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Impact of Gestational Diabetes Mellitus on Maternal and Fetal Health: A Hospital Perspective

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A B S T R A C T

Introduction: This study investigates the prevalence and risk factors of gestational diabetes mellitus (GDM) among diabetic pregnant women and pregnant normal women in Muridke, Pakistan. Methodology: Data was collected from 80 participants at THQ Hospital Muridke using a structured questionnaire. Statistical analyses, including Chi-square tests, Mann-Whitney U tests, Logistic Regression, and factor score analysis with a Binomial test, were conducted to identify significant associations. Results: The results indicate that GDM is significantly linked to a history of high blood sugar, previous gestational diabetes, hypertension, high sugar intake, and pregnancy complications, while healthy eating habits and lower HbA1c levels serve as protective factors. The mean factor score was found to be 25.4875 ± 0.24777, suggesting a strong overall relationship between these variables and the presence of GDM. Risk complications significantly effect on diabetic pregnant and non-diabetic pregnant women life. Conclusion: These findings highlight the urgent need for early screening, lifestyle modifications, and health education to reduce the risks associated with gestational diabetes and improve maternal and neonatal health outcomes.

Keywords: *Gestational Diabetes, Maternal, Fetal Health, A Hospital Perspective*.

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INTRODUCTION

The word "diabetes" originates from the Greek term meaning "passing through," referring to the frequent urination common in the disease. "Mellitus" comes from Latin, meaning "honeyed," describing the glucose present in the urine of diabetic patients. While diabetes mellitus is occasionally called "sugar diabetes," it is most referred to simply as diabetes (Mahajan, 2023). Diabetes mellitus is a long-term condition caused by either a hereditary or acquired lack of insulin production or resistance to the insulin that is produced. It occurs when the pancreas fails to produce enough insulin, a hormone that regulates blood sugar, or when the body cannot effectively use the insulin, it makes. People with diabetes have at least twice the risk of dying compared to those without the condition (Yameny, 2024). Diabetes mellitus is a prevalent endocrine disease, affecting nearly 10% of the global population. Currently, 347 million people worldwide are living with diabetes. In 2004, an estimated 3.4 million deaths occurred due to the effects of high blood sugar. A similar number of deaths were projected for 2010. Over 80% of diabetes-related deaths occur in low- and middle-income countries (Pliszkaet al., 2024).

Many experts continued to recommend strict carbohydrate restriction, leading most people with diabetes to adopt a high-fat, low-carbohydrate diet (Moran, 2004). Diabetes mellitus (DM) may also act as a risk factor for the development and progression of liver disease. (Chianelli et al., 2025)

Types of diabetes

There are three types of diabetes: Type 1 diabetes, Type 2 diabetes, Gestational diabetes

Gestational diabetes

Gestational diabetes is a form of diabetes that is diagnosed for the first time during pregnancy. Similar to other types of diabetes, it impacts how your cells process sugar (glucose). This condition leads to high blood sugar levels, which can affect both the pregnancy and the health of the baby (McIntyre at el., 2019). Although any pregnancy complication can be worrying, there's positive news. You can manage gestational diabetes by maintaining a healthy diet, staying active and taking medication if needed. Keeping your blood sugar under control helps ensure both you and your baby stay healthy and reduces the risk of a complicated delivery (Jalal at el., 2024). If you experience gestational diabetes during pregnancy, your blood sugar typically returns to normal shortly after delivery. However, having gestational diabetes increases your risk of developing type 2 diabetes. As a result, you'll need to monitor your blood sugar levels more frequently (Khin at el., 2025). Gestational diabetes is a type of diabetes that arises during pregnancy and impacts on how the body handles glucose (sugar). It usually occurs when the body is unable to produce enough insulin to meet the increased demands of pregnancy, resulting in elevated blood sugar levels. This condition is most common in the second or third trimester and can pose risks to both the mother and the baby if not properly managed (Ashwal at el., 2015).

While gestational diabetes typically resolves after childbirth, it can present risks during pregnancy, including preterm labor, high blood pressure, and a higher likelihood of needing a cesarean section. It may also impact the baby's health, potentially causing excessive birth weight, low blood sugar after birth, or breathing difficulties (Kim, 2010). Symptoms of Gestational Diabetes are Increased thirst, Frequent urination, Fatigue, Nausea, Blurry vision, Unexplained weight loss, Frequent infections (such as urinary tract infections), Slow-healing wounds.Causes of Gestational diabetes are Hormonal fluctuations, Insulin resistance, Excess body weight, Genetic factors, Older age, History of gestational diabetes, Ethnic background , Polycystic ovarian syndrome (PCOS).Complications that effect are Excessive birth weight, Premature birth , Severe breathing problems, Low blood sugar (hypoglycemia), Obesity and type 2 diabetes in the future, Stillbirth, Complications that may impact you, High blood pressure and preeclampsia, Increased likelihood of a C-section, Future risk of diabetes. While there are no guarantees in preventing gestational diabetes, adopting healthy habits before pregnancy can improve your chances. If you've had gestational diabetes, these healthy choices may also lower your risk of experiencing it again in future pregnancies or developing type 2 diabetes later in life.Eat a balanced diet , Stay active , Achieve a healthy weight before pregnancy, Avoid excessive weight gain.

According to Lee et al. (2025), gestational diabetes mellitus (GDM) affects over 10% of pregnancies globally, including in Korea. It not only increases the risk of adverse pregnancy outcomes, such as pre-eclampsia, preterm birth, macrodome, neonatal hypoglycemia, and shoulder dystopia, but also raises the likelihood of the mother developing type 2 diabetes and cardiovascular diseases after delivery. Additionally, GDM is linked to a higher risk of childhood obesity, diabetes, and neurodevelopment disorders, including autism spectrum disorder, in the offspring.

Wei et al. (2024) Studied that gestational diabetes mellitus (GDM) is a common complication during pregnancy, with numerous studies indicating that it is linked to a range of negative effects on both mothers and their offspring. Given the unique nature of pregnancy, medical nutrition therapy is considered the primary approach for managing GDM. This review examines the progress of research on medical nutrition treatment for GDM, summarizes international guidelines regarding the intake of various nutrients and their impact on the prevalence of GDM, and discusses the effects of nutritional interventions in improving GDM outcomes. The goal is to provide valuable insights for further research in the field of GDM and support the targeted development of enteral nutrition strategies. According to Yefet et al. (2023) ,a systematic review and meta-analysis assessed the relationship between gestational diabetes mellitus (GDM) and infections during pregnancy. Our review included cross-sectional, case-control, cohort studies, and clinical trials that examined the frequency of infections in women with and without GDM. A comprehensive search was conducted across Embase, PubMed, and Web of Science databases, along with a manual reference search, up to March 23, 2022. This led to the selection of 16 studies, with 111,649 women in the GDM group and 1,429,659 in the control group. Cochrane's Q test and I^2 were used to evaluate heterogeneity and the pooled odds ratio (OR) was calculated. Funnel plots and Egger's test were employed to assess publication bias. The results revealed a significant association between GDM and infections (pooled-OR 1.3, 95% CI [1.2–1.5]). Subgroup analyses found a notable association with urinary tract infections (pooled-OR 1.2, 95% CI [1.1–1.3]), bacterial infections (pooled-OR 1.2, 95% CI [1.1–1.4]), and SARS-CoV-2 (pooled-OR 1.5, 95% CI [1.2–2.0]), but no significant association with gingivitis or vaginal candidiasis. These findings emphasize the importance of recognizing GDM as a risk factor for infections. Modzelewski et al. (2022) studied that gestational diabetes mellitus (GDM) is the most prevalent pregnancy complication, affecting around 15% of pregnancies worldwide. It elevates the risk of gestational hypertension, pre-eclampsia, and Caesarean section, while also increasing the chances of long-term complications such as cardiovascular disease, obesity, and type 2 diabetes (T2DM) for both mother and child. The rising incidence of GDM presents a considerable economic burden, highlighting the need for greater awareness. Effective management involves dietary changes, increased physical activity, and medications like insulin, glipalamides, and metformin. This paper provides an overview of the most recent research on epidemiology, pathogenesis, diagnosis, and treatment of GDM.

According to Volkova et al. (2021), gestational diabetes mellitus (GDM) is the most prevalent complication during pregnancy, associated with both immediate and long-term risks for the mother and fetus. However, there is no established agreement on the specific glycemic thresholds for diagnosis and treatment. Managing GDM effectively through diet, physical activity, and weight management can help reduce perinatal complications, although some women may require medication. The necessity for drug treatment often depends on the root cause of hyperglycemia, such as insulin resistance, β-cell dysfunction, or a combination of both. Alejandro et al. (2020)studied that gestational diabetes mellitus (GDM), a temporary form of diabetes triggered by insulin resistance and pancreatic β-cell dysfunction during pregnancy, is a significant barrier to improving maternal and child health. This condition affects approximately 9-25% of pregnancies worldwide and leads to both immediate and long-term health complications that can extend across generations. In this article, we explore how GDM influences long-term maternal and neonatal outcomes, as well as the health risks that may persist in future generations. Alongside the current challenges in diagnosing, managing, and addressing the complications of GDM, we examine existing preclinical models that help deepen our understanding of the disease's underlying pathophysiology. We also highlight the urgent need to expand our scientific toolkit to develop strategies for preventing and treating GDM, thereby improving clinical care.

McIntyre et al. (2019) found his study that Hyperglycemia during pregnancy, which resolves postpartum, has been recognized for over 50 years, yet there is no global agreement on the glycemic thresholds required to diagnose gestational diabetes mellitus (GDM) or initiate treatment. GDM is the most common pregnancy complication, with a rising incidence of undiagnosed hyperglycemia and overt diabetes in young women. Key risk factors include maternal obesity, older age, a history of GDM, a family history of type 2 diabetes, and ethnicity. Diagnosis is commonly made using an oral glucose tolerance test (OGTT), though some regions use a glucose challenge test (GCT) for screening. The primary treatment for GDM involves dietary modifications and increased physical activity, with insulin or oral hypoglycemic agents like metformin used when blood sugar control is not achieved. According to Johns et al. (2018), gestational diabetes mellitus (GDM) is the most common metabolic disorder during pregnancy. Its prevalence has been increasing, closely linked to the rise in maternal obesity over recent decades. The causes of GDM are multifactorial, with both genetic and environmental factors playing a role, as seen in mechanistic and epidemiological research. GDM poses significant short- and long-term health risks for the mother, developing fetus, and offspring. These risks include a higher likelihood of the mother developing type 2 diabetes (T2DM) later in life, as well as potential adverse cardiometabolic conditions in the offspring. While lifestyle changes and pharmacological treatments have shown short-term benefits, the long-term effects of intrauterine exposure to anti diabetic medication on the offspring remain uncertain. Additionally, the most effective and cost-efficient methods for screening GDM are still not fully determined.

Mack at el. (2017) examined the impact of integrating new research and practices in obstetrics and gynecology is accelerating, driven by advancements in disease mechanisms, screening technologies, and genetic insights. Physicians are required to continually refresh their knowledge, stay current with evolving guidelines, and reassess outdated approaches. Obstetrics and gynecology, like other medical fields, has transitioned from achieving board certification to engaging in ongoing, lifelong education. Damm et al. (2016) Gestational diabetes mellitus (GDM) occurs in 2–6% of pregnancies in Europe, making it one of the most prevalent pregnancy-related conditions. Although maternal glucose levels typically normalize post-pregnancy, women who experience GDM are at a substantially higher risk of developing type 2 diabetes later in life, with around 50% developing it within 10 years. Type

2 diabetes can be prevented or delayed in these women through lifestyle modifications or medical treatment, though many lack access to structured follow-up programs. Children born to mothers with GDM also face an increased risk of obesity, metabolic syndrome, and type 2 diabetes, with their risks being two to eight times greater than those born to mothers without GDM. The mechanisms behind these risks, possibly linked to epigenetic changes resulting from maternal hyperglycemia, are still not fully understood.

Al Fadhli et al. (2015) Studied that gestational diabetes mellitus (GDM) is the most common complication during pregnancy and is associated with negative outcomes for both the mother and baby. Proper management of blood glucose levels in GDM can help reduce these risks. However, there is no standardized approach for screening and diagnosing GDM worldwide. Treatment typically starts with dietary changes and exercise, and if these are not enough to achieve glycemic control, insulin therapy is recommended. Insulin analogs such as lispro, as part, and detemir are considered more physiological than human insulin, reducing the risk of hypoglycemia and providing better control.

Begum et al. (2014) examined that diabetes mellitus (DM) refers to a group of metabolic disorders characterized by consistently high blood sugar levels. Between 2012 and 2013, diabetes was responsible for 1.5 to 5.1 million deaths annually, making it the 8th leading cause of death worldwide. Common symptoms include frequent urination, excessive thirst, and hunger. If left untreated, diabetes can lead to severe complications such as heart disease, stroke, kidney failure, foot ulcers, and vision problems. The global number of people with diabetes is projected to reach 592 million by 2035. In 2013, approximately 382 million people had diabetes, with type 2 diabetes accounting for about 90% of cases. There are three primary types of diabetes: Type 1, which occurs when the body fails to produce insulin; Type 2, which begins with insulin resistance and is often linked to obesity and a lack of physical activity; and Gestational diabetes, which develops during pregnancy and usually resolves after delivery but increases the risk of type 2 diabetes later in life.

According to Collars et al. (2013), he performed a meta-analysis of transcription profiles from peripheral blood lymphomonon uclear cells (PBMC) of 56 diabetes patients (19 with type 1, 20 with type 2, and 17 with gestational diabetes) using a whole human genome oligomicroarray platform. Gene expression analysis through Gene Spring and hierarchical clustering revealed greater similarities between gestational and type 1 diabetes compared to type 2. A total of 3,747 differentially expressed genes were identified, with 486 unique to gestational diabetes, 202 to type 1, and 651 to type 2. Furthermore, 19 genes, including EGF, FAM46C, and HBEGF, were shared among all three types of diabetes. This analysis underscores the transcriptional similarities between gestational and type 1 diabetes.

Hayes et al. (2012)examined that incidence and prevalence of gestational diabetes mellitus (GDM) and impaired glucose tolerance (IGT) during pregnancy have significantly increased over the past decade, primarily due to rising rates of pre-pregnancy obesity and diagnoses of Type 2 diabetes mellitus. This article examines how assistant practitioners (APs) and healthcare assistants (HCAs) can play a key role in promoting healthy eating among women who are pregnant or planning pregnancy. By raising awareness of GDM and IGT in women who are not yet pregnant, APs and HCAs could help reduce the incidence of these conditions. The article also discusses the short- and long-term health implications for both mothers and their neonates diagnosed with GDM or IGT, highlighting the higher risk of progressing to Type 2 diabetes after pregnancy. In conclusion, the article underscores the valuable opportunity for APs and HCAs to empower women of childbearing age to take an active role in managing their reproductive and overall health, which may help prevent or better manage GDM and IGT.

According to Landon et al. (2011), gestational diabetes mellitus (GDM) encompasses a range of metabolic disorders that lead to varying levels of maternal hyperglycemia and pregnancy-related risks. The incidence of GDM is rising globally, and it may continue to increase if less stringent diagnostic criteria are adopted. The growing number of GDM cases places an additional strain on healthcare systems, prompting a reassessment of diagnostic methods and current treatment strategies. Despite several recent large-scale studies addressing these issues, debates continue over both the diagnosis and management of GDM.

This study aims to assess the impact of gestational diabetes mellitus on pregnancy outcomes, including maternal and fetal health and its complications among woman.

METHODOLOGY

Study design

It was a cross-sectional study.The Study was conducted at Obstetrics and Gynecology (OB/GYN), T-H-Q HOSPITAL MURIDKE. THQ Hospital Muridke is a tehsil-level healthcare facility located in District Sheikhupura, Punjab, Pakistan. The hospital's management is considered better compared to other government hospitals. People have trust in this institution, which is why most of them prefer to come here for their treatment. This is the reason we selected THQ Hospital Muridke for our project/research.

Target population

All the patients visited the outpatient diabetes department of THQ Hospital Muridke and were diagnosed with gestational diabetes.

Duration of study

The duration of study was two months (20-01-2025 to 20-03-2025) after the approval of synopsis.

Sample Selection

Selecting an appropriate sample is one of the most crucial steps in conducting research. Since the study's conclusions are drawn from the sample and then generalized to the entire population, the sample must accurately represent the target population.

Tool of Research

The questionnaire was designed for participants and served as a tool for data collection. Educators commonly use questionnaires to gather information about past, present, and anticipated events, outcomes, practices, and to explore attitudes in order to obtain reliable data. Therefore, it is essential that questionnaires are constructed with great care and precision.

Sampling Technique

Non-probability convenient sampling technique was used for collection of data.

Sample size

80 cases were used in this study.

Data collection procedure

Data was collected using face to face method keeping in mind the difficulty of locating the respondent after giving them the questionnaire. So, it was the best way to give the questionnaire to the respondent and be there for a while until the respondent filled and gave it back. Respondents ask the purpose of the survey, meaning of the questions which they do not completely understand. The collection of accurate data depends upon the careful construction of a tool of data collection. There are some difficulties in field experience. The respondents' behavior was good, but some respondents refused to fill out the questionnaire.

Inclusion criteria

The patient who came to the outpatient diabetes department agreed to provide information.

Exclusion criteria

Patients who do not agree to provide information.

Data Analysis

Software package

Data was entered into and analyzed by using SPSS (Statistical Package for Social Science) version 23.

Statistical Techniques

Normality tests

Kolmogorov Smirnov test

The **Kolmogorov-Smirnov (K-S) test** is a non-parametric method used to determine whether a sample matches a reference probability distribution (one-sample K-S test) or whether two samples come from the same distribution (two-sample K-S test).

One Sample test

$$\boldsymbol{D_n = \sup_x |F_n(x) - F(x)|} \qquad \textbf{Equation (3.1)}$$

Where:

Dn is the Kolmogorov-Smirnov statistic,

$Fn(x)$ is the empirical cumulative distribution function (ECDF)

$F(x)$is the theoretical cumulative distribution function (CDF).

Two sample tests

$$\boldsymbol{D_{n,m} = \sup_x |F_n(x) - G_m(x)|} \qquad \textbf{Equation (3.2)}$$

Where:

Dn, m is the two-sample K-S statistic,

$Fn(x)$ and Gm(x) are the ECDFs of the two samples.

Pearson's Chi-Square Test

The Chi-square test is a widely used statistical method for assessing independence and goodness of fitness. When testing for independence, it evaluates whether two or more variables from different populations are related, meaning if one variable can be used to predict the other. In contrast, the goodness of fit test examines whether the observed frequency distribution aligns with the expected (theoretical) frequency distribution.

Test Statistics

$$\mathbf{X^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{i,j} - E_{i,j})^2}{E_{i,j}}} \qquad \textbf{Equation (3.3)}$$

Where

X^2 = Person's cumulative test statistic, which asymptotically approaches a X^2distribution.

O_i= an observed frequency.

E_i= an expected (theoretical) frequency, asserted by the null hypothesis.

n= the number of cells in the table.

R_i = Row Total.

C_i= Column Total.

G = Grand Total.

Mann Whitney Test Statistics

$$\mathrm{U} = \mathbf{n_1 n_2 + \frac{n_2(n_2+1)}{2} \sum_{i=n_2+1}^{n_2} R_i} \qquad \textbf{Equation (3.4)}$$

Where:

U=Mann-Whitney test

n_1 = Sample size one
n_2 = Sample size two
R_i= Rank of the sample size

Logistic Regression

Logistic regression is a statistical modeling technique used to predict the probability of a binary outcome such as yes/no, success/failure, or 0/1 based on one or more independent variables.. It's widely used in fields like medicine, finance, and marketing for classification tasks.

$$\boldsymbol{P(Y = 1 \mid X) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k)}}} \quad \textbf{Equation (3.5)}$$

P(Y=1|X): probability that the dependent variable Y equals 1 given predictor X
$\beta 0$: intercept
β1, β2,…,βk: coefficients for the predictors
$X1, X2, \ldots,$: independent (predictor) variables
e: Euler's number (natural exponent)

This section presents findings from the analysis of data on gestational diabetes, focusing on its prevalence and impact on maternal and neonatal health. The study involved 80 pregnant women, divided equally into two groups: 40 with gestational diabetes and 40 without. Comparing these groups provided valuable insights into the condition's effects and contributing risk factors during pregnancy.

Results Analysis

Descriptive analysis uses statistical methods to summarize and present data clearly, focusing on central tendency, variability, distribution, and variable relationships. In this study, sample data is presented using frequency tables and percentage distributions to highlight key patterns. Data describes the demographic data shows that most participants (90%) were aged 21–40 years and a (62.5%) lived in urban areas, and over half (52.5%) were illiterate. Most households had a monthly income between 31,000–50,000. These factors provide insight into the participants' age, education, location, and economic background, which may influence their health during pregnancy.

The data indicates that a considerable number of pregnant individuals surveyed exhibit risk factors or symptoms commonly associated with gestational diabetes (GD). Specifically, 21.3% had GD in a previous pregnancy, 25% had been diagnosed with diabetes before pregnancy, and 22.5% reported having polycystic ovarian syndrome (PCOS). Additionally, 21.3% had given birth to a baby weighing more than 4kg, 36.3% had experienced miscarriage or pregnancy complications, and 47.5% reported high blood pressure. Regarding lifestyle habits, while the majority regularly consumed healthy foods (71.3%) and engaged in physical activity at least three times per week (57.5%), nearly half (47.5%) also reported frequent intake of sugary foods and beverages. None of the participants smoked. Diabetes-related symptoms were commonly reported: 75% experienced frequent urination, 76.3% felt excessively thirsty, 67.5% reported persistent fatigue, and 56.3% had blurred vision. Furthermore, 30% reported frequent infections, and 56.3% experienced sudden weight gain or swelling. Almost all participants (95%) had undergone a blood sugar test during pregnancy, and of those, 50% had elevated results. Overall, the findings highlight a notable prevalence of GD-related risk factors and symptoms.

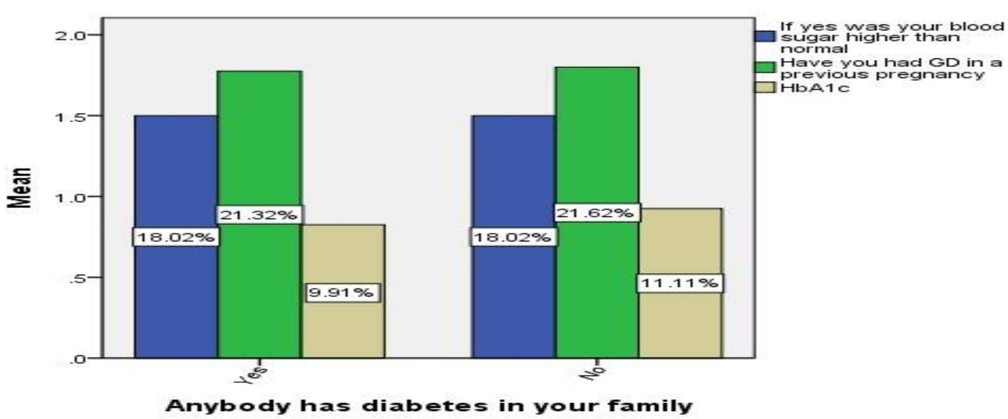

Figure 1: Anybody has diabetes in your family.

The bar chart depicts the main health markers high blood sugar, history of gestational diabetes (GD), and HbA1c levels between those with and without a family history of diabetes. Both groups had approximately 18% higher than optimal blood sugar. For gestational diabetes, very slightly more people without a family history (21.62%)

than those with a family history (21.32%) had a history of GD. Interestingly, the mean HbA1c value is lower in the family history group (9.91%) compared to the nonfamily history group (11.11%). Overall, the findings indicate that family history has little impact on blood glucose and history of GD but could be linked to improved long-term glucose control, as reflected in modestly lower HbA1c values.

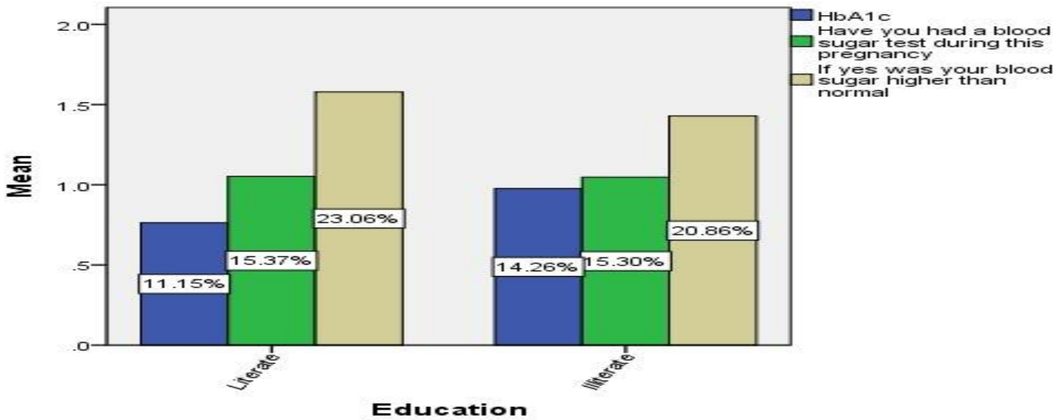

Figure 2: Education.

The bar graph demonstrates that health markers for literate and illiterate respondents based on HbA1c, the rate who had blood sugar testing done when pregnant, and the rate of who had abnormal blood sugar during pregnancy. Literate respondents have a mean HbA1c of 0.78, a 15.37% rate of blood sugar testing when pregnant, and 23.06% of those with abnormal blood sugar when pregnant. Comparatively, illiterate women exhibit a greater mean HbA1c value of 0.98, with a comparable 15.30% of them tested, and 20.86% reporting high blood sugar. The findings also show that although the prevalence of blood sugar testing is almost equal in both groups, literate women had slightly greater prevalence of high blood sugar during pregnancy but demonstrated improved long-term glucose control, as evidenced by their lower mean values of HbA1c.

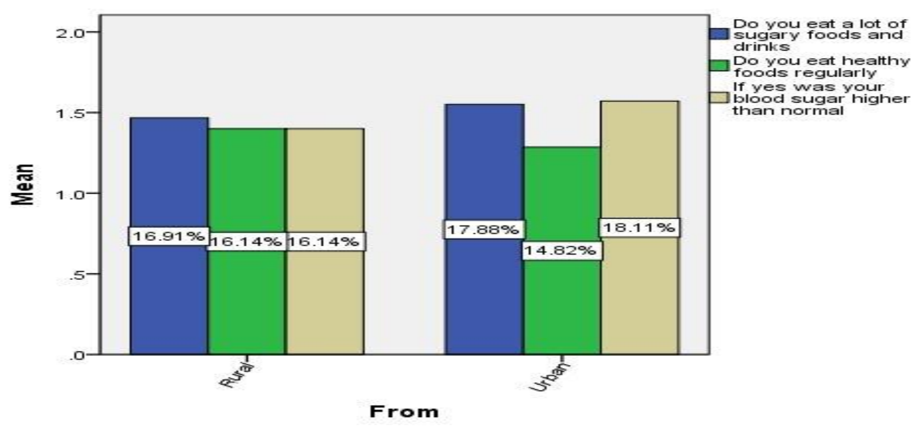

Figure 3: Residence from.

This figure shows that rural and urban people have small differences in eating habits and blood sugar levels. Urban people eat more sugary foods (avg. 1.55) than rural ones (1.5). Rural people eat healthy food more often (avg. 1.4) than urban (1.3). Urban people also have slightly higher blood sugar cases (avg. 1.6 and 18.11%) than rural people (1.4 and 16.14%). In short, urban people eat more sugar and face more sugar problems, while rural people eat a bit healthier, but the difference is small.

This bar graph in Figure 4 compares health issues in women with and without PCOS. Women with PCOS show slightly lower rates of high blood sugar during pregnancy (13.81%)

than those without PCOS (15.24%), but similar rates of having a baby over 4 kg and previous GD (both 17.68%). Women without PCOS had slightly higher rates for both (17.80%). Overall, the graph suggests a possible link between PCOS and the increased risk of pregnancy-related complications, though differences are minor.

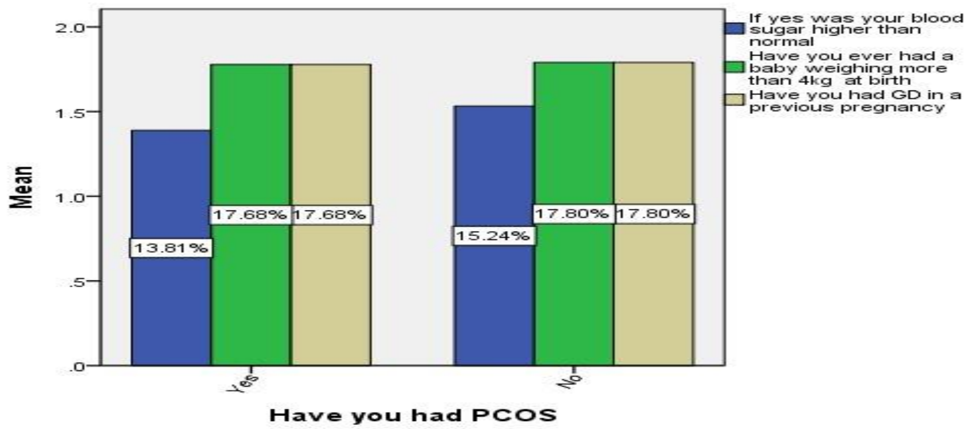

Figure 4: Have you had PCOS.

Normality

First, we will check the normality of the data with Kolmogorov Smirnov and Shapiro Wilk- test. In summary, based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests, none of the variables in the table found normally distributed.

Chi Square Test

In this section the association of variables is observed. Hence the significance of association between each predictor and response variable is tested by Pearson chi-square. When the value of p is smaller than 0.05, the factors are significant (there is association), if p-value is greater than 0.05, then factors are insignificant (there is no association). Results of bivariate analysis for demographic variables, risk variables are presented in given below:

Table 1: Association of Education with risk variables.

Null Hypothesis	χ^2	P-value	Result
There is no association between education and GD-Previous-Pregnancy.	0.346	0.556	Insignificant
There is no association between education and Diabetes-Pre-Pregnancy.	0.602	0.438	Insignificant
There is no association between education and PCOS-History.	3.421	0.064	Insignificant

P*(P < 0.05)

Table 2 shows that the chi-square test showed that education level had no significant link with most risk factors like previous gestational diabetes, diabetes before pregnancy, PCOS, baby weight, high blood pressure, sugary food, healthy eating, and exercise. However, a significant association was found between education and the history of pregnancy complications, meaning education may affect the chances of having past pregnancy problems.

Table 2: Association of Diagnosed with diabetes in pregnancy or not with risk variables.

Null Hypothesis	χ^2	P-value	Result
Residence with diagnosis of gestational diabetes	0.071	0.790	Insignificant
Education level with diagnosis of gestational diabetes	0.602	0.438	Insignificant
Family history of diabetes with diagnosis of gestational diabetes	1.067	0.302	Insignificant
PCOS with gestational diabetes diagnosis	0.860	0.354	Insignificant
Baby over 4kg at birth with gestational diabetes diagnosis	4.208	0.040	Significant
Previous pregnancy complications with gestational diabetes diagnosis	6.509	0.011	Significant
High blood pressure with gestational diabetes diagnosis	5.414	0.020	Significant

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High sugar diet with gestational diabetes diagnosis	11.295	0.001	Significant
Healthy diet vs gestational diabetes diagnosis	12.713	0.000	Significant
Physical activity level vs gestational diabetes diagnosis	2.280	0.516	Insignificant
Frequent urination vs gestational diabetes diagnosis	0.356	0.551	Insignificant
Excessive thirst vs gestational diabetes diagnosis	6.649	0.010	Significant
Fatigue vs gestational diabetes diagnosis	0.684	0.408	Insignificant
Blurred vision vs gestational diabetes diagnosis	12.343	0.000	Significant
Frequent infection vs gestational diabetes diagnosis	0.000	1.000	Insignificant
Excessive hunger vs gestational diabetes diagnosis	2.389	0.122	Insignificant
Having a blood sugar test vs diagnosis of gestational diabetes	1.404	0.236	Insignificant
High blood sugar result vs gestational diabetes diagnosis	21.600	0.000	Significant

The table 2 shows the Chi-square test results examining associations between various categorical factors and gestational diabetes diagnosis. Several variables such as giving birth to a baby over 4kg, previous pregnancy complications, high blood pressure, diet (both high sugar and healthy food intake), excessive thirst, blurred vision, and high blood sugar test results show statistically significant associations with gestational diabetes ($p < 0.05$). Other factors, including place of residence, education level, family history, PCOS, physical activity, frequent urination, fatigue, frequent infections, excessive hunger, and having a blood sugar test, show no significant association ($p > 0.05$). These findings highlight key risk factors and symptoms linked to gestational diabetes, while also indicating which factors are not significantly related in this dataset.

Mann Whitney U test

Mann-Whitney U test was used to compare literate and illiterate women in terms of age, HbA1c levels, weight, height, and household income. The results showed that none of the differences were statistically significant**.** This means that education level (literate vs illiterate) didn’t make a meaningful difference in any of these variables.

Table 3: Testing of education with risk factors.

Null Hypothesis	Mann-Whitney U	p-value	Results
There is no significant difference in age between literate and illiterate women.	726.000	.182	Insignificant
There is no significant difference in HbA1c levels between literate and illiterate women.	698.500	.300	Insignificant
There is no significant difference in household income between literate and illiterate women.	672.500	.205	Insignificant

Table 4: Testing of area of residence with risk factor.

Null Hypothesis	Mann-Whitney U	p-value	Results
There is no significant difference in age between rural and urban women.	710.000	.444	Insignificant
There is no significant difference in HbA1c levels between rural and urban women.	631.000	.201	Insignificant
There is no significant difference in household income between rural and urban women.	580.500	.078	Insignificant

Mann-Whitney U tests were applied to examine whether there were significant differences in age, HbA1c levels, weight, height, and household income between rural and urban women. The results showed that all p-values were greater than 0.05, indicating no statistically significant difference in any of these variables between the two groups. This suggests that the area of residence (rural or urban) does not have a significant impact on these characteristics in the given sample.

This table summarizes the Mann-Whitney U test results comparing various factors between women diagnosed with gestational diabetes and those not diagnosed. For age, months of pregnancy, weight, height, and household income, the p-values are greater than 0.05, indicating no significant differences between the two groups. However, the HbA1c levels show a p-value of 0.000, which is highly significant, meaning HbA1c levels differ notably between women with and without gestational diabetes. This highlights HbA1c as an important marker associated with gestational diabetes, while other factors in this study do not show a significant association.

Table 5: Diagnosed with diabetes in pregnancy or not with risk factor.

Null Hypothesis	Mann-Whitney U	P-value	Results
There is no difference in the distribution of age between diagnosed and not diagnosed women.	560.000	0.392	Insignificant
There is no difference in the distribution of months of pregnancy between the two groups.	570.000	0.721	Insignificant
There is no difference in the distribution of weight between diagnosed and non-diagnosed women.	474.000	0.143	Insignificant
There is no difference in the distribution of height between the two groups.	531.000	0.382	Insignificant
There is no difference in the distribution of household income between women with and without GD.	573.000	0.753	Insignificant
There is no difference in the distribution of HbA1c levels between diagnosed and non-diagnosed women.	282.000	0.000	Significant

Logistic regression

Omnibus Tests of Model Coefficients

The Omnibus Tests of Model Coefficients table shows that the logistic regression model is statistically significant. With a Chi-square value of 61.152 and 12 degrees of freedom, the p-value is 0.000, which is much lower than the typical 0.05 threshold. This indicates that the group of predictors included in the model significantly improves the model's fit compared to one without predictors. In other words, the model effectively explains variations in the outcome variable, demonstrating that the predictors are valuable for predicting the diagnosis of gestational diabetes.

Table 6: Logistic regression(Omnibus Tests of Model Coefficients).

	Chi-square	Df	Sig.
Model	61.152	12	.000

Table 7: Logistic regression (Model Summary).

Step	-2 Log likelihood	Cox and Snell R Square	Nagelkerke R square
1	28.822	.534	.791

The Model Summary shows good fit and explanatory power. The -2 Log Likelihood is 28.822 (lower is better). Cox and Snell R^2 is 0.534, meaning predictors explain 53.4% of variation. Nagelkerke R^2 is 0.791, indicating strong explanatory power (~79.1%). Overall, the model fits well and explains much of the variation in gestational diabetes diagnosis.

Hosmer and Lem show Test

The Hosmer and Lem show Test shows a Chi-square of 4.708 with 8 degrees of freedom and a p-value of 0.788 (>0.05), indicating no significant difference between observed and predicted values. This means the model fits the data well and adequately represents the relationship between predictors and outcome.

Table 8: Logistic regression (Hosmer and Lem show Test).

Step	Chi-square	Df	Sig.
1	4.708	8	.788

Variables in Equation

The logistic regression analysis reveals that excessive thirst is a significant predictor of gestational diabetes, with women experiencing this symptom having dramatically higher odds of being diagnosed (odds ratio of 174.28). Interestingly, the history of gestational diabetes in a

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previous pregnancy and frequent urination are also significant but show a strong negative association with diagnosis in this model, which may suggest data or coding issues that need further review, as this contradicts common clinical expectations. Other variables such as residence, education level, PCOS history, healthy eating habits, constant fatigue, blurred vision, frequent infections, sudden weight gain, and frequent hunger were not found to be statistically significant predictors. Overall, the model highlights excessive thirst as a key symptom related to gestational diabetes, while other factors require cautious interpretation.

Table 9: Logistic regression (Variables in Equation).

	B	S.E.	Wald	df	Sig.	Exp(β)	Lower CI (95%)	Upper CI (95%)
Area	-.141	1.286	.012	1	.913	.869	.070	10.801
GD-Previous-Pregnancy	-5.201	2.061	6.369	1	.012	.006	.000	.313
Education	1.927	1.897	1.032	1	.310	6.866	.167	282.615
PCOS-History	-.862	1.284	.450	1	.502	.423	.034	5.230
Healthy-Eating	1.090	1.116	.953	1	.329	2.975	.333	26.532
Frequent-Urination	-4.662	2.313	4.063	1	.044	.009	.000	.879
Excessive-Thirst	5.161	2.032	6.448	1	.011	174.278	3.246	9356.804
Constant-Fatigue	1.255	1.676	.560	1	.454	3.507	.131	93.731
Blurred Vision	-1.336	1.573	.721	1	.396	.263	.012	5.742
Frequent Infections	-.767	1.373	.312	1	.576	.465	.032	6.845
Sudden_Weight_Gain	-1.318	1.541	.731	1	.393	.268	.013	5.492
Frequent Hunger	-3.562	1.998	3.177	1	.075	.028	.001	1.426
Constant	5.887	3.022	3.796	1	.051	360.269		

$\ln\left(\frac{p}{1-p}\right) = 5.887 - 3.562 * Frequent\_Hunger - 1.318 * \text{sudden\_weight\_gain} - .767 * \text{Frequent\_Infctions} - 1.336 *$ Blurred_Vision $+$ 1.255 $*$Constant_Fatigue+5.161* Excessive Thirst$-$ 4.662* Frequent Urination+ 1.090*Healthy_Eating-.862*Consistory +1.927*Education $-$ 5.201* GD_Previous_Pregnancy$-$.141* Area.

Table 10: Factors Score (one sample Kolmogorov-Smirnov test).

Variable	Diagnosed with diabetes in pregnancy or not
Test Statistics	.125
Asymp. Sig. (2-tailed)	.004

Mean and Standard Error of GDM

The test statistic value of .125 with a p-value of 0.004 (less than 0.05) indicates a statistically significant result. This means there is a significant association between the variable and whether a woman is diagnosed with diabetes during pregnancy. In other words, this variable has a meaningful impact on the diagnosis of gestational diabetes.

Binomial Test

The Binomial Test shows a test proportion of 0.50 with a p-value of 0.000, indicating a statistically significant result. This means the proportion of women diagnosed with gestational diabetes is significantly different from 50%, suggesting a meaningful deviation from equal distribution.

Table 11: Factors Score (one sample Kolmogorov-Smirnov test).

Scores	Mean	Std. Error
80	25.4875	0.24777

Table 12: Binomial Test.

	Test Prop.	Exact Sig. (2- tailed)
Diagnosed with diabetes in pregnancy or not	.50	.000

DISCUSSION

This study focused on the analysis of gestational diabetes and its impact on maternal and neonatal health. Data was gathered from 80 pregnant women, with half diagnosed with gestational diabetes and half serving as a control group. Descriptive statistics showed that the majority of participants were between 21–40 years of age, with higher cases found among urban and illiterate women. Most participants had a medium-sized household income and were in the third trimester. Risk variable analysis indicated that several factors were commonly observed in those with gestational diabetes, including previous gestational diabetes, high HbA1c levels, consumption of sugary foods, high blood pressure, and pregnancy complications. Chi-square tests revealed significant associations between gestational diabetes and variables such as baby weight, complications, diet, and blood pressure. Mann-Whitney U tests indicated significantly differences in HbA1c levels between diagnosed and non-diagnosed groups. Odds ratio analysis confirmed that previous gestational diabetes, high blood sugar, and unhealthy lifestyle factors substantially increased the risk. Logistic regression further validated the strength of these associations, with high model fit (Nagelkerke R^2 = 0.791) and significant predictor variables.

CONCLUSION

The study concludes that gestational diabetes is influenced by multiple interconnected risk factors. Key predictors include a prior history of gestational diabetes, elevated blood sugar levels, poor dietary habits especially high sugar intakehigh blood pressure, limited physical activity, and complications in previous pregnancies. Elevated sugar levels and excessive sugar consumption significantly increase the chance of developing GDM, particularly in women with a history of pregnancy complications. Effective management strategies such as improved nutrition with controlled sugar intake, regular physical activity, routine antenatal screening, and enhanced public health awareness are crucial to reducing the incidence and complications of gestational diabetes. Future research should expand the sample size and include longitudinal studies to better understand long-term outcomes and to refine preventive healthcare strategies for pregnant women. Risk complications show that life of pregnant diabetic and non diabetic disturb.The miscarriage rate was higher among women who were both pregnant and had diabetes compared to those who were only pregnant without diabetes. Dietary habits have more effect on pregnant diabetic patients as their quality of life is poor. Risk complications were severe in population of pregnant diabetic patients.

RECOMMENDATIONS

Gestational diabetes management involves a balanced diet, regular physical activity, and blood sugar monitoring. Medication or insulin may be prescribed under doctors guidance. Regular prenatal check-ups help monitor mother and babies health, reducing risks. Medical camps should placed in rural areas. So that women of rural area get treatment properly.

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CONFLICT OF INTEREST

It is declared that the authors have no conflicts of interest related to research, authorship, or publication.

AUTHORS CONTRIBUTION

Ms. Aasma Riaz is Assistant Professor and in College of Statistical Sciences University of the Punjab Lahore. She did all her research work, collects data and analyzed.

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