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Burden and Feto-Maternal Effects of Gestational Glucose Intolerance Among Expectant Mothers

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Abstract

Background: Pregnancy is associated with progressive insulin resistance, which may lead to gestational glucose abnormalities. Gestational Glucose Intolerance (GGI), defined as borderline hyperglycemia that does not meet diagnostic criteria for gestational diabetes mellitus (GDM), has been relatively under-investigated despite potential feto-maternal risks.

Methods: This prospective observational study included 200 pregnant women attending antenatal care at PSP Medical College Hospital over two years (May 2023–May 2025). Screening for glucose intolerance was performed using the DIPSI 75 g oral glucose challenge at first (9–14 weeks), second (24–28 weeks), and third (32–34 weeks) trimesters. GGI was defined as a 2-hour post-glucose value of 120–139 mg/dL, while GDM was ≥140 mg/dL. Maternal outcomes (hypertensive disorders, polyhydramnios, preterm labor, mode of delivery, and postpartum complications) and fetal/neonatal outcomes (respiratory distress, hypoglycemia, hyperbilirubinemia, growth abnormalities, congenital anomalies, and intrauterine death) were recorded. Data analysis was performed using SPSS v20, applying appropriate parametric and non-parametric tests.

Results: First-trimester screening revealed 6.5% GGI and 1% GDM, which increased in the second trimester to 17.5% and 12.5%, respectively, and in the third trimester to 32.5% GGI and 25% GDM. Maternal complications were more common in the GGI and GDM groups. Among GGI pregnancies, notable fetal outcomes included respiratory distress syndrome (8%), neonatal hypoglycemia (6%), hyperbilirubinemia (5%), and large-for-gestational-age infants (4%). Rare complications included small-for-gestational-age infants, polyhydramnios, shoulder dystocia, birth trauma, congenital malformations, and intrauterine death (≤2.5% each).

Conclusion: GGI is a significant and progressive metabolic disturbance in pregnancy, with a measurable conversion rate to GDM and notable fetal complications. Early detection, repeat screening, and timely intervention are essential to reduce perinatal morbidity and optimize maternal and neonatal outcomes.

Keywords: Gestational glucose intolerance, gestational diabetes mellitus, DIPSI, pregnancy, maternal outcomes, fetal outcomes, neonatal complications.

Introduction

Pregnancy is a unique physiological state marked by extensive metabolic and hormonal adjustments that allow maternal adaptation and support fetal development. A key change is the gradual increase in insulin resistance during the second and third trimesters, mainly due to placental hormones such as human placental lactogen, progesterone, cortisol, and prolactin [1]. In most healthy pregnancies, this is balanced by enhanced pancreatic β-cell insulin secretion, ensuring that blood glucose levels remain normal [2]. When this compensatory mechanism is inadequate, varying degrees of hyperglycemia may occur [3].

Traditionally, hyperglycemia in pregnancy has been categorized as gestational diabetes mellitus (GDM) or diabetes first recognized during pregnancy. Recently, attention has shifted to an intermediate category termed Gestational Glucose Intolerance (GGI), in which glucose values are elevated but do not meet the diagnostic criteria for GDM [4]. Although previously overlooked, evidence suggests that GGI may contribute to maternal complications, adverse perinatal outcomes, and future metabolic disease in both mother and child [5].

Globally, hyperglycemia affects an estimated 16–18% of pregnancies, with GDM forming the majority of cases [6]. In India, reported prevalence ranges from 10% to 20%, influenced by population characteristics, lifestyle transitions, and diagnostic methods used [7]. With rising obesity rates and increasing incidence of type 2 diabetes, both GGI and GDM have become important public health concerns [8]. GDM is widely recognized as a major contributor to maternal and neonatal morbidity, including pregnancy-induced hypertension, operative delivery, neonatal hypoglycemia, macrosomia, and long-term metabolic risks [9]. In comparison, GGI—defined by the DIPSI criteria as a 2-hour post–75 g glucose value of 120–139 mg/dL—has received limited attention despite being associated with similar adverse feto-maternal outcomes [10]. The lack of epidemiological data on GGI incidence and clinical impact represents a significant gap in obstetric and endocrine practice [11].

Understanding GGI is essential for recognizing the continuum of dysglycemia in pregnancy. Early identification of borderline glucose intolerance offers an opportunity for timely lifestyle counseling, closer monitoring, and preventive care, potentially reducing progression to GDM and future diabetes risk [12]. In India's high-diabetes-burden setting, generating local data on GGI is crucial to refine screening strategies, guide clinical decision-making, and inform updates to guidelines developed by WHO, DIPSI, and ICMR.

Materials and Methods

Study Design

This prospective observational study was conducted to evaluate the prevalence of gestational glucose intolerance (GGI) and gestational diabetes mellitus (GDM), along with their associated maternal and fetal outcomes among pregnant women.

Study Setting and Duration

The study was carried out in the Department of Obstetrics and Gynecology at PSP Medical College Hospital and Research Institute over a period of two years, from May 2023 to May 2025.

Study Population

The study population comprised pregnant women attending the antenatal clinic between 9 and 16 weeks of gestation who planned to deliver at the study institution. Eligible participants were enrolled using convenience sampling.

Sample Size

A total of **200 pregnant women** were included in the study. The sample size was determined based on the estimated prevalence of gestational glucose intolerance reported in previous Indian studies, with a 5% allowable error and a 95% confidence level.

Inclusion Criteria

Pregnant women aged 18 years and above with singleton pregnancies between 9 and 16 weeks of gestation, willing to participate in the study, provide written informed consent, and deliver at the study institution were included.

Exclusion Criteria

Women younger than 18 years, those with pre-existing diabetes mellitus, chronic hypertension, endocrine disorders, cardiac diseases, autoimmune disorders, multiple pregnancies, or those unwilling to provide informed consent or deliver at the study hospital were excluded.

Data Collection Tool

After obtaining written informed consent, demographic characteristics, obstetric history, medical history, and findings of general, systemic, and obstetric examinations were recorded using a structured pre-tested case record proforma. All participants underwent a single-step 75 g oral glucose challenge test (OGCT) according to the Diabetes in Pregnancy Study Group India (DIPSI) guidelines irrespective of fasting status. Two-hour venous plasma glucose levels were estimated using the glucose oxidase–peroxidase method. Gestational Glucose Intolerance (GGI) was defined as a two-hour plasma glucose value between 120 and 139 mg/dL, while Gestational Diabetes Mellitus (GDM) was diagnosed when the value was 140 mg/dL or higher. Women with normal initial screening underwent repeat testing at 24–28 weeks and again at 32–34 weeks of gestation. Participants were prospectively followed throughout pregnancy, labour, delivery, and the postpartum period. Maternal outcomes assessed included gestational hypertension, preeclampsia, polyhydramnios, urinary tract infection, premature rupture of membranes (PROM), preterm premature rupture of membranes (PPROM), preterm labour, malpresentation, labour complications, mode of delivery, postpartum hemorrhage, puerperal sepsis, and duration of hospital stay. Neonatal outcomes included birth weight, large-for-gestational-age status, intrauterine growth restriction, congenital anomalies, intrauterine fetal death, shoulder dystocia, birth trauma, neonatal hypoglycaemia, respiratory distress syndrome, hyperbilirubinaemia, neonatal intensive care unit admission, and neonatal mortality.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of PSP Medical College Hospital and Research Institute prior to commencement of the study. Written informed consent was obtained from all participants after explaining the study objectives and procedures in their local language. Confidentiality of participant information was maintained throughout the study by assigning unique identification numbers. All study procedures were conducted in accordance with the ethical principles of the Indian Council of Medical Research (ICMR) guidelines and the Declaration of Helsinki.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software version 20.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range based on data distribution, while categorical variables were summarized as frequencies and percentages. Normality of continuous variables was assessed using the Shapiro–Wilk test. Comparisons between groups were performed using the independent sample *t*-test or one-way analysis of variance (ANOVA) for normally distributed variables, and the Mann–Whitney U test for non-normally distributed variables. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test, as appropriate. Multivariate logistic regression analysis was performed to identify independent predictors of adverse maternal and neonatal outcomes after adjusting for potential confounding variables. Odds ratios with 95% confidence intervals were calculated. A p-value of ≤ 0.05 was considered statistically significant.

Results

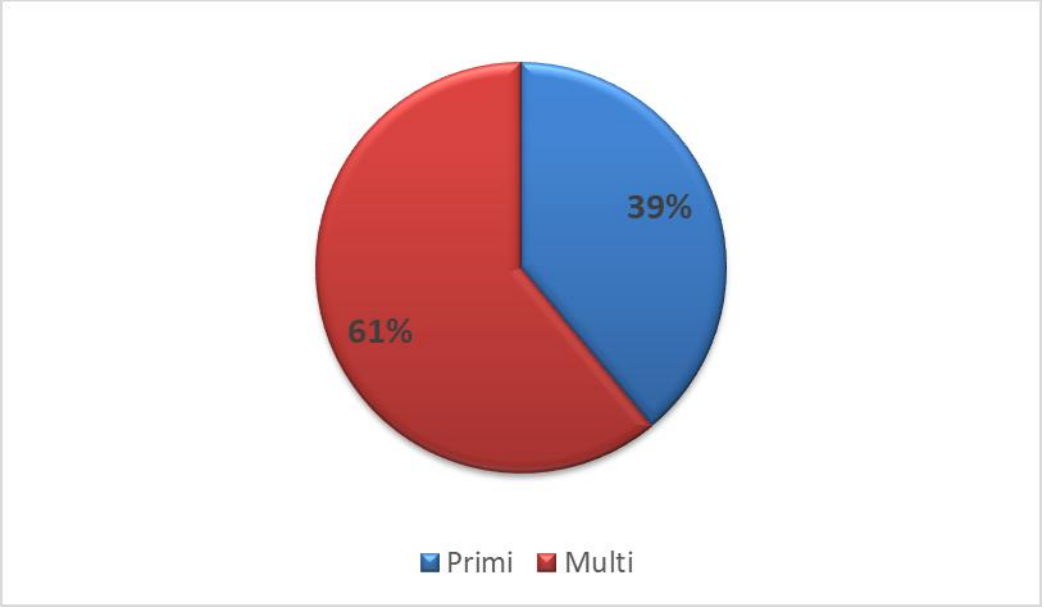

Figure 1: Obstetric Score (N = 200)

The table shows the distribution of pregnant women based on their obstetric score. Out of the 200 participants, 39% were primigravida (first pregnancy) and 61% were multigravida (having had one or more previous pregnancies).

Table 1: DIPSI Screening Values – 1st Trimester (9–14 Weeks)

DIPSI Values (mg/dL)	Frequency	Percent (%)
<120 (NGT)	180	90.0
120–139 (GGI)	13	6.5
≥140 (GDM)	2	1.0
Lost to Follow-up (LTF)	5	2.5
Total	200	100.0

Among the 200 pregnant women screened using the DIPSI test, 90% had normal glucose tolerance (NGT) with values <120 mg/dL. Gestational Glucose Intolerance (GGI) was identified in 6.5%, while Gestational Diabetes Mellitus (GDM) was detected in 1% of the participants. Additionally, 2.5% were lost to follow-up.

Table 2: DIPSI Screening Values – 2nd Trimester (24–28 Weeks)

DIPSI Values (mg/dL)	Frequency	Percent (%)
<120 (NGT)	130	65.0
120–139 (GGI)	35	17.5
≥140 (GDM)	25	12.5
Lost to Follow-up (LTF)	10	5.0
Total	200	100.0

Out of the 200 pregnant women screened, 65% had normal glucose tolerance (NGT) with DIPSI values <120 mg/dL. Gestational Glucose Intolerance (GGI) was observed in 17.5%, and Gestational Diabetes Mellitus (GDM) in 12.5% of the participants. Additionally, 5% were lost to follow-up.

Table 3: DIPSI Screening Values – 3rd Trimester (32–34 Weeks)

DIPSI Values (mg/dL)	Frequency	Percent (%)
<120 (NGT)	65	32.5
120–139 (GGI)	65	32.5
≥140 (GDM)	50	25.0
Lost to Follow-up (LTF)	20	10.0
Total	200	100.0

Among the 200 pregnant women screened using DIPSI, 32.5% had normal glucose tolerance (NGT) with values <120 mg/dL. An equal proportion, 32.5%, were identified with Gestational Glucose Intolerance (GGI). Gestational Diabetes Mellitus (GDM) was detected in 25% of the participants, indicating a considerable burden of hyperglycemia in pregnancy. Additionally, 10% of the women were lost to follow-up.

Table 4: Fetal Outcomes in GGI Mothers (Adjusted for 200 Samples)

Fetal Outcome	Frequency	Percent (%)
Respiratory distress syndrome	16	8.0
Neonatal hypoglycaemia	12	6.0
Hyperbilirubinemia	10	5.0
Large for gestational age (LGA)	8	4.0
Small for gestational age (SGA)	6	3.0
Polyhydramnios	5	2.5
Shoulder dystocia	4	2.0
Birth trauma	1	0.5
Congenital malformations	1	0.5
Intrauterine death	1	0.5

In the present study, respiratory distress syndrome was the most frequently observed fetal complication, affecting 8% of newborns. This was followed by neonatal hypoglycaemia (6%) and hyperbilirubinemia (5%), indicating that metabolic and respiratory issues were relatively common. Growth-related outcomes included large-for-gestational-age infants (4%) and small-for-gestational-age babies (3%). Less frequent complications were polyhydramnios (2.5%), shoulder dystocia (2%), and rare events such as birth trauma, congenital malformations, and intrauterine death (each 0.5%).

Discussion

In our cohort of 200 pregnant women, abnormal glucose tolerance increased progressively with advancing gestation. Gestational glucose intolerance (GGI) and gestational diabetes mellitus (GDM) were uncommon in the first trimester (approximately 7.5%), but by 24–28 weeks, nearly 30% of women had GGI or GDM, and by 32–34 weeks, the combined burden rose to about 57.5%. This progressive rise is consistent with the pathophysiological understanding that insulin resistance increases during the second and third trimesters due to placental hormone effects, as outlined by McIntyre et al. [1] and Zhu and Zhang [2]. Similar Indian hospital-based studies have reported a rising prevalence of carbohydrate intolerance across gestation, with approximately one-third of women screened in mid-pregnancy diagnosed with GGI or GDM, comparable to our findings, as reported by Huvinen et al. [13] and Agarwal [14].

The observed conversion from GGI to GDM in our cohort (11% overall, with higher conversion in later trimesters) aligns with previous literature indicating that a proportion of women with borderline hyperglycemia progress to overt GDM as pregnancy advances. Longitudinal evidence suggests that early glucose abnormalities represent a risk marker for later deterioration, reinforcing the need for repeat screening rather than reliance on a single early test. These observations are consistent with diagnostic and follow-up recommendations described by the World Health Organization [15] and the IADPSG Consensus Panel [16]. Fetal morbidity in our GGI group was notable, particularly respiratory distress syndrome (8%) and neonatal hypoglycemia (6%). Similar associations between mild gestational hyperglycemia and adverse neonatal outcomes have been reported previously. Barquiel et al. [5] documented increased neonatal complications in women with isolated abnormal glucose values, while Li et al. [7] demonstrated a higher risk of neonatal respiratory distress syndrome among infants born to mothers with gestational dysglycemia. These findings support earlier observations from the HAPO study by Metzger et al. [9], which showed a continuous relationship between maternal glycemia and adverse perinatal outcomes, even below traditional diagnostic thresholds, reinforcing that GGI is not a benign condition.

Variations between our prevalence estimates and those reported in other studies may be explained by methodological differences. Diagnostic criteria and screening protocols vary widely; the DIPSI one-step non-fasting 75 g glucose test used in our study may yield prevalence estimates that differ from IADPSG or WHO-based approaches. Comparative analyses have highlighted that DIPSI may under- or overestimate GDM prevalence depending on population characteristics and timing of testing, as discussed by Agarwal [14] and Seshiah et al. [18]. Additionally, tertiary referral bias, maternal age distribution, body mass index, and ethnic or regional factors may further contribute to differences in reported rates, explaining the relatively higher third-trimester burden observed in our cohort compared with community-based studies. Overall, our findings support the growing body of evidence that borderline hyperglycemia in pregnancy (GGI) carries significant perinatal risk and a meaningful likelihood of progression to GDM. This underscores the importance of repeat screening, vigilant follow-up, and timely lifestyle or pharmacological intervention when indicated, particularly in populations with a high baseline risk of diabetes. These conclusions are consistent with recommendations from the American Diabetes Association [6,17] and conceptual frameworks proposed by Gupta et al. [10]. Future studies should incorporate longitudinal glycemic control data and adjust for confounding variables such as maternal BMI, age, and treatment modality to better delineate the independent contribution of GGI to adverse neonatal outcomes.

Strengths

This prospective study utilized the standardized DIPSI screening protocol with repeated glucose testing at different stages of pregnancy, enabling early identification of gestational glucose intolerance and gestational diabetes mellitus. Comprehensive follow-up throughout pregnancy, delivery, and the neonatal period allowed detailed assessment of both maternal and fetal outcomes.

Limitations

The study was conducted at a single tertiary care institution using convenience sampling, which may limit the generalizability of the findings. In addition, long-term maternal metabolic outcomes and childhood follow-up after birth were not assessed, limiting evaluation of the long-term impact of gestational glucose intolerance and gestational diabetes mellitus.

Conclusion

In this study of 200 pregnant women, gestational glucose abnormalities increased across trimesters, with GGI progressing to GDM in some cases. GGI was associated with notable fetal complications, including respiratory distress, neonatal hypoglycemia, and hyperbilirubinemia. These findings emphasize the importance of early detection, repeat screening, and timely intervention to improve maternal and neonatal outcomes.

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