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Original Research Article

Proportion of Gestational Diabetes Mellitus among Pregnant Women Attending Antenatal Clinic of A Teaching Hospital of Tripura, NE Region, India – An Observational Study

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Abstract:

Background: Gestational diabetes mellitus (GDM)is a condition in which carbohydrate intolerance develops during pregnancy. A change in lipoprotein metabolism in the liver & adipose tissue during pregnancy along with insulin resistance leads to an alteration in serum concentration of fatty acids, triglycerides, cholesterol & phospholipids. Undiagnosed in time or inadequately treated, women with GDM are at increased risk for adverse obstetric and perinatal outcome. There are some current challenges and research gaps concerning GDM & its effect on maternal and foetal risk. So, it is necessary to screen, diagnose and manage this disease early in pregnancy to ensure better feto-maternal outcome.

Objectives: To estimate proportion of GDM among antenatal cases and to determine relationship between lipid profile, liver enzymes and GDM.

Materials and Method: A hospital based cross-sectional observational study is conducted among 130 antenatal mothers after 12 weeks of gestation, considering inclusion and exclusion criteria. Estimation of blood glucose, lipid profile, ALT & GGT have been performed by XL- 640 fully automated autoanalyzer. Data analysis is performed using SPSS version 21.0 in windows PC with the help of Chi-square test& Student t-test. A p-value of 0.05 or less is considered statistically significant.

Results: In this study, 12 out of 130 pregnant women are found to have GDM. The serum concentration of total cholesterol, triglyceride, LDL, VLDL, GGT are significantly higher in GDM pregnant women than non GDM pregnant women. The serum HDL is found to be lower in GDM pregnant women. There is no significant difference found in the analysis of serum ALT enzymes for GDM and non GDM pregnant women.

Conclusion: This study highlights that the prevalence of GDM is 9.2%. Serum levels of Total Cholesterol, serum Triglyceride, serum VLDL, LDL & GGT are found higher in these pregnant women which leads to the conclusion that a higher value of serum total cholesterol, triglyceride and GGT can be considered as a predictor of gestational diabetes mellitus.

Keywords: Gestational diabetes mellitus, Screening, OGTT, DIPSI criteria, Dyslipidaemia, GGT.

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Introduction

During pregnancy, progressive and intense metabolic changes occur in a woman's body, virtually involving every organ in response to the greater demands of the rapidly growing foetus and placenta as well [1]. Certain metabolic and hormonal adaptations occur in the function of the hypothalamus, pituitary, parathyroid, thyroid & adrenal glands to support the growth & development of the foetus. A decrease in sensitivity of insulin receptors (44%), with the advancement of the gestational period& an increase inplasma insulin leveldue to a number of contra insulin factors is evident contributing to insulin resistance. The basic defect lies both in insulin secretion and action which contributes to hyperglycaemia and ultimately culminates in the development of gestational diabetes [2].Gestational diabetes (GDM) is defined as carbohydrate intolerance of

variable severity with onset or first recognition during pregnancy irrespective of treatment with diet or insulin [3]. Worldwide, its prevalence differs according to race, ethnicity, age, body composition, screening and diagnostic criteria. It has been estimated that 7% of pregnancies were complicated by any type of diabetes and that approximately 86% of these cases represented women with GDM [4]. In India, gestational diabetes may affect between 5 and 8 million pregnant women annually [5].Gestational diabetes has various adverse effects on maternal health as well as foetal outcomes. There is an increased incidence of macrosomia, hyperbilirubinemia, hypocalcaemia, respiratory distress syndrome, and polycythemia in the neonate. Long-term complications include obesity, diabetes during childhood, impaired motor function [1,6]. There is a 10% risk of polyhydramnios that may increase the risk of abruption placentae and preterm labour as well as of postpartum uterine atony [7]. And further, women with GDM have a higher risk of developing preeclampsia, diabetes and cardiovascular diseases later in life [4,8].

Pregnancy is associated with an altered lipid metabolism where there is a decrease in hepatic lipase activity due to elevated oestrogen while the decrease in lipoprotein lipase is likely due to a combination of factors including insulin resistance and elevated oestrogen levels [9,10].

The triglyceride enrichment of low density lipoproteins (LDL) and high density lipoproteins (HDL) is due to an increase in cholesteryl ester transport proteins (CETP) activity resulting in the transfer of triglyceride from very low density lipoproteins (VLDL) to LDL and HDL and a decrease in hepatic lipase, which decreases the removal of triglycerides from these lipoprotein particles. However, increased levels of small-sized and dense LDL particles, which are characteristic of insulin-resistant conditions associated with increased risk of coronary artery disease, have been consistently found in GDM women [11]. Patients with insulin resistance & type 2 diabetes tend to have lipid and lipoprotein abnormalities including an elevated level of triglycerides (TGs), lower HDLs & higher LDLs which constitute the lipid triad or 'atherogenic lipoprotein phenotype'[12].

As the liver is a major site of insulin action and clearance, it regulates an important role in maintaining glucose-insulin homeostasis and hence it is recognised as a major site of injury due to insulin resistance & other metabolic impairment [13]. The liver enzyme, especially serum Gamma Glutamyl Transferase (GGT) and Alanine Transferase (ALT) are linked with a multitude of cardiovascular diseases including type 2 diabetes [14].

Serum GGT level serves as a marker of oxidative stress and it plays a role in the aetiology of the disease by inducing insulin resistance in the peripheral tissues and impairing insulin secretion from the pancreatic β-cells [15,16].

There are different criteria advocated for screening of gestational diabetes, like WHO (2018),[17] ACOG (American College of Obstetricians and Gynaecologists),[18] IADPSG (International Association of Diabetes & Pregnancy Study Group) [19] & DIPSI (Diabetes In Pregnancy Study Group India). Among these, DIPSI is a relatively simple, feasible and acceptable screening in the Indian scenario. DIPSI criteria recommends a 1-step procedure with 75 gm 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 [2].

Worldwide, GDM is considered a public health problem with the prevalence increasing day by day. There are some current challenges and research gaps concerning GDM & its effect on maternal and foetal risk. To the best of our knowledge, there is no single study done in Tripura regarding the evaluation of GDM in early pregnancy.

In the light of the above facts this study is undertaken to evaluate the proportion of gestational diabetes mellitus among pregnant women attending a teaching hospital of Tripura, India. This study is also highlighting the early detection of GDM in pregnant women which is helpful to reduce the complication of pregnancy through proper management and better outcome.

Materials and Method

This hospital-based observational cross-sectional study had been conducted in the Department of Biochemistry, Agartala Government Medical College and Govind Ballabh Pant Hospital (AGMC and GBP Hospital) in collaboration with the Department of Obstetrics and Gynaecology, Agartala Government Medical College and Govind Ballabh Pant Hospital, Agartala, Tripura, India after receiving approval from the Institutional Ethics Committee (Ref.No.4(6-13)/AGMC/Medical Education/IEC Approval/2022/21,853 Dated, 9th January 2023).The study period was one and one half years from January 2023 to May 2024.A total no of 130 antenatal mothers attending the antenatal clinic of AGMC & GBP Hospital after 12 weeks of gestation were included in this study.

Inclusion Criteria: Patients included in this study have fulfilled the following criteria:

1. Pregnant women attending antenatal clinic.
2. Willing to provide informed written consent for participation.

Exclusion Criteria: Patients are excluded if they had any one or more of the following:

1. Known diabetics.
2. Chronic hypertension, hypothyroidism or any major systemic illness.
3. Patient admitted with obstetric emergencies.
4. Patients on lipid lowering agents.
5. Hepatic & renal impairment.
6. Any Pancreatic or genetic disorder.
7. Patients unwilling to participate in the study.

Blood Sample Collection: Under aseptic measures, 5 ml of blood was drawn preferably from the antecubital vein using a sterile needle and syringe from each patient in the first visit after 12 weeks for routine antenatal analysis. The enrolled patients are asked to attend antenatal clinic within 24 to 28 weeks for collection of blood glucose.

Laboratory Analysis: Blood samples are collected for analysis of lipid profile (Total cholesterol, Triglyceride, HDL&LDL); liver enzymes (GGT & ALT); OGTT by XL- 640 fully automated clinical chemistry autoanalyser and HbA1c by Bio-Rad D10 HPLC autoanalyser .

Statistical Analysis: Data entry and analysis is performed using SPSS version 21.0 in windows PC. Categorical data are presented as mean ± standard deviation with the help of text, tables, charts etc.

Chi-square test for testing the significance of association between two or more risk factors and student t-test for testing the significance of difference between two means have been used. A p-value of 0.05 or less is considered statistically significant.

Results

Table 1: Comparison of Maternal age (years) in GDM and non GDM pregnant women

Maternal age						p value
	Antenatal Pregnant women	N	Mean	Std. Deviation	Mean difference	
Age (year)	Non GDM	118	23.381	4.3832	5.40	<0.001
	GDM	12	28.750	2.3789		

There is a significant statistical difference in age between the gestational diabetes (GDM) pregnant women and the non GDM pregnant women.

Table 2: Comparison of socioeconomic status of GDM and non GDM pregnant women (Chi square test)

Socioeconomic status	Total Nos of study population	GDM	Non GDM	p value
Upper (I)	13	3 (23.08%)	10 (76.92%)	0.001
Upper – middle (II)	27	1 (3.70%)	26 (96.30%)	
Middle (III)	70	2 (2.86%)	68 (97.14%)	
Lower – middle (IV)	15	4 (26.67%)	11 (73.33%)	
Lower (V)	5	2 (40%)	3 (60%)	
Total	130	12	118	

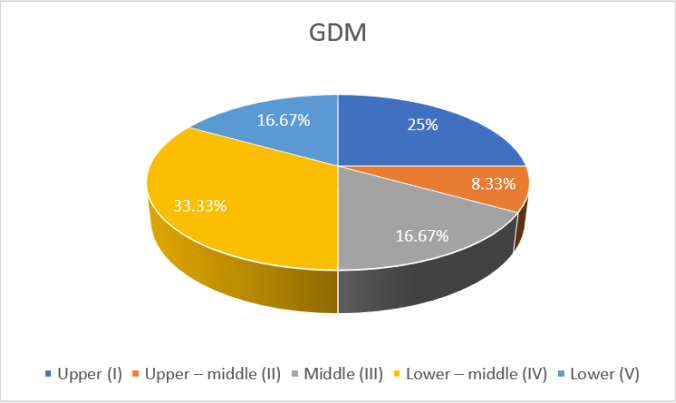

Figure 1: Socioeconomic status of GDM study subjects

Among the GDM pregnant women, 33.33% belonged to lower-middle socioeconomic status.

Table 3: Comparison of BMI (mean ± SD) of GDM and non GDM pregnant women

Comparison of BMI (Mean ± SD)						p value
		N	Mean	Std. Deviation	Mean difference	
BMI	Non GDM	118	23.5781	2.18659	2.58	<0.001
	GDM	12	26.1583	1.44440		

Table 4: Comparison of gravida status among antenatal women

Gravida			

		Non GDM	GDM	Total	P value
1.0	Count	72	2	74	< 0.001
	% within gravida	97.3%	2.7%	100 %	
2.0	Count	44	7	51	
	% within gravida	86.3%	13.7%	100%	
3.0	Count	2	3	5	
	% within gravida	40.0%	60.0%	100%	

In third gravida, 60% of study participant belong to GDM pregnant women whereas 40% of study participant belong to Non GDM pregnant women.

Table 5: Comparative study of Lipid Profile among GDM and Non GDM pregnant women

Comparison of lipid profile (mean ± SD) in between the GDM and non GDM women						p value
	Variable	N	Mean	Std. Deviation	Mean differences	
S.TotalCholesterol	Non GDM	118	172.924	48.60	39.90	0.009
	GDM	12	212.833	56.7624		
S.TG	Non GDM	118	148.898	52.3216	73.10	<0.001
	GDM	12	222.000	77.6097		
S.LDL	Non GDM	118	93.703	34.3089	36.71	0.001
	GDM	12	130.417	45.1713		
S.VLDL	Non GDM	118	29.864	10.6922	14.55	<0.001
	GDM	12	44.417	15.5298		
S.HDL	Non GDM	118	48.695	11.2474	10.69	0.002
	GDM	12	38.000	6.7689		

Table 6: Comparative study of Liver enzymes among GDM and Non GDM women

Comparison of Liver enzymes (mean ± SD)						p value
		N	Mean	Std. Deviation	Mean difference	
S.ALT	Non GDM	118	29.794	45.6255	7.70	0.56
	GDM	12	37.500	21.5090		
S.GGT	Non GDM	118	24.127	8.8009	20.95	<0.001
	GDM	12	45.083	10.6469		

Table 7: Comparative study of OGTT and HbA1c conc. in GDM and Non GDM women

Comparison of (mean ± SD)OGTT and HbA1c among antenatal women						p value
		N	Mean	Std. Deviation	Mean difference	
OGTT	Non GDM	118	106.483	17.0934	60.01	<0.001
	GDM	12	166.500	17.4486		
HbA1c	Non GDM	118	4.859	0.6595	0.94	<0.001
	GDM	12	5.808	0.2193		

A highly significant difference is obtained for OGTT & HbA1c conc. between GDM & Non GDM.

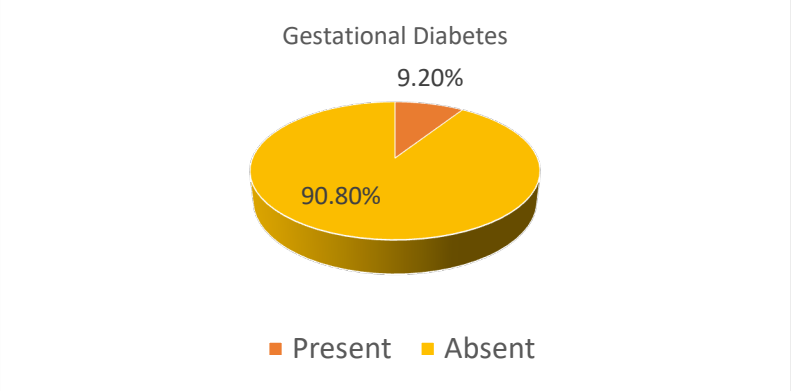

Figure 2: Proportion of Gestational Diabetes among antenatal wome

Proportion of Gestational Diabetes among the antenatal women is found to be 9.2%.

Discussion

Gestational diabetes mellitus is the most common metabolic disorder of pregnancy. Because many women do not receive screening for diabetes mellitus before pregnancy, it can be challenging to distinguish GDM from pre-existing diabetes. Screening and early diagnosis of the condition during pregnancy might be of help in the timely initiation of prophylactic measures and management contributing to a better feto-maternal outcome.

In the present study, demographic characters and anthropometric measurements are highlighted. Among the antenatal mothers, GDM subjects are older than non-GDM pregnant women, with mean ages of GDM and Non GDM pregnant women being 28.75 ± 2.37 years and 23.38 ± 4.3 years respectively and the values are found statistically highly significant (table 1) which is in accordance with a study conducted by Kalra P et al [20]. So it can be concluded that GDM mothers are considerably older in comparison with Non GDM mothers, which may be an important risk factor for gestational diabetes.

The socioeconomic status of all the participants in this study is depicted intable 2. Only 13 patients among the study participants belong to the upper socioeconomic status and out of them only 3(23.08%) are having GDM, whereas 10 (76.92%) of subjects are non-diabetic and belonged to the upper socioeconomic group. In the Fig 1, it has been shown that the maximum percentage (33.33%) of GDM pregnant women belong to lower-middle socioeconomic status. The findings of the study suggest that lower socioeconomic status may be a risk factor for gestational diabetes and the results are similar to a study conducted by Roustaei Z et al [21].

BMI has also shown statistically significant results in GDM subjects in comparison with non GDM pregnant women. The mean BMI ± SD (kg/m^2) in GDM pregnant women & Non GDM pregnant women are 26.15 ± 1.44 and 23.57 ± 2.18 respectively and found to be statistically significant (table 3). Hence, in comparison with the Non GDM individuals, women with GDM have significantly higher BMI. The above findings are consistent with a study conducted by Kalra P et al. [20] which stated that overweight or obesity at the start of pregnancy predisposes to GDM and is an important risk factor and the study results obtained by Etminan-Bakhsh M et al. [22] indicated that GDM was independently associated with BMI. A comparison of gravida status among antenatal women of this study has been described in table 4. In third gravida, 60% of study participant belong to GDM pregnant women whereas 40% of study participant belong to Non GDM pregnant women. In the second gravida, 13.7%of study participant belong to GDM pregnant women whereas 86.3% belong to Non GDM pregnant women. In the primigravida, only 2.7% of study participant belong to GDM pregnant women whereas 97.3% belong to Non GDM pregnant women. Statistical significance is found between them. Thus it can be concluded that increase in gravida increases the risk of GDM. The above findings are similar to a study performed by Raja MW et al [23].

Regarding the biochemical analysis of lipid profile (table 5) in our study, the mean serum cholesterol ± SD (mg/dl) in GDM and Non GDM pregnant women are (212.83 ± 56.76) and (172.92 ± 48.60) respectively which show statistical significance. Hence this study proclaims the association of gestational diabetes with higher serum cholesterol levels and is consistent with the study conducted by Asare-Anane H et al. [24]. The mean serum triglyceride ± SD (mg/dl) in GDM and Non GDM pregnant women were (222 ± 77.6) and (148.89 ± 52.32) respectively also show statistically high significance. Similar observation was found in a study conducted by Layton J et al. where it had been observed that in comparison to women with normal glucose tolerance, women with GDM characterized by a predominant insulin sensitivity defect had significantly higher triglycerides in mmol/L (2.20 vs. 1.82) [25].

In our study, the mean serum HDL ± SD (mg/dl) in GDM and Non GDM pregnant women are (38± 6.76) and (48.69 ± 11.24) respectively which is statistically significant and the result is in accordance with a study conducted by Layton J et al. who opined that in comparison to women with normal glucose tolerance, women with GDM had significantly lower HDL in mmol/L (1.64 vs. 1.90) [25]. The mean serum LDL ± SD (mg/dl) in GDM and Non GDM pregnant women are (130.41 ± 45.17) and (93.70 ± 34.30) respectively as depicted in Table 5 which also show statistically high significance and is consistent with the study conducted by Asare-Anane H et al. [24]. The mean serum VLDL ± SD (mg/dl) in GDM and Non GDM pregnant women in our study are (44.41 ± 15.52) and (29.86 ± 10.69) respectively which is also statistically highly significant. Similar observation was made in a hospital-based study conducted by Das S et al. [26].

Observation of the liver enzymes in this study (table 6) shows a mean serum GGT (mg/dl) in GDM and in Non GDM pregnant women to be (45.08 ± 10.64) and (24.12 ± 8.80) respectively which reflects statistically higher significance. Our result is in consistent with a study performed by Kong M et al. [27] in which it was found that mean GGT level was higher in GDM than non-GDM women (18.7 ± 13.0 vs 14.5 ± 7.0, P <.001). The higher GGT level was 26.9~74.0 U/L, which was significantly associated with increased risk of GDM. The mean serum ALT (mg/dl) in GDM and

Non GDM pregnant women are (37.50 ± 21.50) and (29.79 ± 45.62) respectively and it is found statistically not significant with a p-value of <0.56. The above result is similar to a comparative study performed by Khan R et al. to determine whether the liver and renal functions were disturbed in patients having GDM. In the above mentioned study, ALT was not significantly different among 2 groups as the p value was 0.71 [28].

Table 7 shows the mean ± SD of OGTT (mg/dl) which is done within 24 to 28 weeks in GDM and Non GDM pregnant women & mean ± SD of HbA1c done during early second trimesterand are found to be statistically highly significant and is in accordance with a study conducted by Lenin M et al.[29].

Proportion of Gestational Diabetes among antenatal women enrolled in this study attending the antenatal clinic is shown in Fig 2. Out of 130 participants, 12 pregnant women have been found to have gestational diabetes based on DIPSI criteria, a modified WHO criterion, which is similar to the studies conducted by Raja MW et al.[23] & Swaroop N et al. [30].

Conclusion:

This study detects 9.2 % cases of GDM and all of them are newly diagnosed during the study by DIPSI criterion. It is a one step-cost effective, easy to perform, evidence-based procedure to diagnose GDM in any socio-economic setting and also feasible for remote population. It can be concluded that a higher value of serum total cholesterol, triglyceride and GGT can be considered as a predictor of gestational diabetes mellitus. However, further studies with larger study population and incorporation of multiple study centres having varied population are recommended to draw a better correlation between lipid profile, GGT, ALT& the development of GDM.

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