Readers Insight
Publisher of open access books and journals
PJMLS
Print ISSN: 2707-4471. Online ISSN: 2707-448X

Research Article	Pak-Euro Journal of Medical and Life Sciences
DOI: 10.31580/pjmls.v6i4.1383	Copyright © All rights are reserved by Corresponding Author
Vol. 6 No. 4, 2023: pp. 477-486	
www.readersinsight.net/pjmls	**Revised:** December 09, 2023 **Accepted:** December 13, 2023
Submission: August 11, 2023	**Published Online:** December 31, 2023

INCIDENCE AND CLINICAL ASPECTS OF GESTATIONAL DIABETES MELLITUS IN PATIENTS OF QUETTA DISTRICT, BALOCHISTAN, PAKISTAN

Gohar Shah[1], Sana Ullah[2]*, Baz Muhammad[3], Ejaz-ul-Haq[1], Yousaf Khan[4], Amin Ullah[5]

[1]**Department of Education**, Government of Balochistan, Pakistan

[2]**Department of Zoology,** University, of Balochistan, Quetta, Pakistan

[3]**Department of Pediatrics Medicine**, Bolan Medical Complex Hospital, Quetta, Pakistan

[4]**Department of Gastroenterology,** Bolan Medical Complex Hospital, Quetta, Pakistan

[5]**Department of General Medicine,** Bolan Medical Complex Hospital, Quetta, Pakistan

***Corresponding Author:** Sana Ullah. E. mail: syedsanakhan17.ss@gmail.com

Abstract

Gestational Diabetes Mellitus (GDM) significantly impacts the health of expectant mothers and newborns. The increasing prevalence of non-communicable diseases, associated risk factors, and revised diagnostic criteria from the World Health Organization (WHO) are anticipated to influence the incidence and clinical characteristics of GDM. This cross-sectional study was conducted at the Bolan Medical Complex and Hospital (BMCH) and Civil Provincial Hospitals in the Quetta District, Balochistan Province, Pakistan, following the recommendations of a collaborative clinical research committee of Bolan Medical Complex and the University of Balochistan Quetta. The study spanned from July to August 2022, with a total of 131 reported cases of gestational diabetes mellitus.

The investigation delved into the prevalence, clinical features, and risk factors for gestational diabetes mellitus in the Quetta district, Balochistan, revealing a higher prevalence in urban areas (87 cases or 66.41%) compared to rural areas (44 cases or 33.58%). The study also shed light on monthly family income, indicating that 22 cases (19.0%) had an income less than or equal to 20,000, while 94 cases (81.0%) had an income greater than 20,000. This underscores the socio-economic disparity in GDM prevalence, with women in lower-income households in rural areas being more susceptible to the condition.

The escalating prevalence of gestational diabetes in Pakistan, particularly in Quetta, is a cause for concern. The study highlights that women with lower socio-economic status residing in rural areas are at a higher risk of developing GDM. Globally, the incidence of GDM is on the rise, attributed to increasing rates of obesity and other risk factors. Certain demographics, such as older, overweight, or obese women with a family history of diabetes, are more prone to GDM.

Gestational diabetes is typically identified during routine screening between weeks 24 and 28 of pregnancy. Early detection is crucial for the well-being of both the mother and the child. In cases of GDM, careful management and regular monitoring are essential. The study emphasizes the importance of identifying women at an increased risk of GDM to provide timely interventions and ensure positive health outcomes.

Keywords: *Balochistan, District Quetta, Gestational diabetes mellitus (GDM), Incidence, Prevalence*

INTRODUCTION

In women who did not have diabetes before to becoming pregnant, GDM (gestational diabetes mellitus) is a type of diabetes that manifests when pregnant (1). GDM happens when the body can't produce enough insulin to keep up with the growing demands of pregnancy. GDM is more common in some communities than others, although it is expected to impact 1–14% of pregnancies worldwide (2). Gestational diabetes mellitus (GDM) is the term used to describe any degree of glucose intolerance that emerges or is first identified while a woman is pregnant. Both pregnant women and their newborns may suffer negative

short- and long-term health repercussions from it (3). GDM patients are reported to have a lower quality of life, as well as increased risks for type 2 diabetes, caesarean sections, and pregnancy-related hypertension (4). To examine the clinical features and problems of gestational diabetes mellitus, as well as the effects it has on the health of expectant mothers and fetuses in the area. Draw attention to any differences or unique characteristics between the Quetta District and other parts of Pakistan or the world when comparing the prevalence and clinical aspects of gestational diabetes mellitus. Determine the prevalence and incidence rate of gestational diabetes mellitus (GDM) among pregnant women in Quetta District, Balochistan, Pakistan.

GDM frequently has no symptoms and typically appears in the second or third trimester of pregnancy. However, some women may experience increased thirst and urination, fatigue, and blurred vision. obesity, a history of diabetes in the family, and GDM in the past, and certain ethnicities, such as Hispanic, African American, Asian, and Pacific Islander, are risk factors for GDM (5). GDM has the potential to be harmful to both the mother and the fetus. Uncontrolled GDM can result in the mother having high blood sugar levels, which can raise her chance of developing pre-eclampsia, needing a C-section, and later getting type 2 diabetes. The baby may be born larger than normal (macrosomia), which can lead to difficulties during delivery, such as shoulder dystocia, and an increased risk of birth injuries. Babies of GDM mothers are similarly susceptible to low blood sugar levels (hypoglycemia), respiratory distress syndrome, and jaundice (6).

Depending on demographics (such as maternal age, socioeconomic status, race/ethnicity, or body composition), screening procedures, and diagnostic criteria, the prevalence of GDM varies greatly over the world, ranging from 1% to 28% (7). Genetic variables can also have an impact on GDM, and these factors may have a varying impact on illness occurrence depending on the population (8). 15% of expectant mothers worldwide have GDM. An Australian study found that Asian women have a higher probability of developing GDM than Australian women, 11.5% vs. 3.7%. In the South Asian region, GDM is substantially more common. The stated incidence in Bangladesh ranges from 13.2% to over 40% (9).

Gestational diabetes made up roughly 87.5% of cases of diabetes in pregnant women. Type I diabetes was followed by type II diabetes in 5% and 7.5%, respectively. After delivery, gestational diabetes may or may not disappear (10).The latest recent data indicate type I and type II diabetes have become more common in recent years. Additionally, the prevalence of gestational diabetes has increased as a result of increased obesity rates in the neighborhood and an aging maternal population (11).

About 7% of pregnancies worldwide are complicated each year by GDM, which has a prevalence of 1–14% and is caused by a variety of causes (12). In Pakistan, the frequency of GDM was reported as 3.45% in 2014; however, it is currently 10% (13). The prevalence of hyperglycemia during pregnancy is approximately 21.4 million live births were impacted by this global prevalence of 16.9% in 2013 (14). The majority of instances, more than 90%, are believed to occur in low- and middle-income nations.

90% of all cases of diabetes during pregnancy are caused by gestational diabetes mellitus (GDM), which is also the most common cause of hyperglycemia in pregnancy (15). The symptoms of GDM frequently disappear after delivery, but they can return in consecutive pregnancies. GDM raises the risk of obesity, metabolic syndrome, and diabetes for both the mother and the fetus, among other long-term health problems.

Based on five investigations, the most recent of which was published in 2007, Gestational diabetes prevalence ranged from 0% to 9%, according to a 2011 assessment of diabetes in Sub-Saharan Africa (16). A more recent examination of data from 14 research conducted in six African nations found that the prevalence ranged from 0% in Tanzania to 13.9% among high-risk Nigerian women. Gestational diabetes mellitus (GDM) is a form of diabetes that manifests during pregnancy in women who were not diabetic prior to conception (1). The condition arises when the body fails to produce adequate insulin to meet the escalating demands of pregnancy. Its prevalence is variable across communities, anticipated to affect 1–14% of global pregnancies (2).

GDM is characterized by glucose intolerance emerging or identified for the first time during pregnancy (3). Both maternal and fetal health may suffer adverse short- and long-term consequences, with

GDM patients exhibiting lower quality of life and increased risks of type 2 diabetes, cesarean sections, and pregnancy-related hypertension (4). Symptomatically, GDM often remains asymptomatic and typically becomes apparent in the second or third trimester. However, some women may experience heightened thirst, increased urination, fatigue, and blurred vision. Risk factors include obesity, familial diabetes history, prior GDM, and specific ethnicities such as Hispanic, African American, Asian, and Pacific Islander (5).

Uncontrolled GDM poses risks to both maternal and fetal health. Complications may include elevated maternal blood sugar levels, increasing the likelihood of pre-eclampsia, necessitating a C-section, and elevating the risk of later developing type 2 diabetes. Neonates born to GDM mothers may experience macrosomia, leading to delivery complications like shoulder dystocia, and an elevated risk of birth injuries. Additionally, infants are prone to hypoglycemia, respiratory distress syndrome, and jaundice (6). GDM prevalence varies globally based on demographic factors, screening procedures, diagnostic criteria, and genetic variables. The range spans from 1% to 28%, with ethnicity, maternal age, socioeconomic status, race/ethnicity, and body composition influencing screening outcomes (7, 8).

Approximately 15% of expectant mothers worldwide experience GDM, and regional variations exist. For instance, Asian women exhibit a higher likelihood of GDM than their Australian counterparts (11.5% vs. 3.7%). In South Asia, Bangladesh reports a prevalence ranging from 13.2% to over 40% (9). Gestational diabetes comprises the majority (87.5%) of diabetes cases during pregnancy, with Type I and Type II diabetes following at 5% and 7.5%, respectively. The persistence of GDM postpartum varies, and recent data indicate increasing rates of Type I and Type II diabetes, attributed to rising obesity rates and an aging maternal population (4, 11).

Global estimates indicate that 7% of pregnancies annually are complicated by GDM, with prevalence ranging from 1% to 14%. In Pakistan, GDM frequency has increased from 3.45% in 2014 to 10% presently (12, 13). Hyperglycemia during pregnancy impacts approximately 21.4 million live births globally, with a prevalence of 16.9% in 2013, predominantly in low- and middle-income nations (14). GDM accounts for 90% of diabetes cases during pregnancy, posing risks of obesity, metabolic syndrome, and diabetes for both mother and fetus, persisting into subsequent pregnancies. Symptoms may abate postpartum but can reoccur in subsequent gestations, contributing to long-term health issues (15). Across Sub-Saharan Africa, GDM prevalence varies from 0% to 9%, with a recent analysis indicating a range of 0% in Tanzania to 13.9% among high-risk Nigerian women (16).

MATERIALS AND METHODS

STUDY AREA/ STUDY DESIGN

A cross-sectional investigation was conducted at the Bolan Medical Complex and Hospital (BMCH) and Civil Provincial Hospital in the Quetta District, Balochistan Province, Pakistan. The study, undertaken in accordance with recommendations from a collaborative clinical research committee comprising members from Bolan Medical Complex and the University of Balochistan Quetta, transpired between July and August 2022. Utilizing patient record cards, participants' weights at registration were documented, and their current weights were ascertained using a digital weighing scale, measured in kilograms. Body mass index (BMI) was computed by dividing weight in kilograms by height in meters squared, determined using a height scale.

A total of 131 cases of gestational diabetes mellitus were identified in both Civil Provincial and BMC hospitals within the Quetta district. The selection of the study's 131 participants may have employed a combination of convenience and stratified sampling techniques. Initially, the researchers may have stratified the pregnant women population in Quetta District based on factors such as age, socioeconomic status, and place of residence. Random selection from these strata may have been implemented to ensure representation across diverse attributes. Additionally, convenience sampling might have been employed to select a subset of participants, focusing on pregnant individuals attending specific clinics or healthcare institutions where practical data collection was feasible, addressing logistical and accessibility considerations.

Fig.1. Map of Quetta District (Research Area)

EXCLUSION CRITERIA

Women with both type 1 and type 2 diabetes, as well as those experiencing "Hyperglycemia in Pregnancy," were excluded from participation. Exclusion criteria aim to eliminate confounding variables that could impact the study outcomes. These variables may encompass pre-existing type 1 or type 2 diabetes mellitus, underlying chronic medical conditions like hypertension or renal disease, individuals on medications affecting glucose metabolism, multiple pregnancies (twins or higher-order multiples), a history of previous GDM, or any other conditions complicating the understanding of gestational diabetes or interfering with an accurate assessment. By excluding these variables, researchers can focus more precisely on examining the incidence, prevalence, and clinical features of GDM in a more homogeneous sample, reducing the likelihood of other variables or health issues influencing study results.

SAMPLE COLLECTION

Following the American Diabetes Association guidelines, an oral glucose tolerance test (OGTT) was conducted. Normal OGTT results were defined as blood sugar levels of less than 95 mg/dL when fasting, 180 mg/dL after one hour, 155 mg/dL after two hours, and 140 mg/dL after three hours. Patients with discrepancies between any two readings were diagnosed with GDM. A comprehensive history of each research participant was compiled from their records. Various criteria, including those from the International Association of Diabetes in Pregnancy Study Groups (IADPSG), were utilized for GDM diagnosis during the OGTT.

GDM diagnosis occurs if the blood glucose level exceeds the threshold for at least one of these conditions. The woman fasts overnight (at least 8 hours), and blood samples were drawn at fasting, one hour, and two hours after consuming a sugary beverage.

STATISTICAL ANALYSIS

SPSS version 16 and 23.0 were used for data examination and analysis. Descriptive statistics, including frequency (%), mean, standard deviation (SD), and median, were employed. Significance was assessed through chi-square analysis and the Student's t-test. Univariate analysis explored GDM variables, reporting unadjusted odds ratios (OR) with a 95% confidence interval (CI), considering $P < 0.05$ as statistically significant.

ETHICAL APPROVAL

The study protocol received approval from the Bolan Medical Complex Hospital (BMCH) and Sandeman Provincial Hospital, Quetta District, Balochistan. All study participants provided full, informed consent, assured of the voluntary and non-compulsory nature of their participation.

RESULTS

The study comprised 131 pregnant women in all. The mean age of the matched control group was 29.09 ±4.01, while the GDM participants' mean age was found to be 29.30±4.37) years. Sociodemographic characteristics were included in Table 1 and Figure 2 as shown. It was determined that there was no statistically significant difference.

Table I. Sociodemographic information based on area wise

Area	Cases (*N*=131), *n* (%)	Control (*N*=131), *n* (%)	OR (CI 95%)	*p*-value
Inhabited position				
Rural	44 (33.58)	33 (25.190)	1.51 (0.385 - 1.135)	0.133
Urban	87 (66.41)	98 (74.80)		
Family's monthly income (PKR)				
≤20 000	94 (81.0)	93 (78.8)	1.149 (0.605 - 2.180)	0.672
>20 000	22 (19.0)	25 (21.2)		

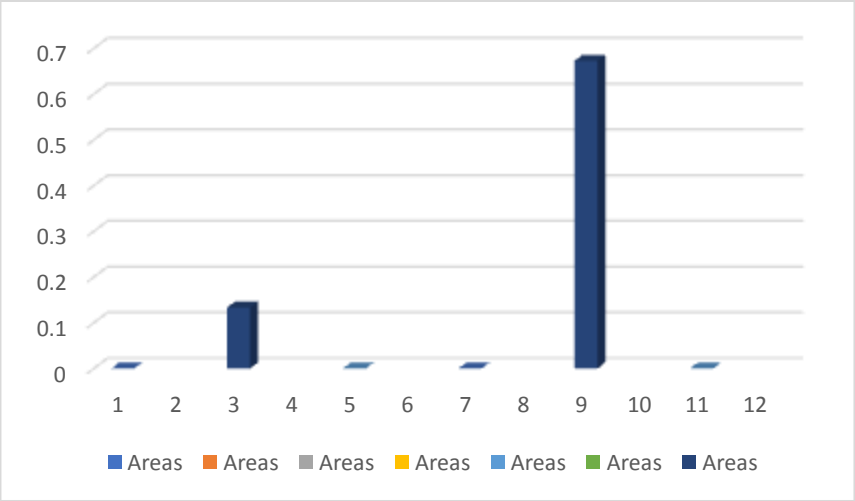

Fig. 2. Sociodemographic information based on area wise

Despite the majority (71.37%) of study participants residing in urban areas, a noteworthy observation emerged. Contrary to expectations, women from rural settings demonstrated a higher susceptibility to Gestational Diabetes Mellitus (GDM) compared to their urban counterparts. This disparity suggests that factors beyond urbanization play a pivotal role in elucidating GDM prevalence, potentially rooted in distinctions in lifestyle and healthcare accessibility between rural and urban locales.

Survey results highlighted that a significant proportion (79.91%) of respondents reported a monthly household income below INR 20,000. This demographic, indicative of a lower socioeconomic status, constituted a substantial majority within the research sample. Despite the predominant urban representation, the variation in GDM prevalence between urban and rural areas raises inquiries into the intricate determinants influencing health outcomes. The urban-rural divide in GDM risk may be influenced by environmental factors, cultural practices, dietary behaviors, and disparities in healthcare accessibility.

The study underscores an imperative for targeted interventions and healthcare support for economically disadvantaged groups, as underscored by the prevalence of respondents with lower household incomes. Furthermore, it accentuates the necessity for nuanced strategies addressing GDM, considering the interplay among socioeconomic position, residential circumstances, and healthcare availability.

Table II. Risk factors based on current pregnancy related of the Patients

Risk factors	Cases (*N*=131), *n* (%)	Control (*N*=131), *n* (%)	OR (CI 95%)	*p*-value
BMI at GDM diagnosis (kg/m2)				
>23	37 (55.1)	20 (30.6)	2.774 (1.352 - 5.692)	0.005
≤23	32 (44.9)	42 (69.4)		
Weeks of gestation at the time of GDM diagnosis				
≤28	13 (13.8)	9 (7.7)	1.976 (0.772 - 5.055)	0.150
≤28	81 (86.1)	107 (92.2)		
Pregnancy-induced hypertension				
Yes	9 (14.5)	10 (11.2)	1.317 (0.478 – 3.626)	0.594
No	53 (85.4)	79 (88.7)		
Polyhydramnios				
Yes	8 (12.9)	11 (12.3)	6.940 (0.793 - 60.778)	0.044
No	54 (87.0)	78 (87.6)		
Oligohydramnios				
Yes	7 (10.4)	8 (8.6)	1.208 (0.387 - 3.774)	0.744
No	60 (89.5)	85 (91.3)		

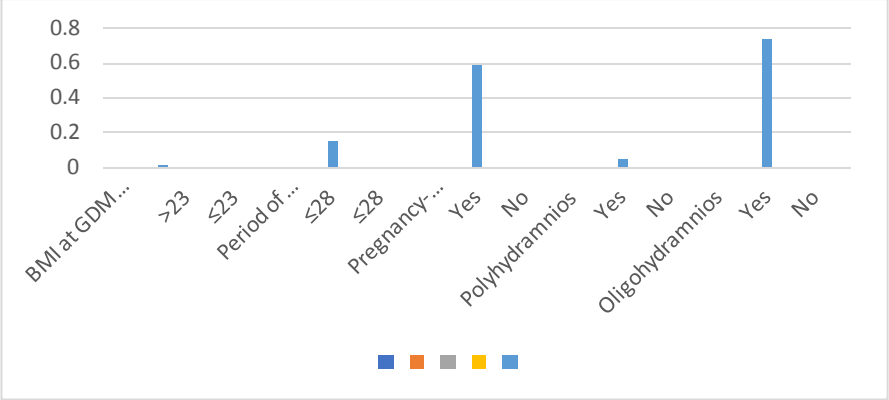

Fig. 3. Risk factors based on current pregnancy related of the patients

Table II and Fig. 3 illustrate pregnancy-related risk factors, revealing that the risk of gestational diabetes mellitus (GDM) is elevated in women with a BMI >23 kg/m2 (OR 2.774; 95% CI 1.352 - 5.692). Additionally, the likelihood of GDM diagnosis increases when identified at or before 28 weeks of pregnancy (OR 1.976; CI 0.772-5.055). Notably, polyhydramnios and oligohydramnios during the early stages of pregnancy exhibited a potential association with GDM (OR 1.31; 95% CI 0.48 - 3.63), as did pregnancy-induced hypertension (OR 6.940; 95% CI 0.793 - 60.778). However, it's essential to acknowledge that the sample size may have been insufficient to establish statistical significance.

The study identified several factors associated with a heightened incidence of gestational diabetes mellitus (GDM). These encompassed age over 25, overweight or obesity, a family history of diabetes, and a history of delivering a child weighing more than 9 pounds. Additionally, women experiencing polyhydramnios, characterized by excessive amniotic fluid, exhibited an increased likelihood of developing GDM. However, the investigation did not reveal a significant correlation between GDM and pregnancy-induced hypertension.

Table III. Prevalence of gestational diabetes mellitus

Gestational Diabetes	Frequency	Percentage
Yes	12	9.17 %
No	192	90.83 %
Total	131	100 %

Table III presents the frequency distribution of gestational diabetes mellitus, indicating an average frequency of 102 with a standard deviation of 127.28. The range spans from a minimum frequency of 12 to a maximum of 192. The 25th percentile is represented by 57, while the 75th percentile is marked at 147. This implies that out of the 204 participants, 9.17% were diagnosed with gestational diabetes mellitus, while 90.83% were not.

DISCUSSION

In the present investigation, Table No.1 elucidates the incidence and clinical aspects, considering risk factors for gestational diabetes mellitus (GDM) in both urban and rural areas of Quetta district, Balochistan. The prevalence was higher in urban areas, with 87 cases (66.41%), compared to 44 cases (33.58%) in rural areas. Additionally, the table presents the distribution of monthly family income, indicating that 22 cases (19.0%) had an income less than INR 20,000, while 94 cases (81 .0%) had an income greater than or equal to INR 20,000. This underscores the alarming rise of GDM in Pakistan, particularly among rural women with lower socioeconomic status.

A noteworthy observation is the association between educational attainment and GDM, revealing a correlation between lower levels of schooling and the incidence of GDM. Previous research conducted in Sindh reported a GDM prevalence of 9.8%, while another study in Pakistan found a 6.25% prevalence (13)

Inam et al., 2020). Moreover, data from 2005 to 2018 in a tertiary care hospital in Karachi demonstrated a gradual increase in GDM prevalence from 6.3% to 19% (17).

The study's insights shed light on the incidence of GDM in expectant mothers in the Quetta District, offering valuable information on the associated risk factors. These factors may encompass genetic, behavioral, dietary, and sociodemographic components unique to the local population. Furthermore, the study delves into the clinical aspects of GDM, examining its impact on maternal health during pregnancy and its consequences for the unborn child. Exploring issues related to pregnancy, labor, and the health outcomes for infants born to mothers with GDM adds depth to the study's findings.

Comparing these findings with global and Pakistani literature on GDM is pivotal for contextualizing the results within the broader scientific understanding of GDM epidemiology, risk factors, clinical implications, management, and preventive measures. Drawing comparisons with studies from diverse regions, ethnicities, or socioeconomic backgrounds contributes to a comprehensive understanding of GDM incidence and clinical characteristics. Such comparisons facilitate the identification of potential interventions or strategies effective in managing or preventing GDM among pregnant women in the Quetta District (18).

In our observation, women with a substantial increase in gestational BMI exhibited a higher frequency of GDM during the first trimester of pregnancy. A cohort study in Norway corroborated that weight gain increased the risk for GDM in both normal-weight and overweight individuals (19). Similarly, a study in Beijing identified the rise in BMI before 24 weeks as a risk factor for GDM (20). Controlling excessive weight gain in the early months of pregnancy and addressing weight concerns before conception may significantly reduce the incidence of GDM.

The complications associated with GDM include high blood pressure, preterm birth, and an elevated risk of requiring a cesarean delivery (21). Children born to mothers with GDM are more likely to be large for gestational age, experience low blood sugar at delivery, and have an increased risk of developing type 2 diabetes. The prevalence of GDM varies across countries, with India reporting 24%, divided into 9.9% in rural areas and 16.9% in urban areas (22). In Nepal, the prevalence is around 1%, contrasting with Bangladesh's estimated 10% prevalence (23). Notably, the frequency of GDM among pregnant women in different trimesters shows no significant difference, according to research (24, 25).

In conclusion, advocating for awareness regarding the significance of maintaining a healthy diet and regular exercise to keep the general population's BMI within a normal range is crucial. Additionally, the study recommends screening and early detection of GDM through oral glucose tolerance tests (OGTT) or glycated hemoglobin (HbA1C) alone in all pregnant women, accompanied by regular monitoring, to prevent a range of maternal and newborn complications.

CONCLUSION

In conclusion, globally, the prevalence of GDM is rising, most likely as a result of rising rates of obesity and other risk factors. Older women, those who are fat or overweight, have a family history of diabetes, or those who are from a specific ethnic group, like African Americans, Hispanic/Latino, or South Asian women, are among the populations where GDM is more prevalent. During a routine screening, GDM is frequently discovered between weeks 24 and 28 of pregnancy. Early detection, cautious management, and routine monitoring are crucial in cases of GDM to guarantee the health of both the mother and the child. However, some women may be at increased risk. To manage their illness and lower the risk of complications, pregnant women should collaborate closely with their healthcare professional.

Suggestion and Recommendations:

1. Educate and raise awareness of gestational diabetes mellitus (GDM) among healthcare professionals and expectant mothers. Pregnancy clinics, community outreach initiatives, and healthcare practitioner education can all help achieve this.
2. Make GDM screening a regular practice for all expectant mothers. An oral glucose challenge test (OGCT) or a fasting plasma glucose (FPG) test can be used for this.

3. Treat and care for ladies with GDM in a proper manner. This could involve changing one's diet and level of activity as well as taking medication like insulin.
4. Keep a tight eye out for issues like big for gestational age (LGA) babies, premature birth, and preeclampsia in women with GDM.
5. Women with GDM should receive help and instruction on how to control their illness and avoid long-term consequences.

Acknowledgments:

We acknowledge all staff of Bolan Medical Complex Hospital (BMCH), and Sandeman Provincial Hospital Quetta District, Balochistan for their support and guidance in this research work.

References:

1. McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P. Gestational diabetes mellitus. Nature reviews Disease primers. 2019;5(1):47.
2. Etminan-Bakhsh M, Tadi S, Hatami M, Darabi R. Prevalence of Gestational Diabetes Mellitus and Its Associated Risk Factors in Boo-Ali Hospital, Tehran. Galen Medical Journal. 2020;:e1642.
3. Farrar D, Simmonds M, Bryant M, Sheldon TA, Tuffnell D, Golder S, Dunne F, Lawlor DA. Hyperglycaemia and risk of adverse perinatal outcomes: systematic review and meta-analysis. bmj. 2016;354.
4. Renugasundari M, Krushna PG, Chaturvedula L, Nanda N, Harichandrakumar KT, Vidyalakshmi L. Assessment of a short-course yoga practice on cardiometabolic risks, fetomaternal outcomes and psychophysical health in gestational diabetes mellitus. Biomedicine. 2021;41(2):337-43.
5. Saeed MA, Nisar U, Akram S, Shahid S, Saleem A, Cheema AM. The Hormonal Levels of Progesterone in Second and Third Trimesters of Gestational Diabetes Mellitus Patients with or without Family History. Pakistan Journal of Medical & Health Sciences. 2019;13(4):957-961.
6. Voormolen DN, de Wit L, van Rijn BB, DeVries JH, Heringa MP, Franx A, Groenendaal F, Lamain-de Ruiter M. Neonatal hypoglycemia following diet-controlled and insulin-treated gestational diabetes mellitus. Diabetes Care. 2018;41(7):1385-90.
7. Jiwani A, Marseille E, Lohse N, Damm P, Hod M, Kahn JG. Gestational diabetes mellitus: results from a survey of country prevalence and practices. The Journal of Maternal-Fetal & Neonatal Medicine. 2012;25(6):600-10.
8. Yan J, Su R, Ao D, Wang Y, Wang H, Yang H. Genetic variants and clinical relevance associated with gestational diabetes mellitus in Chinese women: a case-control study. The Journal of Maternal-Fetal & Neonatal Medicine. 2018;(16):2115-21.
9. Riaz M, Nawaz A, Masood SN, Fawwad A, Basit A, Shera AS. Frequency of gestational diabetes mellitus using DIPSI criteria, a study from Pakistan. Clinical Epidemiology and Global Health. 2019;(2):218-21.
10. Rajendram R, Patel VB, Preedy VR. Recommended resources on maternal diabetes. Nutrition and Diet in Maternal Diabetes: An Evidence-Based Approach. 2018:495-500.
11. Tasneem S, Kashif S. Gestational Diabetes Mellitus (GDM) Related Common Risk Factors and Recurrence among Pregnant Patients: A Multifactorial Cross-Sectional Study. Life and Science. 2021;2(2):5-.
12. Nguyen CL, Pham NM, Binns CW, Duong DV, Lee AH. Prevalence of gestational diabetes mellitus in eastern and southeastern Asia: a systematic review and meta-analysis. Journal of diabetes research. 2018;2018.
13. Inam I, Madnia E, Ahmed Ammar SS. Prevalence of Gestational Diabetes Mellitus in Pakistan: A Cross Sectional Study. Pakistan Journal of Medical & Health Sciences. 2022;16(10):241-.
14. Hadar E, Ashwal E, Hod M. 28 Diabetic pregnancy in the developing world. Textbook of Diabetes and Pregnancy. 2018:234.
15. Farahvar S, Walfisch A, Sheiner E. Gestational diabetes risk factors and long-term consequences for both mother and offspring: a literature review. Expert review of endocrinology & metabolism. 2019;14(1):63-74.
16. Stephani V, Opoku D, Beran D. Self-management of diabetes in Sub-Saharan Africa: a systematic review. BMC public health. 2018:1-1.
17. Aamir AH, Ul-Haq Z, Mahar SA, Qureshi FM, Ahmad I, Jawa A, Sheikh A, Raza A, Fazid S, Jadoon Z, Ishtiaq O. Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus

and prediabetes using HbA1c: a population-based survey from Pakistan. BMJ open. 2019;9(2): e025300.
18. Wong VW. Gestational diabetes mellitus in five ethnic groups: a comparison of their clinical characteristics. Diabetic Medicine. 2012,(3):366-71.
19. Sorbye LM, Skjaerven R, Klungsoyr K, Morken NH. Gestational diabetes mellitus and interpregnancy weight change: A population-based cohort study. PLoS medicine. 2017;14(8): e1002367.
20. Zhu WW, Yang HX, Wang C, Su RN, Feng H, Kapur A. High prevalence of gestational diabetes mellitus in Beijing: effect of maternal birth weight and other risk factors. Chinese medical journal. 2017;130(09):1019-25.
21. Mohammadi M, Maroufizadeh S, Omani-Samani R, Almasi-Hashiani A, Amini P. The effect of prepregnancy body mass index on birth weight, preterm birth, cesarean section, and preeclampsia in pregnant women. The journal of maternal-fetal & neonatal medicine. 2019;32(22):3818-23.
22. Dias S, Adam S, Rheeder P, Pheiffer C. Prevalence of and risk factors for gestational diabetes mellitus in South Africa. South African Medical Journal. 2019;109(7):463-7.
23. Hasan M, Sutradhar I, Gupta RD, Sarker M. Prevalence of chronic kidney disease in South Asia: a systematic review. BMC nephrology. 2018 (1):1-2.
24. Crusell MK, Hansen TH, Nielsen T, Allin KH, Rühlemann MC, Damm P, Vestergaard H, Rørbye C, Jørgensen NR, Christiansen OB, Heinsen FA. Gestational diabetes is associated with change in the gut microbiota composition in third trimester of pregnancy and postpartum. Microbiome. 2018:1-9.
25. Artzi NS, Shilo S, Hadar E, Rossman H, Barbash-Hazan S, Ben-Haroush A, Balicer RD, Feldman B, Wiznitzer A, Segal E. Prediction of gestational diabetes based on nationwide electronic health records. Nature medicine. 2020 (1):71-6.