E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.574

Research Article

Biochemical and Pathological Determinants of Gestational Diabetes Mellitus among Pregnant Women and Its Effects on Neonatal Outcomes

Shabana Bano Soomro[1], Sobia Azeem Siddiqui[2*], Sidra Nosheen Kiani[3], Safiya Javed[4], Roshaan Bashir[5], Sundas Shabir[6]

[1]Assistant Professor, Department of Obstetrics and Gynaecology, Shaikh Zayed Women Hospital, Chandka Medical College, Shaheed Muhtarma Benazir Bhutto Medical University, Larkana, Pakistan.
[2*]Assistant Professor, Department of Obstetrics and Gynaecology, Rehman Medical College and Institute, Peshawar, Pakistan.
[3]Assistant Professor, Department of Pathology, Rawal Institute of Health Sciences, Islamabad, Pakistan
[4]Associate Professor, Department of Pathology, Isra University, Islamabad, Pakistan.
[5]Senior Registrar, Department of Pediatrics, Al-Nafees Medical College and Hospital, Islamabad, Pakistan.
[6]Assistant Professor, Department of Pathology, Muhammad College of Medicine, Peshawar, Pakistan.
Corresponding Author: Sobia Azeem Siddiqui
Assistant Professor, Department of Obstetrics and Gynaecology, Rehman Medical College and Institute, Peshawar, Pakistan.
Email: so_zeem@hotmail.com
Received: 08.03.26, Revised: 23.05.26, Accepted: 02.06.26

ABSTRACT

Background: Gestational diabetes mellitus is a common metabolic disorder of pregnancy that may adversely affect maternal and neonatal outcomes if not diagnosed and managed at an early stage. Biochemical factors and pathological factors such as obesity, hypertension, dyslipidaemia, vitamin D deficiency, previous GDM, and family history of diabetes.

Objective: To determine the biochemical and pathological determinants of gestational diabetes mellitus among pregnant women and to assess its effects on neonatal outcomes.

Methods: The descriptive cross sectional study was done at Muhammad College of Medicine, Peshawar 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, obstetric, biochemical, pathological, lifestyle, and neonatal outcome 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. Pathological determinants included overweight/obesity, raised blood pressure, previous GDM, previous macrosomic baby, dyslipidaemia, vitamin D deficiency, and anemia. Lifestyle-related factors included physical activity, dietary pattern, antenatal visits, and awareness of GDM. 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. Neonates of GDM mothers had higher frequencies of macrosomia, neonatal hypoglycemia, and NICU admission compared with neonates of non-GDM mothers.

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, Pathological Determinants, Obesity, Dyslipidaemia, Vitamin D Deficiency, Neonatal Outcomes, Macrosomia, Neonatal Hypoglycemia.

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 because it can affect both maternal and neonatal health. 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 antenatal period 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).

Pathological determinants of GDM include obesity, pregnancy-induced hypertension, previous history of GDM, previous macrosomic baby, dyslipidaemia, vitamin D deficiency, and anemia. These factors reflect underlying metabolic, vascular, nutritional, and obstetric abnormalities that may increase insulin resistance and worsen maternal glucose regulation during pregnancy. Identification of these pathological factors during antenatal visits can help in early risk stratification and timely management of high-risk pregnant women. (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).

The neonatal findings of the present study further support the clinical importance of GDM. Macrosomia, neonatal hypoglycemia, and NICU admission were significantly more common among babies of GDM mothers. Maternal hyperglycemia increases fetal glucose exposure, which stimulates fetal insulin secretion and may contribute to excessive fetal growth. After delivery, persistent fetal hyperinsulinemia may result in neonatal hypoglycemia. Increased NICU admission among neonates of GDM mothers may reflect the combined effects of hypoglycemia, respiratory distress, jaundice, and birth weight abnormalities. These findings highlight the need for strict glycemic monitoring during pregnancy and early neonatal assessment after delivery.

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 biochemical and pathological factors associated with GDM in pregnant women. Such evidence can help improve antenatal screening, early risk identification, and neonatal outcome prevention. Therefore, the present study was conducted to determine the biochemical and pathological determinants of gestational diabetes mellitus among pregnant women and to assess its effects on neonatal outcomes.

METHODOLOGY

This descriptive cross-sectional study was conducted at Muhammad College of Medicine, Peshawar, from January 2025 to June 2025. The study was designed to evaluate biochemical and pathological determinants associated with gestational diabetes mellitus and to assess neonatal outcomes among babies of GDM and non-GDM mothers. 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.

Pathological determinants were recorded from clinical examination, obstetric history, and available medical records. These included overweight/obesity, raised blood pressure during pregnancy, previous history of gestational diabetes mellitus, previous macrosomic baby, previous miscarriage, family history of diabetes mellitus, vitamin D deficiency, raised triglycerides, dyslipidaemia, and anemia. These variables were compared between women with GDM and non-GDM women to identify pathological factors associated with gestational diabetes mellitus.

Neonatal outcomes were recorded after delivery from delivery records, neonatal assessment sheets, and NICU records where applicable. These outcomes included birth weight, macrosomia, low birth weight, neonatal hypoglycemia, neonatal jaundice, respiratory distress, APGAR score at 5 minutes, and NICU admission. Neonatal outcomes were compared between babies of GDM mothers and babies of non-GDM mothers.

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. Overall 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**

Pathological determinants including overweight/obesity, raised blood pressure, previous history of GDM, previous macrosomic baby, family history of diabetes, raised triglycerides, and vitamin D deficiency were significantly more frequent among women with GDM. Anemia was more common among GDM women but did not show a statistically significant association.

Table 6. Pathological Determinants Associated With Gestational Diabetes Mellitus

Pathological determinant	GDM Present n=24	GDM Absent n=51	p-value
Overweight/obesity	21 (87.5%)	30 (58.8%)	0.013
Raised blood pressure	8 (33.3%)	6 (11.8%)	0.027
Previous history of GDM	8 (33.3%)	3 (5.9%)	0.002
Previous macrosomic baby	6 (25.0%)	4 (7.8%)	0.041

Family history of diabetes	15 (62.5%)	14 (27.5%)	0.003
Raised triglycerides	17 (70.8%)	18 (35.3%)	0.004
Vitamin D deficiency	18 (75.0%)	23 (45.1%)	0.016
Anemia	10 (41.7%)	16 (31.4%)	0.379

Neonates born to mothers with GDM showed higher frequencies of macrosomia, neonatal hypoglycemia, and NICU admission compared with neonates of non-GDM mothers. Neonatal jaundice and respiratory distress were also more frequent in the GDM group, although the differences were not statistically significant.

Table 7. Neonatal outcomes among babies of GDM and non-GDM mothers

Neonatal outcome	Babies of GDM mothers n=24	Babies of non-GDM mothers n=51	p-value
Macrosomia	7 (29.2%)	5 (9.8%)	0.032
Low birth weight	3 (12.5%)	8 (15.7%)	0.714
Neonatal hypoglycemia	6 (25.0%)	3 (5.9%)	0.019
Neonatal jaundice	8 (33.3%)	9 (17.6%)	0.124
Respiratory distress	5 (20.8%)	4 (7.8%)	0.101
NICU admission	9 (37.5%)	8 (15.7%)	0.032
APGAR score <7 at 5 minutes	4 (16.7%)	3 (5.9%)	0.132

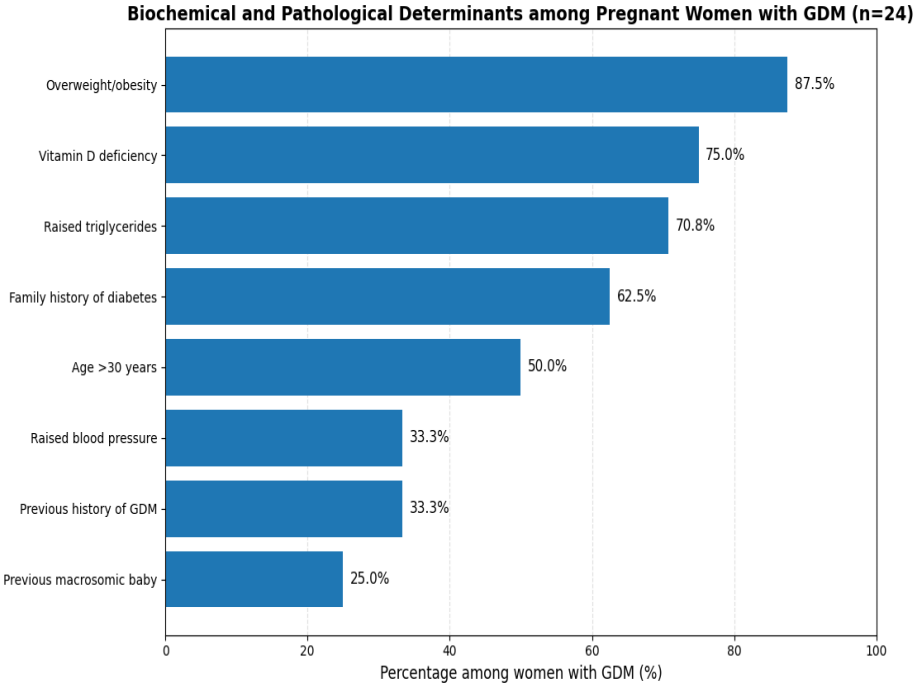

Figure 1. Biochemical and pathological determinants among pregnant women with gestational diabetes mellitus

Horizontal bar chart showing the percentage distribution of selected biochemical and pathological determinants among 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%), family history of diabetes (62.5%), age >30 years (50.0%), raised blood pressure (33.3%), previous history of GDM (33.3%), and previous macrosomic baby (25.0%).

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 Muhammad College of Medicine, Peshawar. 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 over weight / 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 pathological 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, with a frequency of 32.0%. GDM was significantly associated with biochemical and pathological determinants including higher fasting blood glucose, random blood glucose, HbA1c, raised triglycerides, vitamin D deficiency, overweight/obesity, raised blood pressure, family history of diabetes, previous history of GDM, and previous macrosomic baby. Neonates of GDM mothers had higher frequencies of macrosomia, neonatal hypoglycemia, and NICU admission. Early identification of high-risk pregnant women, regular antenatal screening, nutritional counseling, weight control, safe physical activity, and timely neonatal monitoring may help reduce maternal and neonatal complications associated with GDM.

REFERENCES

1. Jiang L, Tang K, Magee LA, von Dadelszen P, Ekeroma A, Li X, et al. A global view of hypertensive disorders and diabetes mellitus during pregnancy. 2022;18(12):760-75.
2. Mazumder T, Akter E, Rahman SM, Islam MT, Talukder MRJIjoer, health p. Prevalence and risk factors of gestational diabetes mellitus in Bangladesh: findings from demographic health survey 2017–2018. 2022;19(5):2583.
3. Zhuang W, Lv J, Liang Q, Chen W, Zhang S, Sun XJE, et al. Adverse effects of gestational diabetes-related risk factors on pregnancy outcomes and intervention measures. 2020;20(4):3361-7.
4. Ciarambino T, Crispino P, Leto G, Mastrolorenzo E, Para O, Giordano MJIjoms. Influence of gender in diabetes mellitus and its complication. 2022;23(16):8850.
5. Karaçam Z, Çelİk DJTJoM-F, Medicine N. The prevalence and risk factors of gestational diabetes mellitus in Turkey: a systematic review and meta-analysis. 2021;34(8):1331-41.
6. Wani K, Sabico S, Alnaami AM, Al-Musharaf S, Fouda MA, Turkestani IZ, et al. Early-pregnancy metabolic syndrome and subsequent incidence in gestational diabetes mellitus in Arab women. 2020;11:98.
7. Lendoye E, Ngoungou EB, Komba OM, Ollomo B, N'negue-Mezui M-A, Bekale S, et al. Prevalence and factors associated to gestational diabetes mellitus among pregnant women in Libreville: a cross-sectional study. 2022;41:129.
8. Mdoe MB, Kibusi SM, Munyogwa MJ, Ernest AIJBN, Prevention, Health. Prevalence and predictors of gestational diabetes mellitus among pregnant women attending antenatal clinic in Dodoma region, Tanzania: an analytical cross-sectional study. 2021;4(1):69.
9. Ogundipe E, Samuelson S, Crawford MAJN, diabetes. Gestational diabetes mellitus prediction? A unique fatty acid profile study. 2020;10(1):36.
10. Read SH, Rosella LC, Berger H, Feig DS, Fleming K, Ray JG, et al. BMI and risk of gestational diabetes among women of South Asian and Chinese ethnicity: a population-based study. 2021;64(4):805-13.
11. Alesi S, Ghelani D, Rassie K, Mousa AJIjoms. Metabolomic biomarkers in gestational diabetes mellitus: a review of the evidence. 2021;22(11):5512.
12. Li G, Yin P, Chu S, Gao W, Cui S, Guo S, et al. Correlation analysis between GDM and gut microbial composition in late pregnancy. 2021;2021(1):8892849.
13. Pheiffer C, Dias S, Adam SJIjoer, health p. Intimate partner violence: a risk factor for gestational diabetes. 2020;17(21):7843.
14. Onat T, Demir Caltekin M, Turksoy VA, Baser E, Aydogan Kirmizi D, Kara M, et al. The relationship between heavy metal exposure, trace element level, and monocyte to HDL cholesterol ratio with gestational diabetes mellitus. 2021;199(4):1306.
15. Ruszała M, Pilszyk A, Niebrzydowska M, Kimber-Trojnar Ż, Trojnar M, Leszczyńska-Gorzelak BJIjoms. Novel biomolecules in the pathogenesis of gestational diabetes mellitus 2.0. 2022;23(8):4364.
16. Diboun I, Ramanjaneya M, Majeed Y, Ahmed L, Bashir M, Butler AE, et al. Metabolic profiling of pre-gestational and gestational diabetes mellitus identifies novel predictors of pre-term delivery. 2020;18(1):366.
17. Versteegen M, Bozlak CT, Larkin H, Appleton AAJBP, Childbirth. Maternal depression, adverse childhood experiences, and social support in relation to gestational diabetes risk: results from the Albany Infant and Mother Study (AIMS). 2021;21(1):335.

18. Ekeke P, Mendez DD, Yanowitz TD, Catov JMJIJoER, Health P. Racial differences in the biochemical effects of stress in pregnancy. 2020;17(19):6941.
19. Doughty KN, Taylor SN, editors. Barriers and benefits to breastfeeding with gestational diabetes. Seminars in Perinatology; 2021: Elsevier.
20. Mashayekh-Amiri S, Mohammad-Alizadeh-Charandabi S, Abdolalipour S, Mirghafourvand MJD, Syndrome M. Myo-inositol supplementation for prevention of gestational diabetes mellitus in overweight and obese pregnant women: a systematic review and meta-analysis. 2022;14(1):93.
21. Zhang X, Zhao X, Huo L, Yuan N, Sun J, Du J, et al. Risk prediction model of gestational diabetes mellitus based on nomogram in a Chinese population cohort study. 2020;10(1):21223.