 5% GDM rate at this stage is not negligible — missing these cases early means missing the window for timely dietary intervention and lifestyle modification.

The age-related increase in GDM prevalence from 5.5% in women below 20 years to 27.7% in those above 30 years mirrors findings from multiple Indian and global studies, reflecting the well-documented decline in beta-cell function and insulin sensitivity with advancing age. The strong BMI-GDM gradient observed in our cohort — from approximately 3% in underweight women to 33–34% in obese women — is consistent with evidence that adipose tissue dysfunction, low-grade chronic inflammation, and adipokine dysregulation collectively worsen insulin resistance and lower the threshold for GDM development. These findings reinforce that age and BMI remain the most clinically actionable risk factors that should prompt early and repeated GDM screening.

The correlation between higher glucose values and antenatal complications is both biologically plausible and clinically important. Elevated postprandial glucose — most directly captured by PPBS and GCT — promotes foetal hyperinsulinaemia, which in turn drives increased foetal fat deposition, accelerated somatic growth, and macrosomia. The same mechanism underlies polyhydramnios through foetal polyuria, and the vascular effects of chronic maternal hyperglycaemia contribute to the pathogenesis of preeclampsia through endothelial dysfunction.11 The FLAMINGO randomised controlled trial demonstrated that improved postprandial glycaemic control via flash glucose monitoring significantly reduced the incidence of foetal macrosomia, providing direct evidence that postprandial glucose values — and by extension GCT — are not merely diagnostic thresholds but continuous predictors of adverse obstetric outcomes.[9] The stronger correlation of GCT with complications (r=0.63) compared to PPBS (r=0.51) and FBS (r=0.42) supports using the GCT value not just for diagnosis but as a prognostic marker of obstetric risk.

The importance of not missing any GDM case cannot be overstated. Kansu-Celik et al. found that women who refused glucose tolerance testing had a GDM prevalence of 30.9%, compared to just 8.8% in those who were screened — a threefold difference that illustrates the dangers of undetected gestational diabetes.[8] Their finding that fasting and postprandial plasma glucose testing could serve as an acceptable alternative in women who decline the glucose load further supports our approach of using FBS and PPBS alongside GCT rather than in isolation. Our combined three-test strategy, which yielded a detection rate of 16.2%, reflects exactly this principle.

From a public health and policy perspective, the DIPSI guidelines already recommend universal trimester-wise screening: at the first antenatal visit or before 12 weeks, at 24–28 weeks, and again at 32–34 weeks in high-risk women.[4] Our data strongly support this three-point strategy. The threefold rise in GDM prevalence from the first to the third trimester in our cohort — from 5% to 23% — demonstrates that each trimester provides unique and complementary diagnostic information. A single negative screen in early pregnancy should never be considered sufficient, and repeat testing at each trimester must be reinforced as standard antenatal practice, particularly in a high-risk population like ours.

This study has some limitations that deserve acknowledgement. The overall sample size of 130 is modest, and the first-trimester subgroup (n=28) is relatively small, which may limit the precision of trimester-specific estimates. The study

was conducted at a single tertiary centre in Mahbubnagar, and the findings may not be fully generalisable to all Indian settings or to populations with different background diabetes prevalence. Long-term postnatal follow-up data to assess neonatal outcomes and maternal progression to type 2 diabetes were not available. Future multicentre prospective studies with larger first-trimester cohorts, standardised testing protocols, and long-term follow-up would help consolidate and extend these findings.

## CONCLUSION

The findings of this study make a clear case for the glucose challenge test as the preferred screening tool for GDM in the Indian setting. It detected more cases than fasting or postprandial testing alone, and its values correlated most strongly with adverse pregnancy outcomes. The fact that it does not require fasting makes it realistic to offer at every antenatal visit.

GDM is not a condition that stays the same across pregnancy — it gets more common and more severe as gestation progresses. Screening only once, or only in the second trimester, will miss a meaningful number of cases. The data from this study support trimester-wise repeat testing, ideally at the first antenatal visit, at 24–28 weeks, and again in the third trimester for high-risk women.

The combination of GCT, FBS, and PPBS gave the highest detection rate of 16.2%. The bottom line: screen early, screen again, and use the GCT as the primary tool. It is simple, it works, and in a country where GDM is as common as it is, there is no good reason not to.

## Declaration

**Conflict of Interest:** The author declares no conflict of interest.

**Ethics:** Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

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