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PREVALENCE, SCREENING, DIAGNOSIS, AND MANAGEMENT OF GESTATIONAL DIABETES MELLITUS – A MINIREVIEW

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ABSTRACT

The prevalence of Gestational Diabetes Mellitus (GDM) is an alarming situation all over the world. Numerous factors affect the occurrence of GDM. Some predisposing factors could be old age, family history of diabetes, sedentary lifestyle, low education and income, etc. The diagnosis of GDM remains contentious, with significant practice variability. The new diagnostic criteria for GDM proposed by the IADPSG and the technological advances in GDM diagnosis have the potential to significantly impact the prevalence of GDM and the management of this condition. Recent advances in GDM encompass improved diagnostic criteria, innovative management strategies and a deeper understanding of long-term implications. These developments are crucial for enhancing maternal and fetal health outcomes and preventing future metabolic disorders.

***Keywords*:** Gestational Diabetes Mellitus, Prevalence, Screening, Diagnosis, Management

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1. INTRODUCTION

Gestational Diabetes Mellitus (GDM) is a significant health concern affecting a substantial number of pregnant women, developing spontaneous hyperglycemia (Plows et al., 2018; ADA, 2018; ElSayed et al., 2023). GDM is glucose intolerance with the onset or first detection during pregnancy (Gyasi-Antwi et al., 2020). Risk factors include a family history of diabetes or insulin resistance, obesity/overweight, micronutrient deficiencies, a westernized diet and older maternal age (Plows et al., 2018). Though the pathogenesis of GDM is not so clear, however, insufficient insulin production and or development of insulin resistance may contribute to increased adiposity and insulin-desensitizing effects of placental hormones (Buchanan & Xiang, 2005; Desoye & Hauguel-de Mouzon, 2007). It has been suggested that placental growth hormones, prolactin, and Human Placental Lactogen (HPL) have a significant role in the onset of GDM. The development of GDM could be due to increased maternal food intake, mobilizing nutrients for fetal growth from the mother, and also snowballing insulin resistance to the mother's nutrients (Desoye & Hauguel-de Mouzon, 2007). Thus, pancreatic β-cells boost their insulin excretion to compensate for the high glucose levels and insulin resistance caused, leading to a defect in pancreatic β-cells' function over time (Buchanan & Xiang, 2005; Gyasi-Antwi et al., 2020). GDM can have long-lasting health concerns, in the mother such as increased risk for cardiovascular disease (CVD), T2DM, and future obesity, and in the child, T2DM, CVD, and/or GDM (Plows et al., 2018).

GDM could contribute to a vicious intergenerational cycle of diabetes and obesity that influences the whole population's health. Unfortunately, no widely accepted treatment or prevention strategy for GDM exists, except lifestyle intervention (Feig & Moses, 2011; Camelo Castillo et al., 2015; Plows et al., 2018). Therefore, safe, effective, and easy-to-administer new treatments are sought. In this review, authors have tried to provide various predisposing factors, prevalence, screening, diagnostic tests, and management and treatment of GDM in the light of published literature.

2. PREVALENCE OF GDM

The prevalence of GDM varies significantly across different countries and regions.

2.1. Global Overview

Table 1 indicates that globally, the prevalence of GDM is 0.7 to 36.8% (Karakiliç, 2020; Hannah et al., 2022;

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Wang et al., 2022; Mantri et al., 2024; Balogun et al., 2024), though it varies from 3.8% (Saudi Arabia) to 27.6% (Middle East & North Africa). The prevalence of GDM has exceeded 30% worldwide in the last 20 years (Selek, 2020).

Table 1: Prevalence (%) of GDM globally and in various countries

Region/Country	Prevalence (%)	References
Global	14	Karakiliç (2020); Wang et al. (2022); IDF (2017)
	0.7 to 36.8	Hannah et al. (2022)
	13	Mantri et al. (2024)
	25	Balogun et al. (2024)
Africa	14.2	Wang et al. (2022)
Europe	7.8-12.3	Eades et al. (2017); Paulo et al. (2021)
Middle East & North Africa	27.6	Wang et al. (2022)
South-East Asia	20.8	Wang et al. (2022)
North America & Caribbean	7.1	Wang et al. (2022)
South America & Central America	10.4	Wang et al. (2022)
Western Pacific	14.7	Wang et al. (2022)
Bangladesh	9.7-12.9	Jesmin et al. (2014)
Germany	4.47	Kleinwechter (2016)
Pakistan	9.47	Inam et al. (2022)
	16.7	Adnan & Aasim (2024)
	36.8	Siddique et al. (2023)
Turkey	16.2	Aydın et al. (2019)
Saudi Arabia	3.8-12.5	Al-Rowaily and Abolfotouh (2010)

2.2. Regional Variations in GDM Prevalence

According to Wang et al. (2022), GDM prevalence in North America and Caribbean (7.1%), followed in South and Central America (10.4%), Africa (14.2%), Western Pacific region (14.7%), South-East Asia (20.8%), Middle East and North Africa (27.6%), The prevalence varies widely in Europe, with estimates ranging from 7.8 to 12.3% depending on the sub-region (Eades et al., 2017; Paulo et al., 2021). Eastern Europe has the highest prevalence within Europe at 31.5% (Paulo et al., 2021).

2.3. Countries' Variation in GDM Prevalence

GDM prevalence varies widely across different populations. Some nations have a low risk, e.g., Sweden, where the GDM prevalence is <2% with a universal testing method (Karakiliç, 2020). Some populations have a high risk of GDM, i.e., Northern Californian Asians, Native American Cree, and Northern Californian Hispanics in these nationals, GDM prevalence has been reported to be 4.9 to 12.8% (Karakiliç, 2020). A meta-analysis of developed countries in Europe reported an overall prevalence of GDM at 5.4% (Wang et al., 2022). In Eastern and Southeastern Asia nations, 10.1% GDM has been reported (Selek, 2020). The prevalence of GDM in Europe was estimated at 10.9%, with the highest prevalence in Eastern European countries at 31.5% (Eades et al., 2017). The national prevalence of GDM in Turkey is 16.2% (Aydın et al., 2019). The prevalence of GDM in Saudi Arabia ranges from 3.8 to 12.5%, depending on the diagnostic criteria used (Al-Rowaily & Abolfotouh, 2010). In Bangladesh, the prevalence of GDM is 9.7% according to WHO criteria and 12.9% according to ADA criteria (Jesmin et al., 2014). In Germany, a 4.47% prevalence of GDM was recorded in 2014 (Kleinwechter, 2016).

According to Adnan and Aasim (2024), the prevalence of GDM in Pakistan was much higher in Balochistan (35.8%), followed by Islamabad (23.9%), Khyber Pakhtunkhwa (17.2%), Sindh (13.2%), and Punjab (11.4%). World Diabetes Foundation funded a project in Pakistan from 2013 to 2017. According to the findings of this project, cardiovascular diseases pose a huge burden and account for around 25% of all deaths, and on the International Diabetes Federation (IDF) top 10 of countries with diabetes, Pakistan ranks tenth with 6.6 million cases (Anonymous, 2025). According to Siddique et al. (2023), the higher the parity in Pakistani mothers, the higher the risk of GDM (83.5%). Similarly obesity plays an important role in the onset of GDM (59.2%), and family history (41.4%) also have increased effect of GDM happening. GDM was more prevalent in age group of 33-43 years 30(55%) in Pakistani women than other age groups (Inam et al., 2022).

3. RISK FACTORS ASSOCIATED WITH GDM

3.1. Ethnicity

American Indians, Hispanic women and Asian women have higher prevalence rates (Hunt & Schuller, 2007; Selek, 2020). Based on demographic factors, the prevalence of GDM is more significant for pregnant women from selected ethnic groups, such as Indigenous, Asian, and Indian women, as well as for older pregnant women (Al-

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Rowaily & Abolfotouh, 2010). Ethnic/racial origin, along with type 2 diabetes family history, has a modest influence on GDM risk (Paulo et al., 2021). Contrary to these findings, Dong et al. (2025) found a significant influence of the occurrence of GDM in ethics groups.

3.2. Income Levels

Low or upper-middle-income countries (LMICs) are more prone to GDM than high-income countries (Nguyen et al., 2018; Balogun et al., 2024). On the other hand, there are views that the prevalence of GDM and the risk of exposure to pregnant women are sparse and varied, particularly in LMICs. There could be a lack of national policies on diagnosing and managing GDM (Gyasi-Antwi et al., 2020).

3.3. Education Level

According to Dong et al. (2025), lower levels of education were linked with a higher risk of GDM (Fig. 1). Creating familiarity via prenatal education and encouraging a healthy lifestyle can help decrease GDM prevalence in less-educated populations (Zhao & Xiao, 2022). Perhaps education imparts a better lifestyle, better eating habits, etc., significantly lowering the risk of diabetes (Sweeting et al., 2022; Azmat et al., 2024).

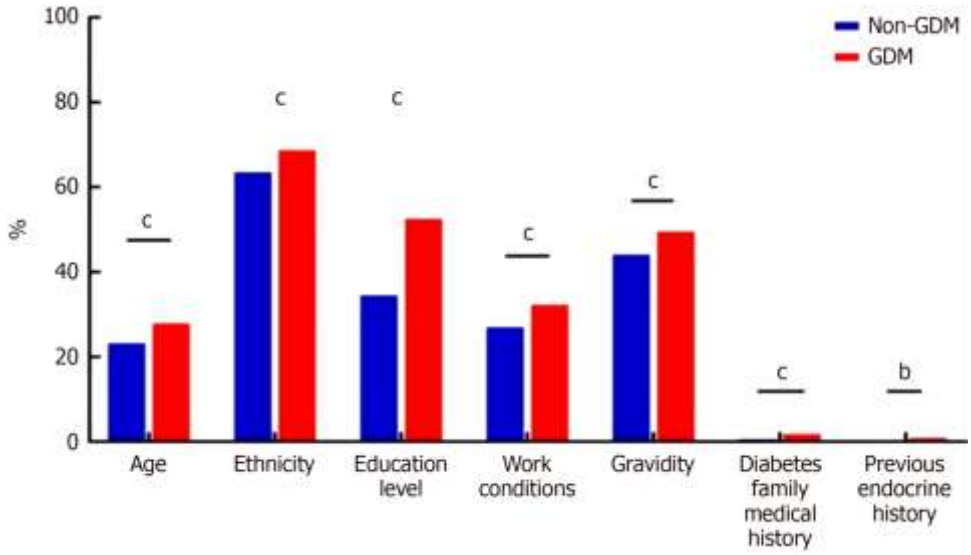

Fig. 1: Various factors affecting gestational diabetes mellitus (Dong et al., 2025). b(P<0.01); c(P<0.001).

3.4. Sedentary Lifestyle

A sedentary lifestyle plays a significant role in the onset of GDM. In this lifestyle, family history of diabetes, unhealthy diet, pre-pregnancy adiposity, parity number, and socioeconomic elements may also influence the discrepancies in GDM prevalence (Zhang & Ning, 2011; Zhu & Zhang, 2016; Riaz et al., 2024; Dong et al., 2025).

3.5. Maternal Age and BMI

Old age (Fig. 1) and higher BMI are significant predictors of GDM (Aydın et al., 2019; Yaping et al., 2022; Dugalic et al., 2022; Riaz et al., 2024; Azmat et al., 2024). Dong et al. (2025) analyzed the variable factors of GDM. According to their analysis, the older the age of the mother, the higher (P<0.001) the incidence of GDM (Fig. 1). The analysis further revealed that the risk of 0.05 times of GDM increases by for every year increase in maternal age. The risk factors for GDM have been reported to be previous diabetes in gestation, older maternal age, and obesity, which have the most significant impact on GDM risk (Paulo et al., 2021). Aydın et al. (2019) reported that age >25 years, family history of diabetes, and body mass index >25 have a significant independent association with GDM. The maternal age has a significant (P<0.001) correlation with GDM, Dong et al. (2025) found the risk of GDM higher in mothers with ≥35 years as compared to those mothers with age <35 years (P<0.001).

3.6. Obesity

With the increasing trend of sedentary lifestyles and obesity, the global burden of GDM is forecasted to proliferate, putting women of reproductive age and their offspring at risk of the spread of type 2 diabetes (Ma & Popkin, 2017; Azmat et al., 2024). Compared to normal-weight women, Caucasian Hungarian women who were overweight or obese prior to pregnancy had approximately twofold increased risk of GDM, regardless of the diagnostic criteria (Kun et al., 2011).

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3.7. Urbanization

The prevalence of GDM varies across rural, urban, and semi-urban areas, significantly correlating with age greater than or equal to 25 years, family history of diabetes, and body mass index >25 (Aydın et al., 2019). Urbanization indicates economic development, but it may contribute to the varied prevalence of GDM. A Tanzanian study reported approximately five times more prevalence of GDM in urban communities than in rural counterparts (Mwanri et al., 2014). Other non-classical risk factors for GDM include short maternal height, low birth weight and polycystic ovaries (Paulo et al., 2021; Dugalic et al., 2022).

3.8. GDM Correlation with Other Diseases

Qamar et al. (2022) observed that the frequency of gestational diabetes in HCV-positive pregnant women. Li et al. (2018) found that GDM was associated with significantly higher risks of both coronary artery disease and stroke. Moreover, GDM has also been associated with angina pectoris, myocardial infarction, and hypertension (Goueslard et al., 2016).

3.9. Screening Methods

One-step screening shows higher prevalence rates than the two-step method (Nguyen et al., 2018).

4. SCREENING OF GDM

There is no universally accepted method for diagnosing and screening GDM, leading to varied practices worldwide (Virally & Laloi-Michelin, 2010; Kuo & Li, 2019; Sert & Ozgu-Erdinc, 2021; Ragea et al., 2022; Luo et al., 2024). However, recent recommendations emphasize distinguishing pre-existing diabetes from GDM diagnosed during pregnancy. New diagnostic criteria are based on pregnancy outcomes rather than maternal risk of future diabetes, which may lead to a higher prevalence of GDM diagnoses (Nudell et al., 2011). Innovations in glucose monitoring, including continuous glucose monitoring tools, have improved the accuracy of GDM diagnosis and management (Nudell et al., 2011; Tocci et al. 2023).

4.1. Screening Strategies

Two main strategies are used, i.e., i) Universal Screening: Recommended by many medical societies as it is cost-effective and avoids missing cases (Kuo & Li, 2019; Luo et al., 2024) and ii) Selective Screening: Targets only high-risk women but may miss many GDM cases (Kuo & Li, 2019; Ragea et al., 2022; Luo et al., 2024).

4.2. Screening Timing

Standard Screening: Typically performed between 24 and 28 weeks of gestation (Virally & Laloi-Michelin, 2010). Early Screening: Insufficient evidence supports early screening (before 14 weeks) (Kuo & Li, 2019).

4.3. Glycemic Thresholds

4.3.1. ***Variability:*** Different guidelines use different glycemic thresholds for diagnosing GDM, contributing to the lack of consensus (Fukatsu et al., 2017; Sert & Ozgu-Erdinc, 2021; Ragea et al., 2022).

4.3.2. ***Impact on Prevalence:*** Stricter criteria, such as those recommended by the International Association of Diabetes and Pregnancy Study Groups (IADPSG), increase the prevalence of diagnosed GDM (Fukatsu et al., 2017).

4.3.3. ***Recommendations:*** Public health initiatives focusing on improved screening and control programs are essential to manage the rising incidence of GDM. These programs aim to reduce maternal and fetal complications and break the cycle of intergenerational diabetes risk (de Sousa et al., 2018; Tocci et al., 2023). Universal Screening is favored due to its cost-effectiveness and comprehensive detection (Kuo & Li, 2019; Luo et al., 2024). Universal Screening is recommended for its association with improved pregnancy outcomes and better perinatal results (Kuo & Li, 2019; Saccone et al., 2020; Luo et al., 2024).

5. DIAGNOSTIC CRITERIA FOR GDM

5.1. IADPSG Criteria

The IADPSG's recommended criteria are the most widely adopted criteria for diagnosing GDM (Jesmin et al., 2014). Evidence from cohort studies suggests that the one-step diagnostic method, as per the IADPSG criteria, is associated with improved pregnancy outcomes (Ghaffari et al., 2020) and appears more cost-effective than the two-step method (Jesmin et al., 2014; Sevket et al., 2014). The lack of standardized diagnostic criteria for GDM remains a subject of ongoing debate, with a need for international uniformity in screening strategies and diagnostic criteria (Jesmin et al., 2014; Kleinwechter, 2016). The IADPSG proposed new diagnostic criteria based on the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study. These criteria have been widely adopted and have led to a 1.5- to 8-fold increase in the diagnosis of GDM, depending on the population (Chihara et al., 2011; Long,

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2011; Savona-Ventura et al., 2012; Langer et al., 2013a; Luo et al., 2024). The criteria include:
Fasting plasma glucose ≥5.1 mmol/L
1-hour plasma glucose ≥10.0 mmol/L
2-hour plasma glucose ≥8.5 mmol/L (Laafira et al., 2016; Leffad et al., 2024).

5.2. WHO 2013 Criteria

The World Health Organization (WHO) revised its criteria in 2013, increasing GDM prevalence. The new criteria are similar to the IADPSG and have been associated with a 2.5 to 3-fold increase in GDM diagnosis (Long, 2011). The adoption of these new criteria has resulted in higher GDM prevalence. It has been associated with significant adverse maternal and neonatal outcomes, such as gestational hypertension, polyhydramnios, Caesarean section, prematurity, and neonatal hypoglycemia (Savona-Ventura et al., 2012; Skupień et al., 2014; Luo et al., 2024).

5.3. Technological Advances in GDM

5.3.1. Glucose Monitoring: Advances in glucose monitoring technologies, such as continuous glucose monitoring (CGM), have improved the management of GDM. These technologies provide real-time glucose readings, which help maintain optimal glucose levels and reduce adverse outcomes (Laafira et al., 2016).

5.3.2. Molecular Markers: Research into molecular markers, such as circular RNAs (circRNAs), is ongoing. These markers have shown potential in early diagnosis and prediction of GDM, which could lead to better management and prevention of adverse outcomes (Olumodeji et al., 2020).

***5.3.3. Pharmacotherapy*:** While insulin remains the primary treatment for GDM, other medications like metformin are being considered, especially when insulin therapy is not feasible. This provides more options for managing GDM effectively (Leffad et al., 2024).

5.4. Challenges and Considerations

The increase in GDM diagnosis poses a significant challenge to healthcare systems, requiring more resources for management and follow-up (Langer et al., 2013a; Laafira et al., 2016; Luo et al., 2024). There is ongoing debate about the applicability of a single set of diagnostic criteria globally due to variations in GDM prevalence and healthcare infrastructure (Chihara et al., 2011; Langer et al., 2013b). Despite the higher healthcare expenditure associated with the new criteria, they are considered cost-effective due to the potential reduction in long-term difficulties for mother and the offspring (Laafira et al., 2016).

6. MANAGEMENT AND TREATMENT OF GDM

6.1. Lifestyle Interventions

Exercise has been shown to play a crucial role in preventing GDM, regulating blood glucose, and improving insulin resistance. It is also considered a valuable therapeutic approach for enhancing maternal and infant outcomes (Chen et al., 2021).

6.2. Medical Nutrition Therapy

Dietary management remains the first-line treatment for GDM. Recent studies highlight the importance of gut microbiota and its metabolites in managing insulin resistance and GDM (Carreiro et al., 2018).

6.3. Pharmacological Treatments

Insulin remains the primary pharmacological treatment for GDM. However, metformin is increasingly considered an alternative, despite concerns about its long-term effects on offspring (Poulakos et al., 2015; Kousta et al., 2020). New insulin analogues and oral hypoglycemic agents are also being explored for their potential benefits (Ouyang et al., 2021; Wang et al., 2023).

6.4. Long-term Implications

6.4.1. Maternal and Offspring Health: GDM significantly increases the risk of developing type 2 diabetes (T2D) in mothers and their children. Recent studies have also linked GDM to adverse cognitive and behavioral outcomes in offspring, which may persist into adulthood (Akinci et al., 2008; Kim & Ferrara, 2010). GDM has a long-term association between maternal and fetal adverse outcomes, including an increased risk of cardiovascular diseases, chronic kidney disease, and cancer for the mother, and offspring obesity, overweight, insulin resistance, and neurocognitive development for the child (Hunt & Schuller, 2007; Kousta et al., 2020).

6.4.2. Preventive Measures: Early detection and lifestyle modifications are critical in preventing the long-term complications associated with GDM. Continuous glucose monitoring and targeted interventions can help mitigate these risks (Nudell et al., 2011; Liu et al., 2023). Women with GDM are at an increased risk of developing diabetes

in the future, predominantly type 2 diabetes, as are their offspring (Aydın et al., 2019). GDM may cause complications during pregnancy and childbirth, including the threat of termination of pregnancy, premature birth, preeclampsia, and high frequency of operative delivery and birth trauma (Nguyen et al., 2018).

***6.4.3. Challenges and Considerations*:** There is ongoing debate and controversy surrounding the proposed changes to the diagnostic criteria for GDM, with concerns about the potential negative impact on medical care, healthcare costs, and unnecessary stigmatization of patients (Olumodeji et al., 2020; Langer et al., 2013b). The disparity in GDM prevalence across different regions raises questions about the feasibility of imposing universal diagnostic strategies and standards for GDM diagnosis (Olumodeji et al., 2020).

The Diabetes Institute of Pakistan has stated (Anonymous, 2021) that the start of treatment of GDM as early as possible is crucial to prevent complications in the baby. The target blood glucose level is fasting up to 95mg/dL, 2 hours post-prandial up to 120mg/dL. This can be achieved by following simple steps: i) Eat adequate vegetables and fruits, limit fat intake to 30% of total daily calories, ii) Avoid undue weight gain during pregnancy, avoid overeating, fatty diets, etc., iii) Follow a simple exercise program so that you remain active. Avoid the exercises that cause pressure on the belly, however, walk and aerobic exercises are the best, iv) During pregnancy, you may have to check your blood sugar 4-6 times a day and maintain a record, v) gestational diabetes is mainly managed by diet and exercise, vi) regular medical checkup initial monthly checkup, then weekly checkup to monitor your blood glucose and growth of your baby, and vii) stress can raise blood glucose levels, so try to relax and stay calm at all times.

7. Conclusion

The prevalence of GDM in various countries is increasing over time. The prevalence of GDM varies across different populations and is influenced by demographic factors. The risk factors for GDM include classical and non-classical factors, and the lack of standardized diagnostic criteria for GDM remains a subject of ongoing debate. The diagnosis and screening of GDM remain contentious, with significant practice variability. Current evidence supports universal screening and the one-step method for better maternal and neonatal outcomes. However, further large-scale randomized controlled trials are needed to establish standardized guidelines. The new diagnostic criteria for GDM proposed by the IADPSG and the technological advances in GDM diagnosis have the potential to significantly impact the prevalence of GDM and the management of this condition. The new diagnostic criteria for GDM have led to an increase in diagnosis rates and have highlighted the need for improved management strategies. Technological advances, such as CGM and molecular markers, offer promising tools for better diagnosis and management. Recent advances in GDM encompass improved diagnostic criteria, innovative management strategies, and a deeper understanding of long-term implications. These developments are crucial for enhancing maternal and fetal health outcomes and preventing future metabolic disorders.

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