

International Journal of Clinical Obstetrics and Gynaecology



ISSN (P): 2522-6614
ISSN (E): 2522-6622
Indexing: Embase
Impact Factor (RJIF): 6.71
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www.gynaecologyjournal.com
2025; 9(6): 58-61
Received: 13-08-2025
Accepted: 19-09-2025

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Incidence of gestational diabetes mellitus and their associated factors: Descriptive study

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DOI: <https://www.doi.org/10.33545/gynae.2025.v9.i6a.1728>

Abstract

GDM is associated with adverse maternal and perinatal outcomes, such as fetal overgrowth, shoulder dystocia, operative delivery, birth injury, pre-eclampsia, haemorrhage and preterm delivery, but also a sevenfold higher risk of the mother developing T2 DM after pregnancy. In addition, the maternal metabolic milieu was also identified as a key determinant for the susceptibility to congenital anomaly, obesity, metabolic syndrome and T2DM in the offspring, a phenomenon often described as ‘fetal programming’. A standard performa was given to all patients meeting the inclusion criteria. Performa included demographics, obstetric history, past history, family history, auxology, 1st trimester HbA1C values, 2nd trimester GTT results and USG, 3rd trimester GTT and USG results, baby details. HbA1c was done routinely with other 1st trimester routine investigations. Among the 420 antenatal women, 18.8% were diagnosed with GDM by 75 g GTT. In the study population, 59.5% subjects were diagnosed with GDM between 24-28 weeks, 40.5% between 32-36 weeks. Mean gestational age of diagnosis of GDM is 29 ± 4.10 weeks. In the study population, 75.9% of subjects diagnosed with GDM were managed with MNT and 24.1% of GDM patients needed insulin.

Keywords: Gestational diabetes mellitus, 1st trimester, HbA1C

Introduction

Gestational diabetes mellitus (GDM) was first defined by O'Sullivan in 1961, as “carbohydrate intolerance of varying severity with onset or first recognition during pregnancy”. In 2013, the WHO introduced the term “hyperglycemia first detected at any time during pregnancy”. The most recent definition comes from the ADA (2017): “diabetes diagnosed in the second or third trimester of pregnancy that is not clearly overt diabetes prior to gestation”^[1].

The increasing number of women with undiagnosed type 2 diabetes mellitus (T2 DM) in pregnancy has led to the recommendation of screening women for pre-existing diabetes at the first antenatal visit. GDM is still diagnosed in the late second or early third trimester, because accurate diagnostic approaches for GDM assessment in first trimester are still lacking^[2].

GDM is associated with adverse maternal and perinatal outcomes, such as fetal overgrowth, shoulder dystocia, operative delivery, birth injury, pre-eclampsia, haemorrhage and preterm delivery, but also a sevenfold higher risk of the mother developing T2 DM after pregnancy. In addition, the maternal metabolic milieu was also identified as a key determinant for the susceptibility to congenital anomaly, obesity, metabolic syndrome and T2DM in the offspring, a phenomenon often described as ‘fetal programming’^[3].

The current—but still widely discussed standard of care in GDM diagnosis is the oral glucose tolerance test (OGTT) of 75 g glucose performed late at 24-28 weeks of gestation as recommended by the International Association of Diabetes and Pregnancy Study Groups (IADPSG). The new screening thresholds are based on the results of a large prospective cohort multicentre trial, the Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) study. The aim of the HAPO study was to associate the degree of maternal glycaemia with adverse perinatal outcome, such as large for gestational age (LGA) infants, neonatal hypoglycaemia and caesarean section rates. The results showed no obvious threshold, but rather a continuous increase of these adverse outcomes across the range of glucose concentrations. The IADPSG criteria resulted in a considerable increase in GDM prevalence of 17.8%^[4].

Methodology

Study Design: Prospective study

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Study Setting: Study was conducted on patients attending Gynaecology OPD of SATH

Study Period: One year, after obtaining clearance from the Institute Research Committee and Institutional Human Ethics Committee

Study Subjects: Antenatal cases attending the antenatal clinic of SAT, Hospital

Inclusion criteria

- 8-14 weeks of gestation
- Singleton pregnancy

Exclusion criteria

- Known case of diabetes mellitus
- 1st trimester HbA1c >6.0
- Concurrent medical illnesses as hypertension, renal disease other diseases

Study Variables

- Demographic variables as age (years)
- BMI (kg/m²)
- Parity
- Obstetric history
- Family history of diabetes
- 1st trimester HbA1c
- 75 g OGTT
- Mode of delivery
- Gestational age at delivery
- Baby birth details: Birth weight (kg), APGAR
- Gestational diabetes

Sampling Technique

All consecutive antenatal women between gestational age 8-14 weeks attending the antenatal clinic of SATH

Data collection technique

After taking informed written consent, antenatal women attending Antenatal clinic of Department of Obstetrics and Gynaecology during 8-14 weeks of gestation, fulfilling the inclusion criteria, were enrolled as study subjects.

A standard performa was given to all patients meeting the inclusion criteria. Performa included demographics, obstetric history, past history, family history, auxology, 1st trimester HBA1C values, 2nd trimester GTT results and USG, 3rd trimester GTT and USG results, baby details. HbA1c was done routinely with other 1st trimester routine investigations.

The study subjects were followed up till delivery. 75 g OGTT was performed at 24-28 weeks and if negative at 24-28 week, GTT was repeated between 32-36 weeks.

Based on IADPSG criteria they were grouped as Normal & GDM.

HbA1c was measured in 2ml of EDTA whole blood sample that was stored at <-70°C and thawed immediately before analysis.

HbA1c was measured using Bio-Rad D10/ HPLC method

The result were expressed in NGSP units.

75 g OGTT was done by the glucose oxidase method

Ethical considerations

- Written informed consent were obtained from the participants
- Confidentiality and privacy was maintained throughout the

study

- No additional expenses were incurred for the patient as part of the study

Data analysis

Data were entered into Microsoft excel

Continuous variables were estimated using mean and standard deviation. Nominal data were expressed as frequency. Appropriate statistical tests like t test, chi square test, were done to know the correlation between the variables.

ROC curve was constructed to assess discriminative capacity of HbA1c for detection of GDM.

Sensitivity, Specificity, Predictive values were calculated.

Results

Table 1: Distribution according to Age

Age (years)	Frequency	Percent
≤20	51	12.2
21 - 25	206	49.0
26 - 30	120	28.6
>30	43	10.2
Total	420	100

In the study population 49% subjects were in the age group between 21-25 years, 28% were in age group 26-30 years and 10.2% subjects were in the age group >30 years. The mean age in the study population was 25 years with SD 4.16 years.

Table 2: Distribution according to Socioeconomic status

Socioeconomic status	Frequency	Percent
Yellow card (extremely poor)	52	12.4
Pink card (below poverty line)	214	51.0
Blue card (above poverty line)	154	36.7
Total	420	100.0

Among the 420 study population, 51% subjects belonged to below poverty line, 36% were belonging to above poverty line and 12.4% were extremely poor

Table 3: Distribution according to Parity

Parity	Frequency	Percent
NULLI	234	55.7
P1	161	38.3
P2	17	4.0
P3	8	1.9
Total	420	100.0

Among the 420 antenatal women tested for HbA1c, 55.7% were primigravid, 38.3% had 1 viable pregnancy (Para 1) 4% had 2 viable pregnancy (Para 2) and 2% had 3 viable pregnancy (para3).

Table 4: Distribution according to BMI

BMI	Frequency	Percent
<18	6	1.4
18-24	345	82.1
25-29	59	14.0
>30	10	2.4
Total	420	100.0

Out of the 420 women, 82.1% had normal BMI, 14% were overweight, 2.4% were obese and 1.4% were underweight.

Table 5: Distribution according to Family h/o diabetes

Family h/o diabetes	Frequency	Percent
YES	28	6.7
NO	392	93.3
Total	420	100.0

In the study sample, 6.7% of the total subjects had family history of diabetes.

Table 6: Distribution according to GDM

GDM	Frequency	Percent
YES	79	18.8
NO	341	81.2
Total	420	100.0

Among the 420 antenatal women, 18.8% were diagnosed with GDM by 75 g GTT

Table 7: Distribution of HbA1c in GDM and Non GDM

HbA1C	Total	GDM	
		Present	Absent
N	420	79	341
Mean	5.39	5.71	5.31
Sd	0.49	0.51	0.46
Minimum	4.65	5.27	4.65
Maximum	6.00	6.00	5.81
Median	5.36	5.74	5.11
Q1	5.14	5.53	4.99
Q3	5.69	5.81	5.46

Among the study population, mean HbA1c was 5.39% with SD 0.49, minimum value of HbA1c in the study sample was 4.65% and maximum value was 6.0%. Among the group with GDM, mean HbA1c was $5.71\% \pm 0.51$ compared to $5.31\% \pm 0.46$ in subjects without GDM.

Table 8: Distribution according to Gestational age of diagnosis of GDM

Gestational age of diagnosis of GDM	Frequency	Percent
24-28 WEEKS	47	59.5
32-36 WEEKS	32	40.5
Total	420	100.0

In the study population, 59.5% subjects were diagnosed with GDM between 24-28 weeks, 40.5% between 32-36 weeks. Mean gestational age of diagnosis of GDM is 29 ± 4.10 weeks.

Table 9: Distribution according to Diabetic status

Diabetic status	Frequency	Percent
Gdm On Mnt	60	75.9
Gdm On Insulin	19	24.1
Total	420	100.0

In the study population, 75.9% of subjects diagnosed with GDM were managed with MNT and 24.1% of GDM patients needed insulin.

Discussion

In the study, majority of the women ie 49% of study subjects were in the age group 21-25 years. Mean age of the study population was 25 ± 4.16 years. In the study, among women with age >25 years, 49.7% had HbA1c value >5.55%. The association between age and HbA1c was statistically significant.

Women with age > 25 years were 3 times more in the group with elevated HbA1c indicating that with increasing age there is more chance of elevated HbA1c (OR 2.74 95% CI 1.81-4.15; $p < 0.001$) and hence early detection and management of gestational diabetes among this age group can bring down the long term adverse consequences in mother as well as baby.

However, in a study by Mane *et al*; [5] there was no significant difference between group with HbA1c <5.9 and >5.9 with respect to age ($p=0.194$). Among the 420 antenatal women 55.7% were primigravid, 38.3% had 1 viable pregnancy (para1), 4% had 2 viable pregnancy (para 2) and 2% had 3 viable pregnancy (para 3). The group was categorized into two as primigravida and multipara (having atleast 1 viable pregnancy). 43% multipara had HbA1c >5.55% compared to 29.5% primigravida.

In the study population, 14% women were overweight, 2.4% were obese. In women with BMI >25, 62.3% had HbA1c value >5.55% compared with 30.2% subjects with BMI <25. There was statistically significant association between BMI and HbA1c values. Women with BMI >25 has an odds of 3.82 of elevated HbA1c (OR 3.82 95%CI (2.23-6.54; $p < 0.001$). In a study by Najmiye Saadati *et al*. [6] the findings showed that BMI variable is significantly effective on HbA1c changes in the diagnosis of GDM before 20 weeks of pregnancy ($P < 0.0001$). Out of 6.7% of subjects who had family history of diabetes, 64.3% had HbA1c value >5.55% and 33.4% of the subjects without family history of diabetes had HbA1c value >5.55%. The association between HbA1c and family history of diabetes was statistically significant with subjects with family history of GDM having 4 times more chance of elevated HbA1c.

In a study to determine the role of first trimester HbA1c as a predictor of adverse obstetric outcome done by Mane *et al* [5] at hospital del Mar, Barcelona, the maternal characteristics were stratified according to HbA1c and it showed that there was significant association between family history of diabetes and HbA1c value with a cut off of 5.9% ($p < 0.001$). In the study, 18.8% of the subjects developed GDM. Women with HbA1c value >5.55%, 45.6% developed GDM and 54.4% did not develop GDM. In the group with HbA1c <5.55%, 4.1% subjects developed GDM and 95.9% did not develop GDM. The association was statistically significant ($p < 0.001$). Women with HbA1c $\geq 5.55\%$ have 11 times more risk to develop GDM. (RR 11.24 95% CI 6.14 - 20.58). In a study by Stefanie N. Hinkle *et al* in 2018 showed there was a significant linear association between HbA1c at enrollment (8-13 weeks) and GDM risk ($P=0.001$). HbA1c was associated with a significant increased risk of GDM such that compared to women with median HbA1c levels 5.2% (33mmol/mol), women with a first trimester HbA1c of 5.7% (39mmol/mol) had a GDM risk of 2.73 (95% CI 1.59, 4.66) times higher [7].

In a study by Nissim Arbib *et al*. in 2019 HbA1c concentration was linearly and inversely correlated to length of gestation ($r = -0.317$, $P < 0.001$). Higher HbA1c was associated with gestational diabetes. An HbA1c concentration of $\geq 5.45\%$ predicted gestational diabetes with 83.3% sensitivity, 69% specificity, and gave positive and negative predictive values of 53% and 90.8%, respectively [8].

According to a study by Shaiesta Amreen *et al*. optimal cut-off for HbA1c was found to be $5.496 \pm 0.48\%$, as it gives a sensitivity of 80% and specificity of 55.3% and can be used as a screening tool for GDM [9].

In a study by Rajesh Rajput *et al* the mean HbA1c value in women with GDM was significantly higher than women without GDM ($5.73 \pm 0.34\%$ compared to $5.34 \pm 0.35\%$). The area under

ROC curve of HbA1c to detect GDM was 0.805 ^[10].

In Saadati *et al* study, HbA1c cut off point for predicting GDM before 20 weeks of pregnancy is 5.5%. The association between HbA1c changes in predicting GDM before 20 weeks and BMI are highly significant ^[11].

A study by Fong *et al.* showed that an HbA1c level of 5.7-6.4% (39-46 mmol/mol) is an effective method for identifying patients at the highest risk of developing GDM ^[6].

In the study, 11.4% subjects were diagnosed with GDM between 24-28 weeks and 7.4% were diagnosed with GDM between 32-36 weeks by 75 g GTT. At 24-28 weeks, 61.8% of women with HbA1c>5.55% were diagnosed with GDM compared with 45.5% women with HbA1c <5.55%. The difference in the two groups with respect to gestational age of diagnosis of GDM was not statistically significant ^[12].

Among the total study population, 14.2% of GDM subjects' blood sugar levels were controlled with medical nutrition therapy and 4.5% women required insulin. 25% women with HbA1c >5.55% required insulin therapy compared to 18.2% women with HbA1c value <5.55%. However the difference was not statistically significant indicating that the level of blood sugar control was not associated with HbA1c values.

In a study by Amylidi *et al.* the mean HbA1c values were similar in women who needed insulin treatment during pregnancy [insulin $5.7 \pm 0.36\%$ (39 ± 3 mmol/mol)] compared with women that did not need insulin treatment [$5.42 \pm 0.05\%$ (36 ± 1 mmol/mol); $p = 0.161$] ^[5].

Conclusion

Maternal age, parity, pre-pregnant BMI are modifiable risk factors that are significantly associated with elevated HbA1c and hence if steps are taken early in patients with these modifiable risk factors, the burden of gestational diabetes mellitus can be reduced.

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How to Cite This Article

Devi MRR, Bindu P, Chacko L. Incidence of gestational diabetes mellitus and their associated factors: Descriptive study. *International Journal of Clinical Obstetrics and Gynaecology.* 2025; 9(6): 58-61.

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