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Research Article

Assessment of Biochemical and Community Factors Associated With Gestational Diabetes Mellitus among Pregnant Women

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ABSTRACT

Background: Gestational diabetes mellitus is an uncomplicated metabolic condition of pregnancy, which can have a detrimental effect on maternal and fetal outcome if not diagnosed and treated on time. Biochemical factors and community factors like diet, physical activity, utilization of antenatal care and awareness of the disease affect its development.

Objective: To determine the biochemical and community determinants of gestational diabetes mellitus among pregnant women attending Women and Children Hospital, Dera Ismail Khan.

Methods: The descriptive cross sectional study was done at Women and Children Hospital, Dera Ismail Khan from January 2025 to June 2025. The total number of pregnant women that were included in the study were 75; which were obtained through non-probability consecutive sampling. The data collected includes demographic data, obstetric data, clinical data, biochemical data and community data, which was taken with a structured proforma. Biochemical parameters measured were fasting blood glucose, random blood glucose, HbA1c, lipid profile, hemoglobin and vitamin D level. Community factors consisted of physical activity, dietary pattern, antenatal care visits, awareness of gestational diabetes mellitus and health care. The data were analysed with SPSS software. Frequencies, percentages, means and standard deviations were computed. Where applicable the Chi-square test and independent sample t-test were used, and a p value of less than 0.05 was deemed to be statistically significant.

Results: Out of 75 pregnant women, 24 (32.0%) were diagnosed with gestational diabetes mellitus, while 51 (68.0%) had normal glucose tolerance. Women with GDM had higher fasting blood glucose, random blood glucose, HbA1c, triglycerides, and total cholesterol levels compared with non-GDM women. Vitamin D level and HDL cholesterol were lower among women with GDM. Important associated factors included overweight/obesity, family history of diabetes, previous history of GDM, raised triglycerides, vitamin D deficiency, low physical activity, high carbohydrate diet, frequent sugary food intake, poor awareness, and irregular antenatal visits.

Conclusion: Gestational diabetes mellitus was common among pregnant women in this study. Both biochemical abnormalities and community-related factors were associated with GDM. Early screening, regular antenatal visits, dietary counseling, safe physical activity, and community awareness programs may help reduce the risk and complications of gestational diabetes mellitus.

Keywords: Gestational Diabetes Mellitus, Pregnancy, Biochemical Determinants, Community Determinants, Fasting Blood Glucose, Hba1c, Vitamin D Deficiency, Antenatal Care.

INTRODUCTION

Glucose intolerance first detected during pregnancy is called gestational diabetes

mellitus (GDM). It is one of the most common metabolic complications during pregnancy, and is a major public health issue in the current era of high maternal age, increasing obesity, poor dietary habits, and physical inactivity. Normal physiological changes during pregnancy result in insulin resistance, particularly during the 2nd and 3rd trimesters. For most females, the insulin levels in the pancreas rise to keep the glucose level normal. However, if insulin response is not adequate, a hyperglycemia condition will arise on the mother and will result in gestational diabetes mellitus (1-3).

Gestational diabetes mellitus is important to consider because it may impact mom and baby. Maternal risks include pregnancy induced hypertension, preeclampsia, polyhydramnios, operative delivery, and increased risk for developing type 2 diabetes mellitus later in life. The complications may include fetal and neonatal: macrosomia, birth trauma, neonatal hypoglycemia, respiratory distress and future risk of obesity and metabolic disease. Therefore early screening for GDM during the ante-pregnancy phase is very important to decrease the risk of complications by making appropriate lifestyle changes, monitoring glucose levels and medical management if needed (4-6).

GDM is a complex condition involving multiple biochemical changes, which are responsible for the onset and recognition of GDM. Important metabolic parameters reported among women with GDM include raised fasting blood glucose, abnormal random blood glucose, increased HbA1C, dyslipidaemia and vitamin D deficiency. Lipid abnormalities, such as increased triglycerides and decreased HDL cholesterol, can be a sign of insulin resistance. Likewise, low levels of vitamin D may be associated with impaired glucose metabolism, but the association between vitamin D and GDM can be different depending on diet, sun exposure, nutritional status and lifestyle (7-9).

Community related determinants are also important for the risk of GDM. Failing to eat properly, over-consumption of sugar in food and drink, lack of activity, insufficient knowledge of GDM, irregular prenatal care visits and poor access to health care services may cause the diagnosis to be delayed and also result in poor glycemic control. In many communities, women are not likely to receive antenatal care regularly, unless they experience symptoms. GDM could be asymptomatic in the early stages and so could not be diagnosed, or be diagnosed too late (10, 11).

Other important risk factors are family history of diabetes, history of gestational diabetes, overweight and obesity. These are the factors that need specific attention during antenatal visits with women. Because of clinical history, biochemical screening and lifestyle assessment, high-risk women can be identified early and healthcare providers can plan early counselling and follow-up. It is particularly relevant to adopt a combined approach in regions where there is a possibility of differences in health literacy, attendance at antenatal care and access to diagnostic services (12).

In Pakistan, gestational diabetes mellitus is an emerging concern because of changing lifestyle patterns, increasing obesity, and a high background burden of diabetes mellitus. Local evidence is needed to understand the biochemical and community-level factors associated with GDM in different regions. Such evidence can help improve antenatal screening strategies and guide community-based preventive programs. Therefore, the present study was conducted to determine the biochemical and community determinants of gestational diabetes mellitus among pregnant women attending Women and Children Hospital, Dera Ismail Khan.

METHODOLOGY

This descriptive cross-sectional study was conducted at Women and Children Hospital, Dera Ismail Khan, from January 2025 to June 2025. The study was designed to evaluate the biochemical and community-related determinants associated with gestational diabetes mellitus among pregnant women attending the antenatal clinic. A total of 75 pregnant women were included in the study after fulfilling the eligibility criteria. All participants were enrolled during routine antenatal visits, and relevant clinical, biochemical, obstetric, and community-based information was collected using a structured proforma.

The second and third trimester of pregnancy were included as pregnant women are generally screened for gestational diabetes during this time. The following were excluded from the study: women with a history of diabetes mellitus prior to conception (both type 1 and type 2), chronic renal disease, chronic liver disease, endocrine disorders, multiple pregnancies, and those receiving drugs that affect glucose metabolism. The participants were selected using non-probability consecutive sampling method until the sample

size of 75 participants was reached. Informed consent was obtained from all participants before data collection, and the purpose of the study was explained.

Demographic data such as age, place of residence, education, occupation, and socioeconomic status were collected. Obstetric history was also recorded such as gravidity, parity, previous history of GDM, history of macrosomic infant, history of miscarriage and family history of diabetes mellitus. Clinical parameters measured were weight, height, body mass index and blood pressure. The BMI was computed as weight (kg) divided by the height (m2) and classified as normal, overweight and obese based on standard criteria.

Biochemical assessment was done to find the metabolic and nutritional factors related to gestational diabetes mellitus. Fasting blood glucose, random blood glucose, HbA1c, lipid profile, hemoglobin, vitamin D level and serum creatinine measurements were taken under aseptic conditions as needed. Gestational diabetes mellitus was determined with the abnormal glucose testing done in an institutional manner. The women were then classified into GDM and non-GDM groups and biochemical and community determinants were compared.

Information about the community and lifestyle was gathered by asking questions in an interview format. These were physical activity level, dietary pattern, consumption of sugary foods or drinks, frequency of antenatal care visit, knowledge about gestational diabetes mellitus, availability of health care facility, family support, sleep duration and perceived stress. The physical activity level was considered low, moderate or adequate according to the routine daily activity during pregnancy. Food consumption was evaluated by questions regarding the regular consumption of foods high in carbohydrates, sweetened drinks, fried foods, fruits, vegetables, and balanced meals.

All collected data were checked for completeness before entry and analysis. The data were analyzed on SPSS software. The quantitative variables (age, fasting blood glucose, HbA1c, triglycerides, cholesterol, vitamin D, hemoglobin) were reported as mean and standard deviation. Qualitative variables like awareness of GDM, antenatal care status, dietary pattern, physical activity, family history of diabetes, previous history of GDM, and residence were reported as frequency and percentage. Association between categorical variables and GDM was determined by using Chi-square test. The mean biochemical values in GDM and non-GDM were compared by Independent sample t-test. P-values < 0.05 were deemed to be statistically significant.

RESULTS

A total of 75 pregnant women were included in the study. The age of the participants was 28.6 ± 5.1 years with the highest percentage being the age group 26–30 years. Of the 75 women, 32.0% (24 women) were diagnosed with gestational diabetes mellitus and 68.0% (51 women) had normal glucose tolerance. Most of the participants were multigravida and a significant proportion had at least one clinical, biochemical and community-related risk factor for gestational diabetes mellitus.

Table 1. Baseline demographic characteristics of pregnant women

VARIABLE	FREQUENCY (N)	PERCENTAGE (%)
AGE GROUP		
18–25 YEARS	21	28.0
26–30 YEARS	29	38.7
31–35 YEARS	18	24.0
>35 YEARS	7	9.3
RESIDENCE		
URBAN	43	57.3
RURAL	32	42.7
EDUCATION STATUS		
NO FORMAL EDUCATION	13	17.3
PRIMARY	18	24.0
SECONDARY	25	33.3
HIGHER EDUCATION	19	25.4
SOCIOECONOMIC STATUS		
LOW	28	37.3
MIDDLE	34	45.4

HIGH	13	17.3

Demographic results indicated that majority of women were within the age range of 26-30 years. There were a slightly larger proportion of urban than rural participants. The majority of women were in the middle socioeconomic group, with the lowest socio-economic group coming in second.

Table 2. Obstetric and clinical profile of study participants

Variable	Frequency (N)	Percentage (%)
Trimester		
Second Trimester	31	41.3
Third Trimester	44	58.7
Gravidity		
Primigravida	26	34.7
Multigravida	49	65.3
Body Mass Index		
Normal Bmi	24	32.0
Overweight	31	41.3
Obese	20	26.7
Family History Of Diabetes		
Yes	29	38.7
No	46	61.3
Previous History Of Gdm		
Yes	11	14.7
No	64	85.3
Raised Blood Pressure		
Yes	14	18.7
No	61	81.3

The time of assessment most of the women were in third trimester. The multigravida women were more common than primigravida women. The prevalence of overweight and obesity was high and more than one-third of participants had a positive family history of diabetes.

Table 3. Comparison of biochemical parameters between GDM and non-GDM groups

Biochemical Parameter	GDM Group N=24 Mean ± SD	Non-GDM Group N=51 Mean ± SD	P-Value
Fasting Blood Glucose (Mg/Dl)	103.8 ± 12.6	84.9 ± 8.7	<0.001
Random Blood Glucose (Mg/Dl)	168.4 ± 24.1	119.7 ± 18.5	<0.001
Hba1c (%)	5.9 ± 0.6	5.1 ± 0.4	<0.001
Triglycerides (Mg/Dl)	201.6 ± 38.4	161.9 ± 31.7	<0.001
Total Cholesterol (Mg/Dl)	204.3 ± 34.2	184.7 ± 29.5	0.014
HDL Cholesterol (Mg/Dl)	39.8 ± 7.1	45.6 ± 8.3	0.004
Vitamin D Level (Ng/Ml)	18.9 ± 6.5	25.7 ± 8.1	0.001
Hemoglobin (G/Dl)	10.8 ± 1.1	11.2 ± 1.0	0.118

The mean fasting glucose, random glucose, HbA1c, triglycerides and total cholesterol were significantly higher in pregnant women with GDM than in those without GDM. Vitamin D level and HDL were lower in GDM women. Hb level was slightly decreased in GDM group but not significantly different.

Table 4. Community and lifestyle determinants associated with GDM

Determinant	GDM Present N=24	GDM Absent N=51	P-Value
Low Physical Activity	17 (70.8%)	20 (39.2%)	0.011

High Carbohydrate Diet	18 (75.0%)	24 (47.1%)	0.024
Frequent Sugary Food/Drink Intake	15 (62.5%)	18 (35.3%)	0.026
Irregular Antenatal Visits	14 (58.3%)	16 (31.4%)	0.025
Poor Awareness About GDM	16 (66.7%)	21 (41.2%)	0.038
Difficult Access To Healthcare	10 (41.7%)	13 (25.5%)	0.154
Low Socioeconomic Status	12 (50.0%)	16 (31.4%)	0.117

A clear pattern emerged for community-related factors among women with GDM. Women with GDM were significantly more likely to have low physical activity, high carbohydrate intake, frequent use of sugary foods or drinks, irregular antenatal care visits and poor awareness of gestational diabetes. The GDM group had more frequently difficult access to healthcare as well as low socioeconomic status, although this difference was not statistically significant.

Table 5. Factors significantly associated with gestational diabetes mellitus

Factor	GDM Present N=24	GDM Absent N=51	P-Value
Age >30 Years	12 (50.0%)	13 (25.5%)	0.034
Overweight/Obesity	21 (87.5%)	30 (58.8%)	0.013
Family History Of Diabetes	15 (62.5%)	14 (27.5%)	0.003
Previous History Of GDM	8 (33.3%)	3 (5.9%)	0.002
Raised Triglycerides	17 (70.8%)	18 (35.3%)	0.004
Vitamin D Deficiency	18 (75.0%)	23 (45.1%)	0.016
Low Physical Activity	17 (70.8%)	20 (39.2%)	0.011
Irregular Antenatal Visits	14 (58.3%)	16 (31.4%)	0.025

The prevalence of GDM in this study was 32.0%. Women over the age of 30, overweight or obese women and women with a family history of diabetes were significantly more likely to have GDM. Current GDM was also closely linked to previous history of GDM. In the biochemical factors, high triglycerides level and Vitamin D deficiency were significantly associated with GDM. Low physical activity and infrequent ante natal care visits were important associated factors in the context of community determinants. In general, the findings suggest that a combination of biochemical, clinical and community-based determinants were associated with gestational diabetes mellitus. The most important factors noted in pregnant women with GDM were raised blood glucose, higher HbA1c, dyslipidaemia, Vitamin D deficiency, reduced physical activity, unhealthy diet habits and poor antenatal follow-up.

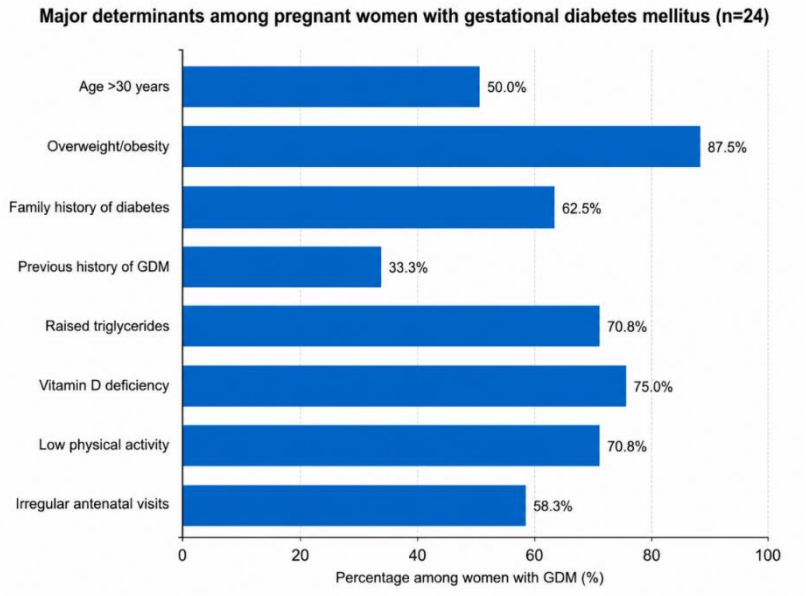

Figure 1. Major determinants among pregnant women with gestational diabetes mellitus. Horizontal bar chart showing the percentage distribution of selected clinical, biochemical, and

community-related determinants among pregnant women diagnosed with GDM (n=24). Overweight/obesity was the most frequent determinant (87.5%), followed by vitamin D deficiency (75.0%), raised triglycerides (70.8%), low physical activity (70.8%), family history of diabetes (62.5%), irregular antenatal visits (58.3%), age >30 years (50.0%), and previous history of GDM (33.3%).

DISCUSSION

Gestational diabetes mellitus is an important metabolic disorder of pregnancy that can affect both maternal and fetal outcomes if it is not identified and managed at an early stage. In the present study, gestational diabetes mellitus was observed in 24 out of 75 pregnant women, giving a frequency of 32.0%. This finding indicates that GDM is a considerable health concern among pregnant women attending Women and Children Hospital, Dera Ismail Khan. The observed frequency may be related to the combined influence of clinical risk factors, biochemical disturbances, dietary habits, reduced physical activity, and limited awareness regarding glucose control during pregnancy (13-15).

Women with GDM had significantly higher fasting blood glucose, random blood glucose and HbA1c levels than women without GDM in this study. This is to be expected as glucose metabolism is the primary diagnostic criterion for gestational diabetes. Higher HbA1C levels among women with GDM also indicate that elevated glucose levels might not just be a one-time occurrence but a reflection of ongoing issues with glycemic control. Hence early biochemical screening during antenatal visits are important particularly for women who have other risk factors like family history of diabetes and obesity or have had GDM previously (16).

The present finding also revealed that a strong association was observed between overweight and obesity with GDM. Of the women who had GDM, 87.5% were overweight / overweight. BMI can also increase during pregnancy, which raises insulin demand and creates insulin resistance during pregnancy.Additionally, pregnancy itself is a period of increased insulin demand, and increased BMI can exacerbate insulin resistance. If overweight, the pancreatic response to insulin may be inadequate resulting in hyperglycemia. This is a reminder of the importance of antenatal care, pre-pregnancy counseling, weight maintenance and nutrition advice (17, 18).

The other factors that were found to be determinant in this study were family history of diabetes and previous history of gestational diabetes mellitus (GDM). History of GDM was present in 62.5% of the women who developed GDM, and 33.3% of affected women had previously developed GDM. The results indicate that the risk of recurrence may be higher in those with genetic susceptibility and previous pregnancy related metabolic disturbance. These risk factors should be taken into account and the pregnant women who are at risk should be carefully monitored during ante-natal follow-up. These women may also need more frequent monitoring and dietary counseling and need to be referred for specialist care early (19).

There were also biochemical changes other than glucose changes. 70.8% of women with GDM had raised triglyceride level and 75.0% had low vitamin D level. Increased triglycerides may indicate a change in lipid metabolism that is often associated with insulin resistance. There is also a potential connection between low vitamin D status and impaired insulin sensitivity, but this link may be affected by the diet, sun exposure, nutritional status and lifestyle. The results suggest that blood glucose alone should not be the only measurement used for diagnosing GDM, and that the entire metabolic profile should be taken into account (20).

The present study also highlighted community and lifestyle related factors. In the 70.8% of the women with GDM, low physical activity was noted, and for 58.3% of the women, the antenatal visits were irregular. Inadequate physical activity could lead to weight gain, insulin resistance and irregular ante-natal attendance can cause delay in screening and diagnosis. Others were also found to be significant, including dietary habits: women with GDM consumed sugary foods and drinks more often and had a higher carbohydrate intake. These findings highlight the importance of community education, healthy eating habits, and prenatal clinic visits and counselling on physical activity measures to mitigate the burden of GDM (21).

Based on the results of this study, it can be concluded that the development of gestational diabetes mellitus can not only be attributed to a single biochemical determinant, but also to biochemical, clinical and community determinants. Obesity, high triglycerides, low Vitamin D levels, family history of gDM, lack of physical activity, unhealthy nutrition and lack of regular antenatal care may work together to increase the risk for gDM. Thus, an integrated

antenatal program is necessary, which involves biochemical screening, risk assessment, lifestyle counseling and community-based awareness programme.

There were some limitations in this study. The sample size was relatively small and the study was conducted in a single hospital, so the results may not be generalizable to all women giving birth in the community. Some lifestyle and dietary variables were based on self-reported information, which may be affected by recall bias. Regardless of the drawbacks, the study offers valuable local data on biochemical and community factors that are associated with gestational diabetes mellitus, and underscores the importance of early screening and preventive counseling during pregnancy.

CONCLUSION

This study concluded that gestational diabetes mellitus was common among pregnant women included in the study, with a frequency of 32.0%. GDM was significantly associated with higher fasting blood glucose, random blood glucose, HbA1c, raised triglycerides, vitamin D deficiency, overweight and obesity, family history of diabetes, previous history of GDM, low physical activity, unhealthy dietary practices, and irregular antenatal visits. These findings show that both biochemical and community-related factors play an important role in the development of GDM.

Early identification of high-risk pregnant women, regular antenatal screening, nutritional counseling, weight control, promotion of safe physical activity, and improvement in awareness about gestational diabetes mellitus may help reduce the burden of GDM and its complications. Community-based health education should be strengthened so that pregnant women can understand the importance of timely antenatal care, healthy diet, and glucose monitoring during pregnancy.

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