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Research Article

An Epidemiology study of Socio-demographic-economic & Gestational Profile of Women with Early Gestational Glucose Intolerance at 8-10 weeks of Pregnancy

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Abstract

Diabetes Accounts for nearly 10% of global deaths among people aged 20 to 99 and is the fourteenth leading cause of Disability-Adjusted Life Years (DALYs) worldwide. The prevalence of diabetes is increasing worldwide due to factors like urbanization, nutrition, the elderly population, genetics, and lifestyle changes.[1] An often-overlooked factor is gestational diabetes mellitus, which leads to glucose intolerance during pregnancy.[2] Women with gestational diabetes often develop diabetes within three to six years after delivery, perpetuating a cycle of obesity, insulin resistance, diabetes, and NCDs across generations. Breaking this cycle is now more crucial than ever.[3]

Gestational diabetes mellitus (GDM), according to the World Health Organization, is characterized by carbohydrate intolerance leading to elevated blood sugar levels, with variable severity, first recognized during pregnancy. It is a very common metabolic disorder in pregnancy. Insulin resistance increases during pregnancy due to the development of carbohydrate intolerance.[4]

Adiponectin, which has antidiabetic and anti-inflammatory effects, is present in low levels in pregnant women with gestational diabetes mellitus (GDM). This decrease is associated with increased insulin resistance during pregnancy, playing a role in the onset of GDM. Insulin resistance, resulting from the β-cells' failure to secrete insulin properly, may also be affected by maternal adiposity.[5]

The rising prevalence of GDM is primarily driven by modifiable risk factors like obesity, poor diet, sedentary lifestyle, and pre-existing insulin resistance, which can be reduced through early interventions. GDM has long-term effects on the mother and offspring, influencing health outcomes across generations.

Rationale for Study:

Previous studies have examined whether first-trimester HbA1c levels can predict GDM. However, these studies often focused on high-risk groups, considered a threshold of 5.7% HbA1c (indicative of prediabetes), or used first-trimester GDM diagnosis as the primary outcome measure.[6] According to NIH researchers, performing a blood test as early as the 10th week of pregnancy could aid in identifying women who are at risk of developing gestational diabetes. This condition carries significant health risks for mothers and infants, emphasizing the importance of early detection.[7]

Previous studies focused solely on predicting gestational diabetes mellitus (GDM) from 24 weeks onward. Therefore, this study was designed to investigate GDM starting at 8-10 weeks of pregnancy. The study aimed to identify early GDM predictions among mothers by studying their Sociodemographic and Socioeconomic profiles.

Material & Methods:

Operational definitions used:

Diabetes mellitus: Diabetes mellitus is a chronic metabolic disorder due to either insulin deficiency (relative or absolute) or peripheral tissue resistance (decreased sensitivity) to the action of insulin.[8]

GDM: GDM is defined as carbohydrate intolerance of variable severity with onset or first recognition during the present pregnancy, and according to DIPSI (Diabetes in Pregnancy Study Group of India), recommends a Single-step Test with 75 g oral glucose without regard to the time of the last meal. A venous plasma glucose value at 2 hours more than ⩾140 mg/dL is diagnosed as GDM.[8]

Primigravida: A primigravida is pregnant for the first time.[8]

Multigravida: A multigravida has previously been pregnant. She may have aborted or delivered a viable baby.[8]

Primipara: A primipara has delivered one viable child. Parity is not increased even if the fetuses are many (twins, triplets)[8]

Multipara: Multipara has completed two or more pregnancies to the stage of viability or more.[8]

Preterm delivery: A baby born before 37 completed weeks of gestation, calculating from the first day of the last menstrual period, is arbitrarily defined as a preterm baby[8]

Term delivery: the birth of a baby that occurs between 37 and 42 weeks of gestation.[8]

Low birth weight (LBW): Low birth weight is defined as a birth weight of less than 2,500 grams (5 pounds, 8 ounces) regardless of gestational age[8]

Macrosomia: Fetal macrosomia (40-50%) with birth weight > 3.5 kg [8]

Large for Gestational Age (LGA): Large for gestational age is defined as a newborn whose birth weight is above the 90th percentile for their gestational age[8]

Gestational glucose intolerance: Gestational Glucose Intolerance (GGI) is defined as a plasma glucose level of 120 to 139 mg/dL after 2 hours of an Oral Glucose Tolerance Test (OGTT). [9]

Material and methods

1. Study design: Hospital-based prospective Cohort study

2. Study setting: Tertiary care Centre.

3. Ethical considerations: Ethical committee approval was obtained from the Institutional Ethical Committee before the start of the study.

4. Study duration:

The present study was conducted over 2 years from October 2022 to September 2024.

5. Study population:

All ANC mothers visiting the tertiary care Centre.

6. Inclusion criteria: ANC mothers at 8 weeks onwards

7. Exclusion criteria: ANC mothers are not willing to participate and are not willing to give consent for the study.

1. Sample Size:

Total population (N): 30,000

Prevalence (P): 0.10 (10%)

Confidence level: 95%

Z value (Z): 1.96

Margin of error (D): Not directly specified, but let's assume a commonly used margin of error of 5% (0.05)

Using the simplified formula for calculating the sample size n for a proportion:

$n=Z2\times P(1-P)/D2$

n=138

The final sample size was 135 ANC mothers attending weekly check-ups. The sample was gathered over 3 months, and participants were included from the 8th to 10th week of pregnancy onwards.

1. Conduct of the Study:

Permission was obtained from the Head of the Department of Obstetrics and Gynecology to conduct ANC examinations, including measurements of height, weight, BMI, blood pressure (BP), postprandial blood sugar (PPBS), and oral glucose tolerance test (OGTT). The ANC mothers were screened for Gestational Diabetes Mellitus (GDM) starting from the 8th week of gestation.

2. Consent of study participants:

Those willing to participate in the study had their written informed consents taken, and they were enrolled.

3. Data collection:

Before enrollment in the study, pregnant women attending the Obs & Gynae OPD were provided with detailed information about the study objectives, procedures, potential risks, and benefits. Written informed consent was obtained from each participant before their inclusion in the study. Participants were assured of the confidentiality of their information and were informed of their right to withdraw from the study at any time without any impact on their ANC services. Participants who declined to provide consent for participation in the study were excluded. Only those who willingly consented to be part of the study were included in the cohort.

After enrolling in the study, participants will have their postprandial blood sugar (PPBS) levels checked at the 8th -10th weeks of gestation. Participants with PPBS levels above 110 mg/dL will receive dietary education, while those below 110 mg/dL will not. Subsequently, both groups will undergo an Oral Glucose Tolerance Test (OGTT) at the 16th, 24th, and 32nd weeks. Additionally, PPBS levels will be measured postpartum for all participants.

Sociodemographic Inquiry:

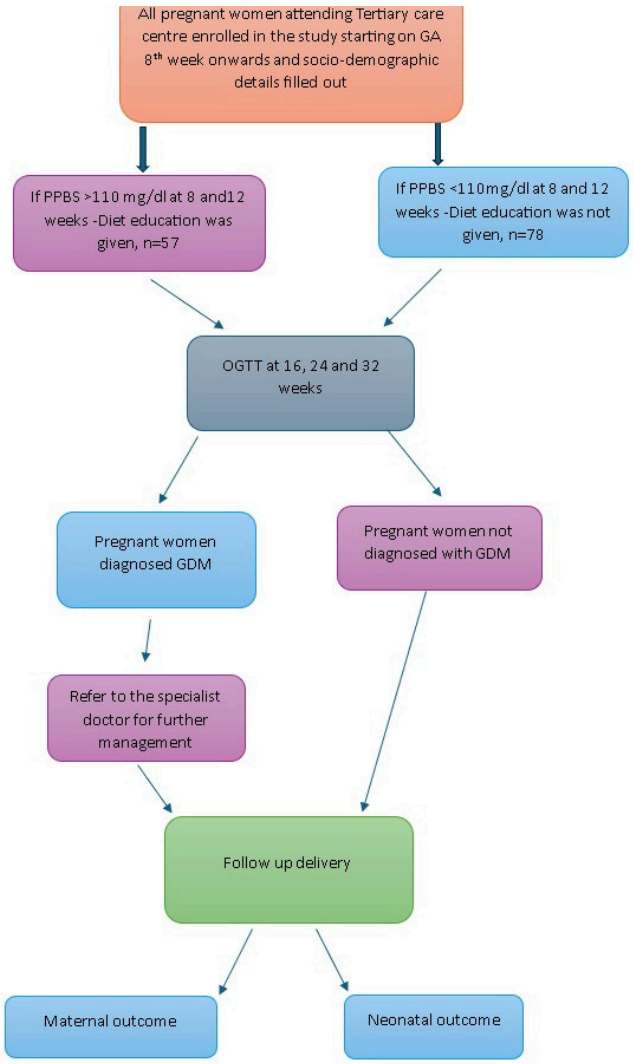
During the initial visit, participants were asked to provide sociodemographic details such as age, educational level, occupation, and socioeconomic status. This information was crucial for understanding the demographic characteristics of the study population and identifying any potential sociodemographic factors associated with gestational diabetes mellitus (GDM) risk.

10. Blood Sugar Level (BSL) Assessment: between the 8th and 10th week of gestation, participants underwent a PPBS (post-prandial blood sugar) assessment to screen for risk of gestational diabetes mellitus (GDM).

11. Oral Glucose Tolerance Test (OGTT): Participants underwent an oral glucose tolerance test (OGTT) during subsequent visits to a tertiary care center starting from the 16th, 24th, or 32nd

Week of gestation. OGTT is a diagnostic test used to confirm the presence of gestational diabetes mellitus (GDM) by assessing the body's ability to metabolize glucose effectively. Participants consumed 75 g of glucose solution, and blood samples were taken after 2 hours to measure glucose levels.

Method of Selection of Participants



13. Instruments used for data collection:

The instruments used in this study included a glucometer, a blood pressure apparatus, and a weighing machine, which didn't need to be standardized throughout the data collection period.

14. Cut-off point:

The Diabetes in Pregnancy Study Group India (DIPSI) recommends a non-fasting Oral Glucose Tolerance Test (OGTT) with 75 grams of glucose, using a cut-off of ⩾ 140 mg/dL after 2 hours as a single-step procedure, irrespective of the last meal. Pregnant women attending the antenatal OPD were given 75 grams of anhydrous glucose dissolved in 250-300 mL of water, and plasma glucose was estimated after 2 hours. A 2-hour plasma glucose level of ⩾ 140 mg/dL is diagnostic for gestational diabetes mellitus (GDM). If the level is between 120 mg/dL and less than 140 mg/dL, it is considered gestational glucose intolerance (GGI).

15. Procedure of Measurement of Oral Glucose Tolerance Test:

After a pregnant woman had undergone a preliminary clinical examination at the antenatal clinic, she was given a 75g oral glucose load, regardless of the time of her last meal. If a 75g glucose packet was not available, 5 level teaspoons (not heaped) of glucose were removed from a 100g packet, which was commonly available.

A venous blood sample was collected two hours later to measure plasma glucose. If the 2-hour plasma glucose level was ⩾ 140 mg/dl, gestational diabetes mellitus (GDM) was diagnosed.

All pregnant women attending the ANC were evaluated for eligibility. Trained research assistants collected data using an interviewer-administered questionnaire. Capillary blood samples were taken from the anterolateral aspect of the pulp of the middle finger on the non-dominant hand for non-fasting blood glucose level testing and OGTT. The first blood drop was wiped away with a sterile dry piece of cotton, and the subsequent blood drops were collected onto the glucose strip inserted into a glucometer.

16. Height, Weight & BMI Recording:

A.Height was measured in cm by drawing a metric scale on the walls.

B. Every subject's weight was recorded using a standardized weighing machine, which was periodically standardized using a standard weight. Before taking the weight, the zero was adjusted properly.

C.Body mass index was calculated by the formula:

Body Mass Index (BMI) = Weight (Kg)/ Height $(M)^2$.

17. Data compilation:

Collected data was entered into Microsoft Excel 2021 worksheets and coded appropriately.

1**8. Data analysis:** Data was analyzed using Microsoft Excel 2021, Open EPI-Info Version 3.01, updated on 2013/04/06. Descriptive statistics (percentage, mean) were used to describe the data appropriately. Appropriate statistical tests were used according to the type of data. A significant association was considered when the p-value was less than 0.05.

Results:

Age distribution:

Most of the 135 antenatal care (ANC) mothers were aged 18-22, while the fewest were over 37 years [Table 1 & Figure 1].

Figure 1. Distribution of study participants according to age

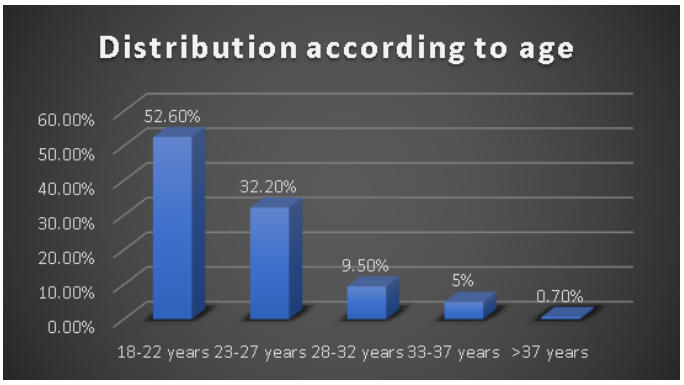


Table 1: Distribution of study participants according to age

AGE	FREQUENCY	%
18-22 years	71	52.60
23-27 years	43	32.20
28-32 years	13	9.50
33-37 years	7	5
>37 years	1	0.70
TOTAL	135	100.00

Schooling Distribution:

In this study, most participants had studied up to secondary school, while the least number of participants were postgraduates [Table 2 & Figure 2].

Figure 2: Distribution of study participants according to Education.

Figure 2: Distribution of study participants according to Education

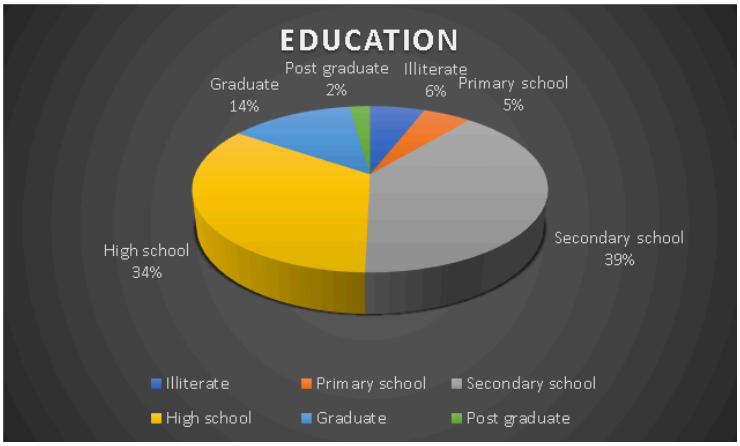


Table 2: Distribution of study participants according to Educationt

AGE	FREQUENCY	%
18-22 years	71	52.60
23-27 years	43	32.20
28-32 years	13	9.50
33-37 years	7	5
>37 years	1	0.70
TOTAL	135	100.00

Occupational Distribution:

The results indicate that 23 participants (17%) are employed, while 112 participants (83%) are unemployed, showing that the majority of the participants are unemployed [Table 03 & Figure no: 03].

Figure 3: Distribution of study participants according to occupation

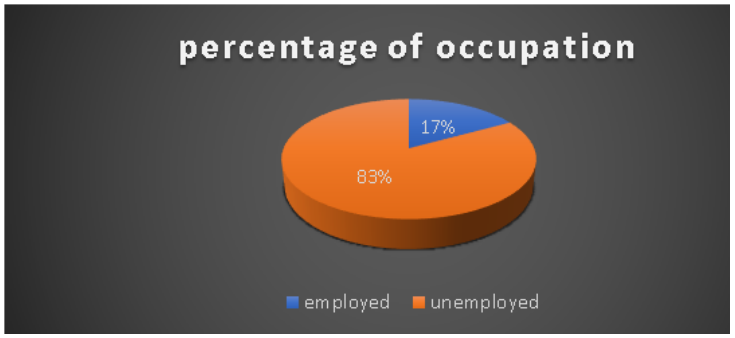


Table 3: Distribution of study participants' occupations

OCCUPATION	FREQUENCY	%
EMPLOYED	23	17
UNEMPLOYED	112	83
TOTAL	135	100

Religion Distribution

According to religion, most participants were Hindus, with 121 individuals (90%), while the least were Muslims, with 14 individuals (10%) [Table 04 & Figure 04].

Figure 4: Distribution of study participants according to Religion

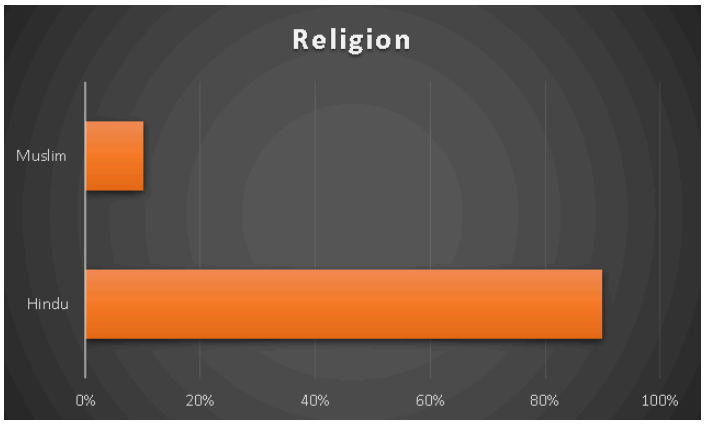


Table 4: Distribution of study participants according to Religion

RELIGION	FREQUENCY	%
Hindu	121	90
Muslim	14	10
TOTAL	135	100

Socio-Economic Distribution:

In this study, most participants belonged to middle-class families, while the fewest belonged to upper-class families. [Table 05 & Figure 05].

Figure 5: Distribution of study participants according to socio-economic status

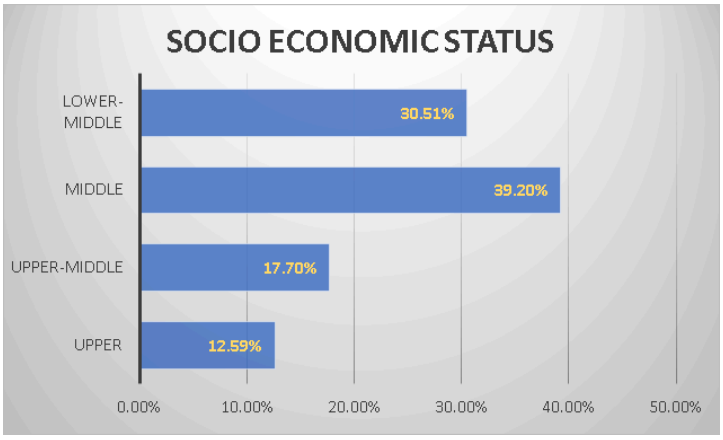


Figure 5: Distribution of study participants according to socio-economic status

SOCIO-ECONOMIC STATUS	FREQUENCY	%
Upper	17	12.59
Upper-middle	24	17.70
Middle	53	39.20
Lower-middle	41	30.51
TOTAL	135	100.00

Distribution of Types of Family

In this study, most participants belonged to joint families, while the fewest belonged to three-generation families [Table 06 & Figure 06].

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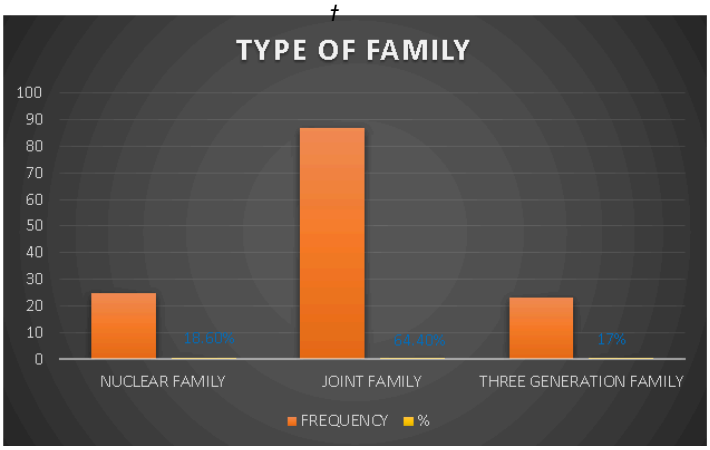

Table 6: Distribution of study participants according to Type of Family

TYPE OF FAMILY	FREQUENCY	%
Nuclear family	25	18.60
Joint family	87	64.40
Three generation family	23	17
TOTAL	135	100.00

Your Distribution of Parity

*I*n this study, most participants were in parity-1, while the fewest were in parity-5 5.

Figure 7: Distribution of study participants according to parity. [Table 07 & Figure 07]

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Figure 7: Distribution of study participants according to parity

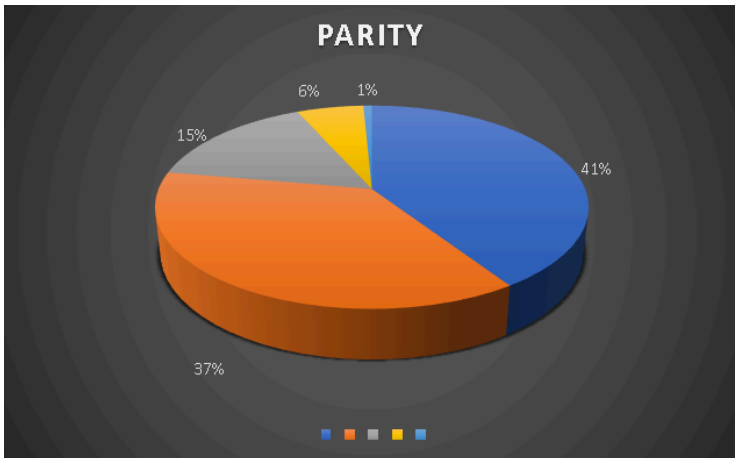

Table no 7: Distribution of study participants according to parity

PARITY	FREQUENCY	%
PARITY 1	55	41.00
PARITY 2	50	37.00
PARITY 3	21	15.00
PARITY 4	8	6.00
PARITY 5	1	1.00
TOTAL	135	100.00

Family history of diabetes mellitus

The study shows that 18 (13.3%) have a family history of diabetes mellitus, and 117 (86.7%) don't [Table 08 & Figure no: 08].

Figure 8: distribution of family history of diabetes mellitus

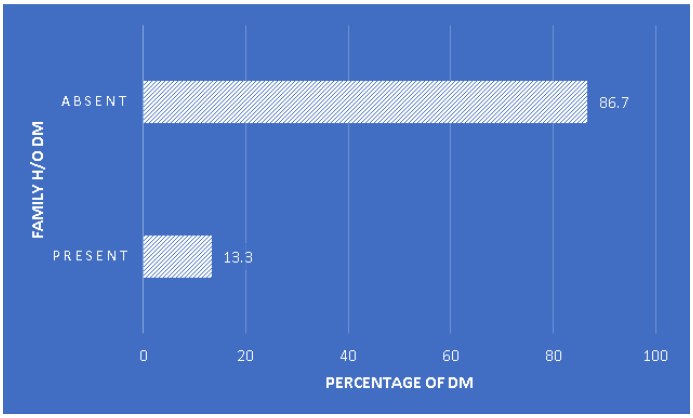

Table 8: distribution of family history of diabetes mellitus

FAMILY H/O DM	FREQUENCY	%
PRESENT	18	13.3
ABSENT	117	86.7
TOTAL	135	100

History of Gestational diabetes mellitus (GDM)

The results indicate that 10 participants (7.4%) had a family history of GDM, while 125 participants (92.6%) did not [Table 09 & Figure 09].

Figure 9: Distribution of the history of Gestational diabetes mellitus

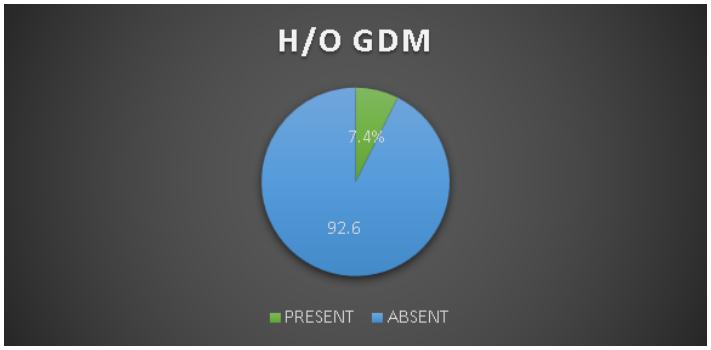

Table no 09: Distribution of history of Gestational diabetes mellitus

H/O GDM	FREQUENCY	%
PRESENT	10	7.4
ABSENT	125	92.6
TOTAL	135	100

BODY MASS INDEX (BMI)

The results show that 71 participants (52.6%) were of normal weight, 39 participants (28.9%) were overweight, and 25 participants (18.5%) were obese. [Table 10 & Figure 10].

Figure 10: Distribution of study participants according to BMI

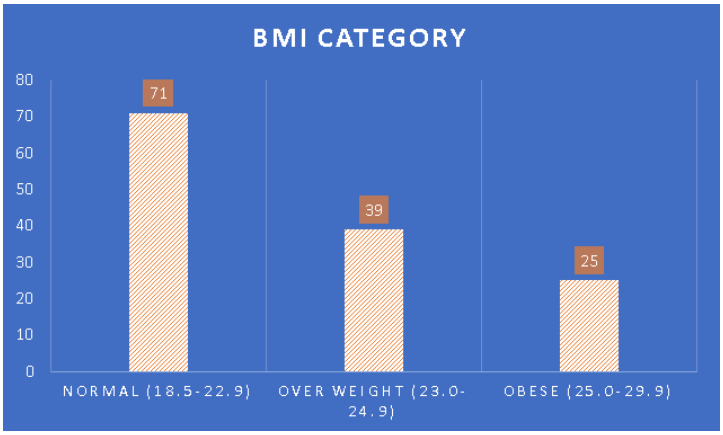

Table 10:Distribution of study participants according to BMI

BMI CATEGORY	FREQUENCY	%
Normal (18.5-22.9)	71	52.6
Over weight (23.0-24.9)	39	28.9
Obese (25.0-29.9)	25	18.5
TOTAL	135	100

Gestational Profile of Participants:

2) Early prediction of Gestational diabetes mellitus based on Gestational Profiles:

The study included 135 participants, split into >110mg/dl (diet education given) with 57 participants and <110 mg/dl (diet education not given) with 78 participants [Table 11a].
The stillbirth rate was 1 (1.75%) in the group with postprandial blood sugar (PPBS) levels above 110 mg/dL and 1 (1.28%) in the group with PPBS levels below 110 mg/dL.

Birth before 37 weeks occurred in 8 (14.03%) of the >110 mg/dL group versus 1 (1.27%) of the <110 mg/dL group. At 37 weeks, 7 (12.28%) of the >110 mg/dL group gave birth compared to 6 (7.7%) of the <110 mg/dL group. At 38 weeks, 30 (52.64%) of the >110 mg/dL group gave birth versus 42 (53.85%) of the <110 mg/dL group. At 39 weeks, 10 (17.55%) of the >110 mg/dL group gave birth compared to 29 (37.18%) of the <110 mg/dL group. At 40 weeks, 2 (3.5%) of the >110 mg/dL group gave birth, while none in the <110 mg/dL group did. Regarding gravida status, primigravida participants made up 45.61% of the >110 mg/dL group and 60.25% of the <110 mg/dL group, while multigravida participants constituted 54.39% of the >110 mg/dL group and 39.75% of the <110 mg/dL group.

In terms of a history of gestational diabetes, 9 (15.79%) of the >110 mg/dL group had a previous history compared to 1 (1.28%) of the <110 mg/dL group.
For delivery type, 29 (50.88%) of the >110 mg/dL group had a normal vaginal delivery (NVD) compared to 63 (76.92%) in the <110 mg/dL group, while 28 (49.12%) of the >110 mg/dL group and 18 (23.08%) of the <110 mg/dL group had a lower segment caesarean section (LSCS).

Table 11a Characteristics of the >110 mg/dl and <110 mg/dl group with post prandial at 8-10 weeks of gestation.

Sr no		PPBS at 8-10 wks. ≥110(mg/dl) (Mean ± SD) No (%), N=57 Diet education+	PPBS at 8-10 wks. < 110 (mg/dl) (Mean ±S D) No (%), N=78 Diet education-	P-value
1	Age(years)	23.04 ± 3.73	23.55 ± 4.47	0.47
2	Still birth ≥ 28 weeks	1(1.75)	1(1.28)	0.82
3	Gestational week birth			
	<37	8(14.03)	1(1.27)	**0.003**
	37+	7(12.28	6(7.7)	0.37
	38+	30(52.64)	42(53.85)	0.88
	39+	10(17.55)	29(37.18)	**0.013**
	40	2(3.5)	0(0.0)	**0.09**
4	Gravida			
	Primi	26(45.61)	47(60.25)	**0.09**
	Multi	31(54.39)	31 (39.75)	**0.09**
5	GDM at 8-10th Week	9(15.79)	0(0.0)	**0.000**
6	Hist of GDM	9(15.79)	1(1.28)	**0.001**
7	Type of delivery			
	NVD	29(50.88)	63 (76.92)	**0.000**
	LSCS	28 (49.12)	18 (23.08)	**0.001**

The study indicates that gestational weeks of birth (<37 weeks, 39 weeks, and 40 weeks), gravida status (primigravida vs. multigravida), history of gestational diabetes, and type of delivery (NVD vs. LSCS) were significant factors, while age and stillbirth were not significant.

Status of the Term of Delivery

The present study shows that the rate of preterm delivery was significantly higher in >110mg/dl group (14.03%) compared to the <110mg/dl group (1.28%, p = 0.003), while term deliveries were more common in the <110mg/dl group (98.72%) than in >110mg/dl group (85.97%) [Table 12 & Figure 12].

Figure 12: Distribution of participants according to the term of delivery

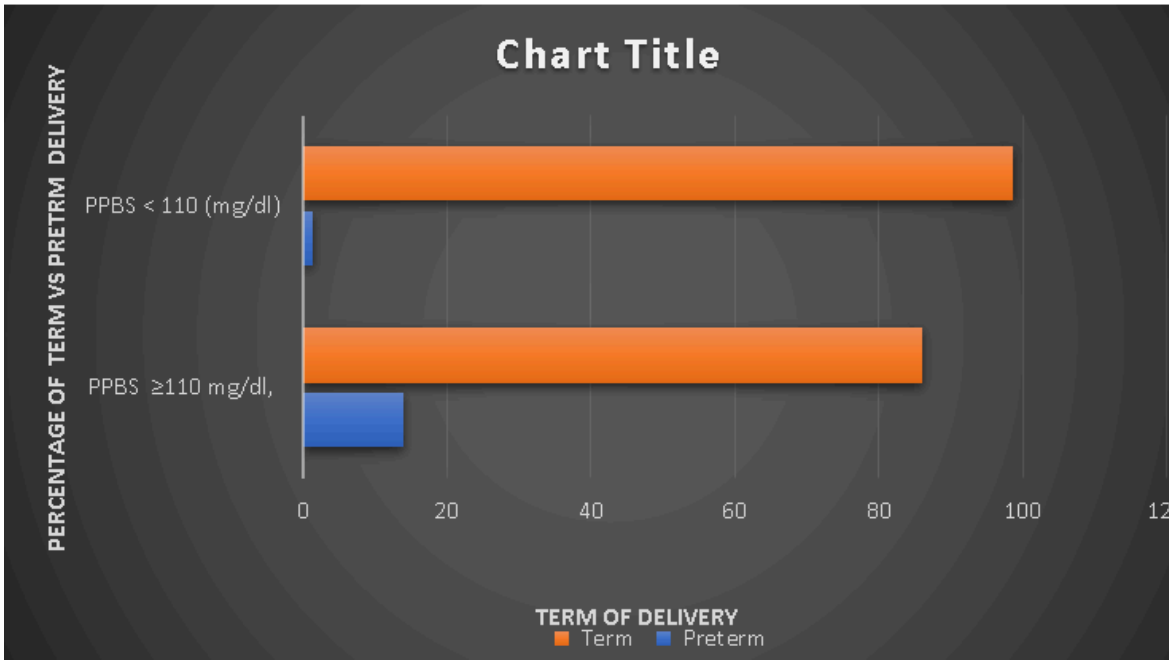

Table 12 Characteristics of the >110 mg/dl and <110 mg/dl group with post prandial at 8-10 weeks of gestation.

Sr no		PPBS at 8-10 wks. ≥110(mg/dl) (Mean ± SD) No (%), N=57 Diet education+	PPBS at 8-10 wks. < 110 (mg/dl) (Mean ±S D) No (%), N=78 Diet education-	P-value
8	**Term of delivery**			1.000
	Preterm	8(14.03)	1 (1.28)	**0.003**
	Term	49(85.97)	77(98.72)	
9	**Family history of DM**			0.75
	YES	12(21.05)	6 (7.69)	**0.024**
	NO	45 (78.95)	95 (92.31)	
	BMI kg/m2	23.93±4.01	23.58±3.3	0.59
10	**BMI category**			
	Normal (18.5-22.9)	19(33.33)	52 (66.67)	**0.000**
	Over weight (23.0-24.9)	20(35.09)	19(24.36)	0.174
	Obese (25.0-29.9)	18(31.58)	7 (8.97)	**0.000**

Regarding delivery, 8 (14.03%) of the >110 mg/dL group had preterm births compared to 1 (1.28%) in the <110 mg/dL group, while 49 (85.97%) of the >110 mg/dL group and 77 (98.72%) of the <110 mg/dL group had term deliveries.

Under the family history of diabetes mellitus, 12 (21.05%) of the >110 mg/dL group had a family history of diabetes compared to 6 (7.69%) in the <110 mg/dL group. Meanwhile, 45 (78.95%) of the >110 mg/dL group and 95 (92.31%) of the <110 mg/dL group had no family history of diabetes.

The study results also indicate that in the normal weight category, 19 (33.33%) of participants were in the >110 mg/dL group and 52 (66.67%) in the <110 mg/dL group. In the overweight category, 20 (35.09%) were in the >110 mg/dL group compared to 19 (24.36%) in the <110 mg/dL group. In the obese category, 18 (31.58%) of participants were in the >110 mg/dL group, while 7 (8.97%) were in the <110 mg/dL group.

Discussion

Given the importance of this population, this study broadly focused on the Profile of antenatal care (ANC) mothers in rural areas. It explored various parameters, including demographic factors, postprandial blood sugar (PPBS) levels, and the Oral Glucose Challenge Test (OGCT) at specific times. The present study was similar to a survey designed 10 to investigate GDM starting at 8 weeks of pregnancy.

PART A: To study the socio-demographic Profile of ANC mothers.

AGE: the results shows that, there were 135 antenatal care (ANC) mothers, the age distribution was as follows: 71 mothers (52.60%) were between 18-22 years, 44 mothers (32.20%) were between 23-27 years, 13 mothers (9.50%) were between 28-32 years, 7 mothers (5%) were between 33-37 years, and 1 mother (0.70%) was over 37 years old. Most mothers were 18-22, while the other were over 37. (Figure 3, Table 2) Similar observations were found in the study: Stuti Bahl et al.[11]. The study population was relatively young, with a mean (SD) age of 23.8 (3.1) years. Kavita Meena et al. (2017)[12], the mean age of the GDM group was 28.4±4.03 years, while the control group had a mean age of 23.34±3.13 years. Other studies showed different observations, like Logakodie S et al. (2017), [13]. The majority of the respondents were under 35 years of age.

Education:

In this study, out of 135 study participants, 8 participants (6%) were illiterate, 7 participants (5%) had completed primary school, 53 participants (39%) had completed secondary school, 46 participants (34%) had completed high school, 18 participants (14%) were graduates, and 3 participants (2%) were postgraduates. Most participants had studied up to secondary school, while the smallest number of participants were postgraduates. (figure 4, table 3)

A similar observation was found in: Saila B. Koivusalo et al. (2016)[14], where in both the intervention and control groups, most participants had upper secondary school and vocational education, with 32% in the intervention group and 41% in the control group.

Other studies showed different observations, like:

Stuti Bahl et al. (2022)[11] approximately half of the study participants had education levels beyond secondary school. P. R. Sreelakshmi et al. (2015). [15] Most participants, 160 (89.8%), had higher educational qualifications than the high school level. Subrata Chanda et al. (2020). [16] half of the participants were educated up to the primary level (50%).

Occupation:

The results indicate that 23 participants (17%) are employed, while 112 participants (83%) are unemployed, showing that the majority of the participants are unemployed (homemakers). (figure 5, table 4) Similar observations were found in Stuti Bahl et al.'s study (2022), where 11 participants were homemakers, 53 (91.4%). P. R. Sreelakshmi et al. (2015)[15]the majority of participants [157 (87.2%)] were homemakers. Other studies showed observations like: Tapas Mazumder et al. (2022)[17] 33 (32.6%) were employed. Achenef Asmamaw Muche et al (2020)[18] 62 (51.2%) were used.

Type of family:

In this study, 25 participants (18.5%) were from nuclear families, 87 participants (64.4%) were from joint families, and 23 participants (17%) were from three-generation families. Most participants belonged to joint families, while the fewest belonged to three-generation families. (figure 8, table 7)

Similar observations were found in Dr. Kavita Meena et al. (2017)[12]. In the study group, most participants (56%) came from joint families, while in the control group, 74% were from joint families. Sudha Jaiswal et al. (2022) [19]. Nearly two-thirds of the pregnant women (78.68%) were from joint families.

Religion:

According to religion, most participants were Hindus, with 121 individuals (90%), while the least were Muslims, with 14 individuals (10%). (figure 6, table 5) Similar observation found in: Subrata Chanda et al. (2020) [16]more than half 102 (55%) of the participants were Hindu. Seema V. Ennazhiyil et al. (2019)[20] that 62.5% (40 individuals) were Hindu. Daniel Atlaw et al. (2022)[21] The study found that 28 participants (41.1%) belonged to the Orthodox religion.

Socio-economic status:

In this study, 17 participants (12.59%) were from upper-class families, 24 participants (17.70%) were from upper-middle-class families, 53 participants (39.20%) were from middle-class families, and 41 participants (30.51%) were from lower-middle-class families. Most participants belonged to middle-class families, while the fewest belonged to upper-class families. (figure 7, table 6)

Similar observation found in: Maryam Askari et al. (2022)[22] conducted a prospective cohort study on the incidence and risk factors of gestational diabetes mellitus among women in Yazd. In this study, 2,320 participants were from the middle-income group, representing 78.3%.

Other studies showed different observations, like Kavita Meena et al (2021)[12] , the majority of antenatal care (ANC) participants belonged to socio-economic status (SES) class II, followed by classes IV, III, and I

Subrata Chanda et al. (2020)[16] conducted a study and found that 134 participants (66%) belonged to the Below Poverty Line category.

Parity:

In this study, there were 55 participants (41%) who were parity 1, 50 participants (37%) who were parity -2, 21 participants (15%) who were parity-3, 8 participants (6%) who were parity-4, and 1 participant (1%) who was parity-5. Most participants were parity -1, while the fewest were parity -5. (figure 9, table 8)

Similar observations were found in Hussain et al. (2020), [23]. The study found that 107 women (69.48%) were experiencing their first pregnancy, 44 women (28.57%) were in their second pregnancy, and 3 women (1.94%) were in their third pregnancy.

Other studies made different observations, such as Areefa SMAK et al. (2014), [24]. They found that 107 individuals (56.6%) had 2-6 children.

Radhia Khan et al. (2013)[25] found that 54.5% of the women with GDM were in the grand multiparous group.

Family history of diabetes mellitus

The study shows that those who have a family history of diabetes mellitus are 18 (13.3%), and those who don't have the family history of diabetes mellitus are 117 (86.7%). (figure 10, table 9)

Similar observation was found in:

Daniel Atlaw et al. (2022)[21] conducted a study which found that 10 participants (14.7%) had a family history of diabetes.

Maryam Askari et al. (2022)[22] found that a small percentage of pregnant women, 3.7%, had a history of diabetes mellitus.

Other studies showed different observations such as;

Kavita Meena et al. (2017)[12], 42% of participants in the study group had a family history of diabetes, compared to 14% in the control group.

History of GDM:

The results indicate that 10 participants (7.4%) had a family history of GDM, while 125 participants (92.6%) did not have a family history of GDM. (figure 11, table 10)

Maha M. Alduayji et al. (2023)[26] The study revealed that 9.9% of the women had a history of GDM

Radhia Khan et al. (2013)[25] found that 75.5% of women with gestational diabetes mellitus (GDM) reported a previous history of gestational diabetes

BMI (body mass index):

The results show that 71 participants (52.6%) were of normal weight, 39 participants (28.9%) were overweight, and 25 participants (18.5%) were obese. (figure 12, table 11)

Similar observation found in: In the study by Sudha Jaiswal et al (2022)[19]., among non-GDM participants, 96.9% were underweight, 95.5% had a normal weight, 81.4% were overweight, and 58.8% were obese. Conversely, among those with GDM, 3.1% were underweight, 4.5% had a normal weight, 18.6% were overweight, and 41.2% were obese.

Subrata Chanda et al (2020), [16]Nearly one-third (32%) had abnormal BMI.

Tahziba Hussain et al (2020) [27] mentioned in this study that about 18% were overweight and 4% were obese.

PART B: To assess the early prediction of gestational diabetes mellitus

The present study shows that the>110mg/dl group had a significantly higher rate of preterm births (<37 weeks: 14.03% vs. 1.27%, p = 0.003), while the <110mg/dl group had a significantly higher rate of term births at 39+ weeks (37.18% vs. 17.55%, p = 0.013). (table 12a, serial no:3)

Azam Kouhkan et al. (2020)[28] found that preterm delivery was significantly higher in the GDM group (11.93%) compared to the non-GDM group (5.11%) with an OR of 2.52 (p = 0.008). Wenrui Ye et al. (2022)[29] found that the odds of preterm delivery were 1.51 times higher in the GDM group compared to the non-GDM group, with an odds ratio (OR) of 1.51 (95% CI: 1.26-1.80).In Ting Zhang et al (2024)[30] study, women with GDM aged 40-44 years had the highest rate of preterm birth at 13.9%, which was statistically significant (P < 0.001).

GRAVIDA:

In the present study, Gravida category, primigravida participants are 26(45.61%) in the >110mg/dl group and 47(60.25%) in the <110mg/dl group, while multigravida participants are 31(54.39%) in the >110mg/dl group and 31(39.75%) in the <110mg/dl group. (Table 12a, serial no:4)

While there were more multigravida participants and fewer primigravida participants in contrast to the above study, Daniel Atlaw et al. (2022)[21], conducted a study and it was found that 39.3% of the women in the non-GDM group were primigravida, while 60.7% were multigravida. In comparison, 33.9% of the women in the GDM group were primigravida, and 66.1% were multigravida.

Azam Kouhkan et al. (2020)[28] it was found that 55.8% of the women in the non-GDM group were multigravida, compared to 71.8% in the GDM group. Additionally, 50.6% of the women in the non-GDM group were nulliparous, while only 33.8% of the women in the GDM group were nulliparous.

Type of delivery:

In the present study, 29(50.88%) of women in the >110 mg/dL group had a normal vaginal delivery, whereas 63(76.92%) of women in the <110 mg/dL group delivered vaginally. Conversely, 28(49.12%) of the >110 mg/dL group underwent a lower segment cesarean section, compared to only 18(23.08%) in the <110 mg/dL group. These differences are statistically significant (p-value = 0.001), indicating that women in the >110 mg/dL group were less likely to have a normal vaginal delivery and more likely to require a cesarean section compared to those in the <110 mg/dL group, as shown in Table 12a, serial no:7)

Similar observations found in;

Azam Kouhkan et al. (2020)[28] it was found that women without gestational diabetes mellitus (non-GDM) had a 13.03% rate of emergency cesarean sections, while women with GDM had a higher rate of 22.05%. This indicates that women with GDM were about 88% more likely to undergo an emergency cesarean section compared to those without GDM, with this difference being statistically significant (p = 0.007).

Achenef Asmamaw Muche et al (2020)[18] conducted a study in which women with GDM had a significantly higher likelihood of undergoing a cesarean delivery, with an increased risk ranging between 67% 130% compared to non-GDM women (p-values < 0.01). For labor induction, the increased risk ranged between 20% to 72%, but this was statistically significant only in one analysis (p = 0.010), while other analyses did not reach significance.

Term of delivery:

The present study shows that the proportion of preterm deliveries was significantly higher in the >110 mg/dL group 8(14.03%) compared to the <110 mg/dL group 1(1.28%), with a p-value of 0.003. In contrast, term deliveries were more common in both groups, occurring in 49(85.97%) of cases in the >110 mg/dL group and 77(98.72%) in the <110 mg/dL group. (table 12a, serail no:8)

Similar observations were found in Dittakarn Boriboonhirunsarn et al (2023), [31]. who reported that the incidence of overall preterm delivery was significantly higher in women with gestational diabetes mellitus (GDM) at 17.5% compared to 8.5% in non-GDM women, with a p-value of 0.004, indicating a statistically significant difference between the two groups. According to Agnesa Preda et al. (2023), [32], among the 14 women with GDM who delivered prematurely, 4 had an average gestational age of 33.36 weeks, highlighting that some women with GDM are at a higher risk for early preterm birth.

From our present study, the socio-demographic profile of the 135 antenatal care (ANC) mothers in the study reveals a diverse distribution in terms of age, education, employment, religion, socioeconomic status, family type, parity, family history of diabetes mellitus, and body mass index (BMI). Most of the participants were young, with 71 mothers (52.60%) aged 18-22 years, making this the largest age group. Only 1 mother (0.70%) was over 37 years, representing the smallest age group. Regarding educational attainment, most participants had completed secondary school 53, 39%), while the fewest were postgraduates 3, 2%).

Regarding employment, most participants were unemployed 112(83%), with only 23 (17%) employed. When examining religious affiliations, the study found that 121 (90%) participants were Hindus, while Muslims constituted 14(10%), making Hindus the majority group. Socioeconomic status varied among participants, with the highest proportion belonging to middle-class families 53 (39.20%), followed by lower-middle-class families 41(30.51%). Upper-class families represented the smallest group, at 17(12.59%).

The study also explored family structure, with most participants, 87(64.4%), coming from joint families, while three-generation families were the least common, 23(17%). Regarding parity, most participants in parity-1 were 55(41%), indicating they had given birth once, while only 1(1%) were parity-5, having given birth five times. Additionally, the study highlighted that a small percentage 18 (13.3%) had a family history of diabetes mellitus, while the majority 117 (86.7%) did not.

Among the participants, 10 (7.4%) had a history of gestational diabetes mellitus (GDM), while 125 (92.6%) did not. The results indicate that, based on BMI categories, 71 (52.6%) were of normal weight, 39 (28.9%) were classified as overweight, and 25 (18.5%) were classified as obese.

Early prediction of gestational diabetes mellitus:

Mehrnaz Valadan et al. (2022)[33] studied the role of first-trimester HbA1c in early GDM detection in 760 pregnant women at Yas hospital from March 2018 to March 2020. They measured HbA1c and fasting blood glucose levels in the first trimester and conducted a Glucose Challenge Test between the 24th and 28th weeks. GDM diagnosis followed ADA criteria, with an average HbA1c level of 5.45±0.39% in GDM patients.

Chen Wang et al. (2021)[34] carried out a study titled "Evaluation of the value of fasting plasma glucose in the first trimester for the prediction of adverse pregnancy outcomes." This retrospective study analysed 22,398 singleton pregnancies, dividing participants into subgroups based on their first-trimester fasting plasma glucose (FPG) and oral glucose tolerance test (OGTT) results.

Your Chuyao Jin et al. (2019)[35] conducted a study titled "Effects of dynamic change in fetuin-A levels from the first to the second trimester on insulin resistance and gestational diabetes mellitus: a nested case-control study." They collected fasting venous blood samples during the first trimester and again during the second trimester oral glucose tolerance test (OGTT). The study found that women with the most substantial increase in fetuin-A levels from the first to the second trimester had a significantly higher risk of developing gestational diabetes mellitus (GDM) compared to those with the smallest increase.

Yin-Yu Wang et al. (2019)[36] conducted a study on the "Frequency and risk factors for recurrent gestational diabetes mellitus in primiparous women: a case control study" at the International Peace Maternity and Child Health Hospital (IPMCH) in Shanghai, China. The study found that the first-trimester HbA1c value was higher in the group with GDM recurrence compared to the group with no recurrence.

Tove Lekva et al. (2018)[37] conducted a study on the "Prediction of Gestational Diabetes Mellitus and Pre-diabetes 5 Years Postpartum using 75 g Oral Glucose Tolerance Test at 14-16 Weeks' Gestation." They investigated whether a 75 g oral glucose tolerance test (OGTT) at 14-16 weeks of gestation could predict the development of GDM or the birth of large-for-gestational-age (LGA) babies in 1031 pregnant women. The results showed that women diagnosed with GDM at 14-16 weeks and 30-32 weeks had higher insulin resistance, a greater area under the curve (AUC) for glucose and insulin, and lower insulin sensitivity and β-cell function, as measured by the insulin secretion-sensitivity index.

E. A. Huhn et al. (2016)[38] conducted a study titled "Screening of gestational diabetes mellitus in early pregnancy by oral glucose tolerance test and glycosylated fibronectin: study protocol for an international, prospective, multicenter cohort trial." This study recruited 748 singleton pregnancies from six centers in Switzerland, Austria, and Germany, excluding those with chronic diseases. The goal was to compare the diagnostic effectiveness of glyFn and the early OGTT at 12-15 weeks with the OGTT at 24-28 weeks of gestation.

Sofia Amylidi et al. (2015)[39] conducted a study titled "First-trimester glycosylated hemoglobin in women at high risk for gestational diabetes" at the Department of Obstetrics and Gynecology, University Hospital Bern, Switzerland. This research involved measuring HbA1c levels in the first trimester and comparing these values between women who later developed gestational diabetes mellitus (GDM) and those who did not. The diagnosis of GDM was determined using the results of a 75-g oral glucose tolerance test, which was performed between the 24th and 28th weeks of gestation. The study also examined the prevalence of GDM concerning the first-trimester HbA1c values.

Early 1st trimester prediction:

İnci Hansu et al. (2022)[40] conducted a study titled "Prediction of gestational diabetes mellitus in the first trimester: is it possible?" Of the 182 pregnant women, 54 had positive

Glucose challenge test (GCT) results and subsequently underwent an oral glucose tolerance test (OGTT). This led to the diagnosis of gestational diabetes mellitus (GDM) in 24 women.

John Punnose et al. (2020)[41] conducted a study titled "Glycated haemoglobin in the first trimester: A predictor of gestational diabetes mellitus in pregnant Asian Indian women." They found that compared to women with a first-trimester HbA1c below 5.2%, those with HbA1c levels of 5.2%-5.5% had an adjusted odds ratio of 1.627 for developing GDM, while those with HbA1c above 5.6% had an adjusted odds ratio of 2.6.

Stefanie N. Hinkle et al (2018)[42] conducted study HbA1c Measured in the First Trimester of Pregnancy and the Association with Gestational Diabetes" a case-control study done in U.S. clinical centers. In the study, women who later developed GDM had significantly higher HbA1c levels at 8-13 weeks of gestation (5.3% vs. 5.1%). Each 0.1% increase in HbA1c at 8-13 weeks was associated with a 22% increased risk of developing gestational diabetes.

Sarah S. Osmundson et al (2016)[43] conducted a retrospective cohort study titled "First Trimester Hemoglobin A1c Prediction of Gestational Diabetes." They found that women with prediabetes were at a higher risk of developing gestational diabetes mellitus (GDM). An A1C level in the prediabetic range during the first trimester predicted the likelihood of developing GDM.

Sofia Amylidi et al. (2015)[39] conducted a study titled "First-trimester glycosylated hemoglobin in women at high risk for gestational diabetes." The study found that women who developed GDM had significantly higher first-trimester HbA1c values. Notably, all pregnant women with HbA1c levels of 6.0% (42 mmol/mol) or higher developed GDM.

Emmy Grewal et al. (2012)[44] conducted a study titled "Prediction of gestational diabetes mellitus at 24 to 28 weeks of gestation by using first-trimester insulin sensitivity indices in Asian Indian subjects." In a survey of 298 women, 40 were diagnosed with gestational diabetes mellitus (GDM). Of these, 24 (60%) were diagnosed in the first trimester (GDM1), and 16 (40%) were diagnosed between 24 and 28 weeks (GDM2).

Shlomit Riskin-Mashiah (2010)[45] et al conducted study in Gestational diabetes mellitus manifests in all trimesters of pregnancy. They concentrated on women carrying a single baby and measured their fasting glucose levels in the first trimester. The study revealed that the risk of developing GDM increased by approximately 1.5 times for every 5 mg/dl increase in fasting glucose. Fasting glucose levels proved to be effective in predicting the onset of GDM.[45]

Conclusions

The socio-demographic and gestational profile in our present study reveals important risk factors and characteristics that can influence pregnancy outcomes among ANC mothers with GDM. The authors, however, suggest that Longer Postpartum Follow-up, Lifestyle Factors, Inclusion of High-Risk Populations, Health Interventions, and Confounding Factors must be considered in future studies on GDM Prevention.

Limitations of the study:

The following limitations can be identified based on the findings of this study: Sample Size, Single-Center Study, Exclusion of High-Risk Populations, Potential Recall Bias, Follow-up Period, Confounding Factors, and Manpower constraints are some limitations under which this study was conducted.

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