Section: Miscellaneous

Original Research Article

PREVALENCE AND ASSOCIATION OF RISK FACTORS AND MATERNAL CHARACTERISTICS WITH EARLY PREGNANCY GLUCOSE INTOLERANCE BASED ON MODIFIED DIPSI CRITERIA

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ABSTRACT

Background: Early pregnancy represents a critical period to identify women at risk for glucose intolerance and prevent adverse maternal and fetal outcomes. The Modified DIPSI criteria offer a single-step, and low-cost method for detecting dysglycemia in pregnancy. The aim is to determine the prevalence and association of risk factors and maternal characteristics with early pregnancy glucose intolerance using the Modified DIPSI criteria.

Materials and Methods: A hospital-based cross-sectional study was conducted among 325 pregnant women attending their first antenatal visit at Rangadore Memorial Hospital, Bengaluru. Each participant received 75 g oral glucose after overnight fasting (due to hospital protocol), and a 2-hour venous plasma glucose was measured using the glucose oxidase-peroxidase method. Women were categorized as normal (<120 mg/dL), decreased gestational glucose tolerance (DGGT: 120-139 mg/dL), gestational diabetes mellitus (GDM: 140-199 mg/dL), or overt diabetes (≥200 mg/dL). Associations with maternal age, BMI, parity, family history of diabetes, PCOS, and hypothyroidism were analyzed using the Chi-square test, with $p < 0.05$ considered statistically significant.

Results: The mean age of participants was 28.6 ± 3.9 years. The prevalence of DGGT, GDM, and overt diabetes was 13.2%, 7.1%, and 0.3%, respectively, yielding an overall glucose intolerance rate of 20.6%. Significant associations were found with BMI >25 kg/m² (RR=4.20, p<0.001), family history of diabetes (RR=11.95, p<0.001), PCOS (RR=3.53, p<0.001), hypothyroidism (RR=4.04, p<0.001), and multiparity (RR=1.82, p=0.001). Women registering after 8 weeks of gestation had a higher prevalence of GDM (p=0.003).

Conclusion: One in five pregnant women screened early in pregnancy exhibited glucose intolerance using the Modified DIPSI criteria. Early universal screening at the first antenatal visit is essential for timely diagnosis and preventive management, particularly among women with obesity, endocrine disorders, and a family history of diabetes.

Keywords: Modified DIPSI criteria, Early pregnancy, Glucose intolerance.

INTRODUCTION

Diabetes mellitus (DM) and gestational diabetes mellitus (GDM) are among the most significant public health concerns worldwide due to their rising prevalence and long-term consequences for both mothers and their offspring. Pregnancy represents a naturally diabetogenic state, largely attributed to increased insulin resistance induced by placental hormones such as human placental lactogen, progesterone, and placental growth hormone. GDM is defined as glucose intolerance of variable severity with onset or first recognition during pregnancy, whereas overt diabetes denotes hyperglycemia meeting diagnostic criteria for diabetes in non-pregnant adults but first detected during gestation.[1]

The global prevalence of hyperglycemia in pregnancy is estimated at approximately 16.9%, with the highest rates in Southeast Asia, where one in seven pregnancies is affected. India, being the diabetes capital of the world, faces an escalating burden due to a combination of genetic predisposition, sedentary lifestyle, and rising obesity rates. Women of Asian descent, particularly South Asians, are more prone to visceral adiposity and insulin resistance, which contribute to their higher susceptibility to glucose intolerance during pregnancy.[2]

The clinical significance of GDM lies in its association with multiple maternal and fetal complications, including preeclampsia, polyhydramnios, macrosomia, shoulder dystocia, neonatal hypoglycemia, and increased perinatal morbidity and mortality. Additionally, women with GDM face a 10-fold higher risk of developing type 2 diabetes later in life, while their offspring are predisposed to obesity, metabolic syndrome, and impaired glucose tolerance in adulthood.[3]

Early screening for glucose intolerance is crucial, as timely intervention through dietary regulation, physical activity, and pharmacologic therapy can significantly reduce these complications. However, conventional diagnostic criteria such as those by WHO, ADA, IADPSG, and Carpenter & Coustan often require fasting samples and multiple blood draws, which are challenging to implement in low-resource settings. The Diabetes in Pregnancy Study Group India (DIPSI) introduced a simplified, single-step, non-fasting 75g oral glucose tolerance test (OGTT) with a 2-hour plasma glucose measurement, making it a cost-effective and practical screening tool for India's diverse population.[4]

The Modified DIPSI criteria have further refined this approach by categorizing outcomes as follows: plasma glucose ≥200 mg/dL for overt diabetes, ≥140 mg/dL for GDM, and 120-139 mg/dL for decreased gestational glucose tolerance (DGGT). Identifying DGGT early allows healthcare providers to initiate lifestyle modifications that may prevent progression to GDM and reduce adverse outcomes.[5]

Aim: To determine the prevalence and association of risk factors and maternal characteristics with early pregnancy glucose intolerance using Modified DIPSI criteria.

Objectives

1. To estimate the prevalence of overt diabetes, gestational diabetes mellitus (GDM), and decreased gestational glucose tolerance (DGGT) during the first antenatal visit.
2. To analyze the association of risk factors such as BMI, parity, age, family history of diabetes, hypothyroidism, and PCOS with glucose intolerance.
3. To assess the relationship between maternal characteristics and the prevalence of GDM, DGGT, and overt diabetes using Modified DIPSI criteria.

MATERIALS AND METHODS

Source of Data: All pregnant women attending their first antenatal (booking) visit at the Department of Obstetrics and Gynaecology, Rangadore Memorial Hospital, Bengaluru, who fulfilled the inclusion criteria.

Study Design: Hospital-based cross-sectional observational study.

Study Location: Department of Obstetrics and Gynaecology, Rangadore Memorial Hospital, Shankarapuram, Basavanagudi, Bengaluru.

Study Duration: March 2023 to August 2024.

Sample Size: 325 pregnant women.

Inclusion Criteria

1. Pregnant women with a confirmed viable intrauterine pregnancy attending the first antenatal visit.
2. Testing performed in the hospital laboratory.

Exclusion Criteria

1. Women with known diabetes mellitus prior to conception.
2. Patients with miscarriage or abortion.
3. Women unable to tolerate oral glucose solution.
4. Samples processed outside the hospital laboratory.

Procedure and Methodology: Eligible participants were enrolled consecutively after obtaining informed consent. Due to hospital protocol participants were instructed to fast overnight prior to the test. Each participant was given 75g oral glucose (Nutriright powder) dissolved in 200 mL of water, as per Modified DIPSI protocol which is designed to be performed irrespective of fasting status. Blood samples were collected exactly two hours after ingestion, and plasma glucose was measured in the hospital laboratory using a glucose oxidase-peroxidase (GOD-POD) enzymatic method.

Based on the 2-hour plasma glucose value:

- ≥200 mg/dL → Overt Diabetes
- 140-199 mg/dL → Gestational Diabetes Mellitus (GDM)
- 120-139 mg/dL → Decreased Gestational Glucose Tolerance (DGGT)
- <120 mg/dL → Normal

Anthropometric data (height, weight, BMI), gestational age, parity, family history of diabetes, hypothyroidism, and polycystic ovarian syndrome were recorded using a structured proforma. Participants were counseled to avoid food and strenuous activity until the 2-hour blood draw.

Sample Processing: Venous blood samples were centrifuged, and plasma glucose estimation was carried out immediately using a fully automated analyzer to avoid glycolytic loss.

Data Collection: Patient details, clinical history, and laboratory results were entered into a predesigned Excel sheet. Confidentiality was maintained throughout.

Statistical Methods: Data were analyzed using IBM SPSS version 29. Descriptive statistics (mean,

standard deviation, frequency, and percentage) summarized baseline variables. The Chi-square test assessed associations between categorical variables such as parity, BMI, and diagnosis categories (Normal, DGGT, GDM, Overt). A p-value <0.05 was considered statistically significant.

RESULTS

[Table 1] presents the baseline demographic and clinical profile of 325 pregnant women assessed during their first antenatal visit. The mean age of participants was 28.6 ± 3.9 years (95% CI 28.18-29.02), with the majority (49.5%) belonging to the 26-30 year age group, followed by 27.1% aged 31-35 years. Only 3.4% were older than 35 years, indicating a predominantly younger cohort. The mean gestational age at booking was 7.2 ± 0.9 weeks, with most women (51.7%) registering between 6-7 weeks of gestation. Primiparous women constituted 52% of the study population, while 48% were multiparous. The mean weight and height were 61.6 ± 7.7 kg and 158.8 ± 3.6 cm respectively, yielding a mean BMI of 24.4 ± 3.1 kg/m². Mean systolic and diastolic blood pressures were 109.3 ± 10.5 mmHg and 71.1 ± 6.2 mmHg respectively, within the normal range. Regarding risk factors, 45.2% of participants had BMI > 25 kg/m², 38.2% had a first-degree family history of diabetes, 10.8% had polycystic ovarian syndrome (PCOS), 10.5% had hypothyroidism, and 2.8% were of advanced maternal age (> 35 years). The mean 2-hour glucose level at booking was 103.7 ± 24.0 mg/dL (95% CI 101.09-106.31), indicating that most women were normoglycemic early in pregnancy.

Table 1: Baseline profile of the cohort (N = 325)

Variable	n (%) or Mean (SD)	95% CI
Age (years)	28.6 (3.9)	28.18 to 29.02
18-20	7 (2.2%)	0.6% to 3.7%
21-25	58 (17.8%)	13.6% to 22.0%
26-30	161 (49.5%)	44.2% to 54.8%
31-35	88 (27.1%)	22.3% to 31.9%
>35	11 (3.4%)	1.4% to 5.5%
Gestational age at booking (weeks)	7.2 (0.9)	7.10 to 7.30
<6	5 (1.5%)	0.2% to 2.8%
6-7	168 (51.7%)	46.3% to 57.0%
7-8	93 (28.6%)	23.7% to 33.4%
>8	59 (18.2%)	14.0% to 22.4%
Parity		
Primipara	169 (52.0%)	46.6% to 57.4%
Multipara	156 (48.0%)	42.6% to 53.4%
Anthropometry & BP		
Weight (kg)	61.6 (7.7)	60.76 to 62.44
Height (cm)	158.8 (3.6)	158.41 to 159.19
BMI (kg/m²)	24.4 (3.1)	24.06 to 24.74
SBP (mmHg)	109.3 (10.5)	108.16 to 110.44
DBP (mmHg)	71.1 (6.2)	70.43 to 71.77
Risk factors		
BMI >25 kg/m²	147 (45.2%)	39.8% to 50.6%
First-degree family history of DM	124 (38.2%)	32.9% to 43.4%
PCOS	35 (10.8%)	7.4% to 14.1%
Hypothyroidism	34 (10.5%)	7.1% to 13.8%
Maternal age >35 years	9 (2.8%)	1.0% to 4.6%
GTT (2-h glucose at booking, mg/dL)	103.7 (24.0)	101.09 to 106.31

Table 2: Prevalence at booking by Modified DIPSI categories (N = 325)

Category	n (%)	95% CI
Normal	258 (79.4%)	75.0% to 83.8%
DGGT (120-139 mg/dL)	43 (13.2%)	9.5% to 16.9%
GDM (≥140-199 mg/dL)	23 (7.1%)	4.3% to 9.9%
Overt diabetes (≥200 mg/dL)	1 (0.3%)	0.0% to 0.9%
Any glucose intolerance (DGGT+GDM+Overt)	67 (20.6%)	16.2% to 25.0%

Table 3: Association of key risk factors with any glucose intolerance (DGGT+GDM+Overt) vs Normal

Risk factor	Exposed: cases / total (%)	Unexposed: cases / total (%)	Association (effect size)	95% CI	Test (χ^2)	p-value
BMI >25 kg/m²	52/147 (35.4%)	15/178 (8.4%)	RR = 4.20	2.47 to 7.14	40.74	<0.001
First-degree family history of DM	59/124 (47.6%)	8/201 (4.0%)	RR = 11.95	5.91 to 24.16	90.05	<0.001
PCOS	20/35 (57.1%)	47/290 (16.2%)	RR = 3.53	2.39 to 5.20	39.00	<0.001
Hypothyroidism	21/34 (61.8%)	46/291 (15.8%)	RR = 4.04	2.79 to 5.85	383.26	<0.001
Maternal age >35 y	5/9 (55.6%)	62/316 (19.6%)	RR = 2.83	1.51 to 5.29		
Multiparity	42/156 (26.9%)	25/169 (14.8%)	RR = 1.82	1.17 to 2.84	16.58	0.001

[Table 2] summarizes the prevalence of glucose intolerance in early pregnancy according to the Modified DIPSI criteria. Out of 325 women screened, 258 (79.4%, 95% CI 75.0-83.8%) were classified as normal. Decreased gestational glucose tolerance (DGGT) was observed in 43 (13.2%, 95% CI 9.5-16.9%), gestational diabetes mellitus (GDM) in 23 (7.1%, 95% CI 4.3-9.9%), and overt diabetes in 1 (0.3%). When combined, any form of glucose intolerance (DGGT + GDM + overt) was detected in 20.6% (95% CI 16.2-25.0%) of the cohort.

[Table 3] explores the association of key maternal risk factors with early pregnancy glucose intolerance. Women with BMI > 25 kg/m² had a four-fold higher risk of glucose intolerance compared to those with BMI ≤ 25 (RR = 4.20, 95% CI 2.47-7.14; $\chi^2 = 40.74$; $p < 0.001$). The strongest association was observed with a first-degree family history of diabetes, conferring nearly a twelve-fold risk (RR = 11.95, 95% CI 5.91-24.16; $\chi^2 = 90.05$; $p < 0.001$). PCOS (RR = 3.53, 95% CI 2.39-5.20; $p < 0.001$) and hypothyroidism (RR = 4.04, 95% CI 2.79-5.85; $p < 0.001$) were also significantly associated with early glucose intolerance. Multiparous women had a nearly two-fold increased risk (RR = 1.82; p = 0.001), and women older than 35 years demonstrated a 2.8-fold elevation in risk (95% CI 1.51-5.29).

Table 4: Relationship between maternal characteristics and distribution of DGGT / GDM / Overt diabetes at booking

Characteristic (levels)	Normal n=258	DGGT n=43	GDM n=23	Overt n=1	Test (χ^2)	p-value
Age groups (y): 18-20 / 21-25 / 26-30 / 31-35 / >35	7/53/125/66/7	0/5/25/12/1	0/0/10/10/3	0/0/1/0/0	19.11	0.086
GA at booking: <6 / 6-7 / 7-8 / >8 w	5/141/75/37	0/20/13/10	0/7/4/12	0/0/1/0	24.87	0.003
Parity: Primipara / Multipara	144 / 114	21 / 22	3 / 20	1 / 0	16.58	0.001
BMI >25 kg/m²: Yes / No	95 / 163	29 / 14	22 / 1	1 / 0	40.74	<0.001
Family history (1° relative): Yes / No	65 / 193	36 / 7	22 / 1	1 / 0	90.05	<0.001
PCOS: Yes / No	15 / 243	14 / 29	5 / 18	1 / 0	39.00	<0.001
Hypothyroidism: Yes / No	12 / 246	11 / 32	10 / 13	0 / 1	383.26	<0.001

[Table 4] delineates the relationship between maternal characteristics and the specific categories of glucose intolerance DGGT, GDM, and overt diabetes identified at booking. Although the prevalence of glucose intolerance increased with age, the association did not reach statistical significance ($\chi^2 = 19.11$, $p = 0.086$). A significant relationship was observed between gestational age at booking and glucose status ($\chi^2 = 24.87$, $p = 0.003$), indicating higher rates of GDM among women registering later in pregnancy. Multiparity showed a strong association ($\chi^2 = 16.58$, $p = 0.001$), with higher glucose intolerance among multiparous women. Elevated BMI (> 25 kg/m²) was significantly related to abnormal glucose levels ($\chi^2 = 40.74$, $p < 0.001$). Similarly, the presence of a first-degree family history of diabetes ($\chi^2 = 90.05$, $p < 0.001$), PCOS ($\chi^2 = 39.00$, $p < 0.001$), and hypothyroidism ($\chi^2 = 383.26$, $p < 0.001$) showed highly significant associations with both DGGT and GDM.

DISCUSSION

In this hospital-based early-pregnancy cohort (N=325), women were relatively young (mean age 28.6 years) with just 3-4% >35 years, and over half booked by 6-7 weeks features typical of Indian urban antenatal clinics with active first-trimester registration. Nearly half were primiparous (52.0%) and 48.0% multiparous, and metabolic risk was common: BMI>25 kg/m² in 45%, and a first-degree family history of diabetes in 38% (Table 1). Rawat D et al (2023).[6] The overall 2-hour glucose at booking averaged 104 mg/dL, yet one in five women already showed dysglycaemia by the Modified DIPSI screen: DGGT 13.2%, GDM 7.1%, and overt diabetes 0.3%, yielding any glucose intolerance = 20.6% (Table 2). Khursheed R et al (2022).[7] These point estimates are consistent with the higher end of Indian data for first-trimester screening using DIPSI/modified DIPSI (typically =10-22%), and higher than many second-trimester, fasting-OGTT-based reports differences that likely reflect earlier timing, single-step non-fasting methodology, and the high background metabolic risk in South Asian women. DGGT proportion (13.2%) is notable: several Indian programs report a substantial "intermediate" dysglycaemia stratum in early pregnancy, which can progress to GDM if not addressed with diet/physical-activity counseling Mishra S et al (2023).[8] (Prevalences and strata from dataset: Normal 79.4%, DGGT 13.2%, GDM 7.1%, Overt 0.3%.)

Risk-factor associations in analyses mirror the global and Indian literature. Elevated BMI (>25 kg/m²) showed a 4-fold higher risk of early glucose intolerance (RR=4.2; χ^2=40.7; p<0.001), aligning with meta-analytic evidence that overweight/obesity confers a 2-4× higher odds of GDM. A first-degree family history of diabetes displayed the strongest signal in data (RR=12; χ^2=90.0; p<0.001), reinforcing the heritable and familial-environment components repeatedly documented in Asian cohorts Rakibul-Hasan M et al (2020).[9] Endocrine comorbidities were also prominent: PCOS (RR=3.5; p<0.001) is a well-established risk enhancer via pre-existing insulin resistance and hyperandrogenism,[6] hypothyroidism (RR=4.0; p<0.001) is consistent with reports linking thyroid dysfunction to higher GDM risk and adverse metabolic milieu.[7] Multiparity (RR=1.8; p=0.001) further increased risk an effect often attributed to cumulative weight retention and progressive insulin resistance across pregnancies Jain

R. (2024)[10]. (specific test statistics: BMI χ^2=40.743; family history χ^2=90.047; PCOS χ^2=39.003; parity χ^2=16.583; all p<0.01.)
Importantly, timing of booking showed a graded association with dysglycaemia categories: later first-visit (>8 weeks) had more GDM (=20%), and overall the χ^2 for GA-at-booking vs diagnosis was 24.9 (p=0.003). This supports early universal screening: a single-step, 75-g load at the first contact catches high-risk women sooner practical and scalable in Indian settings where fasting, multi-sample OGTTs face compliance barriers Biju PB et al (2024).[11] Finding dovetails with recommendations to screen at the first antenatal visit and repeat at 24-28 weeks if normal initially, particularly in South Asian populations with high baseline risk Sontakke NR et al (2022).[12] (GA-booking association: χ^2=24.865; p=0.003.)

CONCLUSION

The present study demonstrated that early pregnancy glucose intolerance, when screened using the Modified DIPSI criteria, was prevalent in approximately one-fifth of antenatal women at their first booking visit. The simplified, single-step DIPSI method proved to be a feasible and practical approach for early detection of dysglycaemia in routine antenatal care. Overweight and obesity, a positive family history of diabetes mellitus, polycystic ovarian syndrome (PCOS), hypothyroidism, and multiparity were strongly associated with early glucose intolerance. These findings emphasize the importance of universal screening at the first antenatal contact rather than selective testing based on risk factors alone. Early identification allows timely intervention through lifestyle modification and monitoring, thereby reducing the likelihood of maternal and fetal complications associated with gestational diabetes mellitus (GDM). The study underscores that the Modified DIPSI approach is well-suited to the Indian context for large-scale screening and early risk stratification in pregnancy.
Limitations: The study was cross-sectional in nature; hence, it could not assess the longitudinal progression of women with decreased gestational glucose tolerance (DGGT) to overt GDM later in pregnancy. The sample was drawn from a single tertiary-care hospital, which may limit generalizability to rural or community settings. Although the modified DIPSI test is recommended irrespective of fasting status, all participants were given glucose solution in fasting state as per hospital protocol. This might have changed the prevalence estimate to slightly lower than expected, because fasting tends to yield lower glucose values. The use of a single 2-hour post-glucose measurement did not allow evaluation of fasting or 1-hour values, potentially leading to underestimation or overestimation of dysglycaemia in some cases. Dietary factors, physical activity, and socioeconomic status were not comprehensively analyzed, which may have influenced the risk factor associations. Finally, biochemical confirmation by HbA1c or repeat OGTT at 24-28 weeks could have strengthened diagnostic accuracy and follow-up outcome correlations.

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