Current Trends in Gestational Diabetes Mellitus among Indian Pregnant Women

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Abstract

Introduction: Gestational Diabetes Mellitus (GDM) is a common metabolic disorder characterized by glucose intolerance first recognized during pregnancy. The prevalence of GDM has been increasing worldwide, particularly in developing countries such as India.
Objective: This chapter aims to summarize the prevalence of GDM among pregnant women in India and identify associated risk factors.
Methods: A review of published literature from various databases including PubMed, Scopus, and Google Scholar was conducted.
Results: Studies published between 2000 and 2024 reporting the prevalence of GDM in Indian populations were included. The reported prevalence ranged from 5% to 27% depending on diagnostic criteria, geographic location, and population characteristics. Urban populations generally showed higher prevalence compared to rural populations. Factors such as maternal age, obesity, family history of diabetes, and sedentary lifestyle were commonly associated with increased risk.
Discussion and Conclusion: Early screening and proper management are essential to reduce maternal and neonatal complications. The findings highlight the growing burden of GDM in India and the need for universal screening strategies.

Keywords: Gestational Diabetes Mellitus, Body mass index, Polycystic Ovary Syndrome, Placenta, Insulin

1. Introduction

Gestational Diabetes Mellitus (GDM) is defined as carbohydrate intolerance that results in hyperglycaemia with onset or first recognition during pregnancy. It is one of the most common metabolic complications of pregnancy and represents a growing public health concern worldwide (McIntyre et al., 2019a; Mirghani Dirar & Doupis, 2017a). GDM occurs when a woman who previously had normal glucose metabolism develops elevated blood glucose levels during pregnancy due to impaired insulin action or inadequate insulin secretion. The condition is particularly important because it can adversely affect both maternal and fetal health during pregnancy and may also have long-term metabolic consequences for the mother and her offspring (McIntyre et al., 2019b; Mirghani Dirar & Doupis, 2017b). With the rising global prevalence of diabetes and obesity, gestational diabetes has become increasingly common, especially in developing countries where healthcare resources may be limited.

Pregnancy is associated with several physiological changes that influence maternal metabolism in order to meet the nutritional demands of the developing foetus. During early pregnancy, maternal metabolism is characterized by increased insulin sensitivity and enhanced glucose storage (Barbour et al., 2007; Buchanan & Xiang, 2005). However, as pregnancy progresses, particularly in the second and third trimesters, there is a gradual increase in insulin resistance. This physiological insulin resistance is primarily mediated by placental hormones such as human placental lactogen, progesterone, cortisol, prolactin, and growth hormone. These hormones act as insulin antagonists and reduce the effectiveness of insulin in maternal tissues. As a result, maternal glucose levels increase slightly, ensuring a continuous supply of nutrients to the foetus for proper growth and development (Barbour et al., 2007; Buchanan & Xiang, 2005).

Under normal conditions, the maternal pancreas compensates for this increased insulin resistance by enhancing insulin secretion from pancreatic β-cells. This adaptive response helps maintain normal blood glucose levels despite the metabolic stress of pregnancy. However, in some women the pancreatic β-cells fail to produce sufficient insulin to overcome pregnancy-induced insulin resistance. When this compensatory mechanism becomes inadequate, blood glucose levels rise and gestational diabetes develops. Women with pre-existing metabolic risk factors such as obesity, genetic susceptibility, or a family history of diabetes are more likely to experience this failure of β-cell compensation (Plows et al., 2018).

In recent decades, the prevalence of gestational diabetes has increased significantly across the world. Several factors contribute to this rising trend, including increasing rates of obesity, sedentary lifestyles, delayed maternal age, and changing dietary patterns. Improved awareness and screening programs have also contributed to the increased detection of gestational diabetes in many populations (Gitlin et al., 2024; Yuen et al., 2025). The growing burden of GDM

is a major concern because it is associated with various maternal and neonatal complications, as well as long-term health risks for both mother and child.

India is considered particularly vulnerable to the growing epidemic of gestational diabetes. The country already has one of the highest numbers of individuals with diabetes globally, and South Asian populations are known to have a higher genetic predisposition to insulin resistance and type 2 diabetes. Rapid urbanization, economic development, and lifestyle changes have further increased the risk of metabolic disorders among women of reproductive age. Modern dietary habits characterized by increased consumption of refined carbohydrates, high-calorie foods, and reduced physical activity have significantly contributed to the rising incidence of gestational diabetes in the Indian population (Misra et al., 2025; Priyadarshini et al., 2024).

Epidemiological studies conducted in different regions of India have reported considerable variation in the prevalence of gestational diabetes. Depending on the population studied and the diagnostic criteria used, the prevalence of GDM among Indian pregnant women has been estimated to range between approximately 4% and 18%. However, some recent large-scale national surveys have reported even higher prevalence rates. For instance, recent data suggest that the overall prevalence of gestational diabetes in India may reach approximately 22.4%, indicating that nearly one in four pregnancies could be affected by abnormal glucose metabolism. These findings highlight the magnitude of the problem and emphasize the importance of early screening and effective management (Anjana et al., 2017; Mantri et al., 2024; Nguyen et al., 2018).

The increasing prevalence of gestational diabetes has significant implications for maternal and child health. Women who develop GDM are at increased risk of pregnancy-related complications such as preeclampsia, pregnancy-induced hypertension, and caesarean delivery. Moreover, these women have a substantially higher likelihood of developing type 2 diabetes later in life. Studies indicate that a large proportion of women with GDM may develop type 2 diabetes within several years after delivery if appropriate preventive measures are not implemented(Bellamy et al., 2009).

Gestational diabetes also has important consequences for fetal and neonatal health. Maternal hyperglycaemia can lead to excessive glucose transfer to the foetus, resulting in fetal hyperinsulinemia and increased fetal growth. This condition often leads to macrosomia, which increases the risk of birth complications, including shoulder dystocia and birth injuries. In addition, infants born to mothers with gestational diabetes may experience neonatal hypoglycaemia, respiratory distress, and a higher risk of developing obesity and metabolic disorders later in life (Mantri et al., 2024).

Given the increasing burden of gestational diabetes and its potential health consequences, it is essential to understand the current trends and determinants of GDM among Indian pregnant women. Early identification through appropriate

screening strategies, along with timely intervention and lifestyle modification, can significantly reduce adverse pregnancy outcomes. Therefore, this chapter aims to discuss about the epidemiology, risk factors, and management strategies of gestational diabetes, which is crucial for improving maternal and neonatal health outcomes and for reducing the long-term burden of diabetes in future generations.

2. Epidemiology of Gestational Diabetes in India

2.1 Global Perspective

Globally, hyperglycaemia during pregnancy affects millions of women each year. According to international estimates, approximately one in six pregnancies worldwide is complicated by elevated blood glucose levels. These cases include both pre-existing diabetes and gestational diabetes. The prevalence of GDM varies widely across regions due to differences in genetic factors, lifestyle patterns, diagnostic criteria, and healthcare infrastructure (Mantri et al., 2024).

2.2 Prevalence in India

India has one of the highest burdens of gestational diabetes globally. Several epidemiological studies have reported varying prevalence rates across different regions of the country.

The ICMR-INDIAB national study reported that the weighted prevalence of GDM in India is approximately 22.4%, indicating that nearly one in four pregnant women may develop gestational diabetes. Other regional studies have reported prevalence ranging from 4% to 18%, depending on population characteristics and diagnostic criteria (Anjana et al., 2017).

Urban areas tend to have higher prevalence rates compared to rural populations due to lifestyle factors such as reduced physical activity and increased consumption of processed foods. However, recent studies indicate that the gap between urban and rural populations is narrowing due to rapid lifestyle transitions.

2.3 Regional Variations

The prevalence of GDM varies considerably across Indian states. National survey data indicate increasing prevalence across several regions between 2015 and 2021. For example:

- Kerala and Goa show relatively higher prevalence rates.
- Northern and eastern states demonstrate moderate increases.
- Some regions show lower prevalence due to underdiagnosis or limited screening programs.

These variations may reflect differences in genetic predisposition, socioeconomic conditions, healthcare accessibility, and nutritional patterns (Chakraborty & Yadav, 2024).

3. Risk Factors for Gestational Diabetes in Indian Women

Several biological, environmental, and lifestyle factors contribute to the increasing incidence of gestational diabetes among Indian pregnant women.

3.1 Maternal Age

Advanced maternal age is a significant risk factor for GDM. Studies show that women above 30 years have a higher risk of developing glucose intolerance during pregnancy due to reduced insulin sensitivity and metabolic changes (Anjana et al., 2017).

3.2 Obesity and Body Mass Index

Obesity is strongly associated with gestational diabetes. Excess adipose tissue leads to increased insulin resistance and impaired glucose metabolism. With increasing rates of overweight and obesity among Indian women, the risk of GDM has increased substantially (Yuen et al., 2025).

3.3 Genetic Susceptibility

South Asian populations have a higher genetic predisposition to insulin resistance and type 2 diabetes. This genetic susceptibility contributes significantly to the high prevalence of GDM in India (Priyadarshini et al., 2024).

3.4 Family History of Diabetes

Women with a family history of diabetes have a significantly higher risk of developing gestational diabetes. Genetic and environmental factors both play important roles in this association (Priyadarshini et al., 2024).

3.5 Lifestyle and Dietary Patterns

Modern lifestyle changes have contributed greatly to the increasing prevalence of GDM. Major contributing factors include:

- Sedentary lifestyle
- High intake of refined carbohydrates
- Increased consumption of processed foods
- Reduced physical activity

These factors increase insulin resistance and metabolic disturbances during pregnancy (Plows et al., 2018).

3.6 Polycystic Ovary Syndrome (PCOS)

Women with PCOS often have insulin resistance and metabolic abnormalities, making them more susceptible to gestational diabetes (Barbour et al., 2007).

3.7 Previous History of GDM

Women who had gestational diabetes in previous pregnancies are at a higher risk of recurrence in subsequent pregnancies (McIntyre et al., 2019b).

4. Pathophysiology of Gestational Diabetes

Gestational Diabetes Mellitus (GDM) develops when the physiological metabolic changes of pregnancy lead to impaired glucose tolerance and elevated blood glucose levels. The path physiology of GDM is primarily characterized by a combination of increased insulin resistance and inadequate pancreatic β-cell compensation. These metabolic alterations occur as part of normal pregnancy adaptation but become pathological when the body fails to maintain normal glucose homeostasis (McIntyre et al., 2019b).

During pregnancy, maternal metabolism undergoes significant changes to support the nutritional demands of the developing foetus. In early pregnancy, insulin sensitivity is generally maintained or may even increase slightly, allowing maternal tissues to store energy in the form of glycogen and fat. However, as pregnancy progresses, particularly during the second and third trimesters, the body develops a state of progressive insulin resistance. This insulin resistance is a normal physiological process that ensures a continuous supply of glucose to the foetus, which is the primary energy source for fetal growth (Plows et al., 2018).

Several placental hormones play a key role in inducing insulin resistance during pregnancy. These include human placental lactogen (hPL), progesterone, estrogen, cortisol, and placental growth hormone. These hormones act as insulin antagonists and reduce the ability of insulin to stimulate glucose uptake in maternal tissues such as skeletal muscle and adipose tissue. As a result, maternal blood glucose levels rise slightly, allowing more glucose to cross the placenta and support fetal development (Plows et al., 2018).

In healthy pregnancies, the maternal pancreas compensates for this insulin resistance by increasing insulin secretion. Pancreatic β-cells undergo functional and structural adaptations, including β-cell hypertrophy and hyperplasia, which increase insulin production. This compensatory increase in insulin secretion helps maintain normal blood glucose levels despite the presence of insulin resistance. However, in women who develop gestational diabetes, this compensatory mechanism is insufficient. The pancreatic β-cells fail to produce enough insulin to overcome the increased insulin resistance, resulting in elevated blood glucose levels (Desoye& Nolan, 2016).

Genetic susceptibility and pre-existing metabolic abnormalities contribute significantly to the development of GDM. Women who have a family history of diabetes, obesity, polycystic ovary syndrome (PCOS), or a history of glucose intolerance are more likely to develop gestational diabetes. These conditions are often associated with pre-existing insulin resistance and impaired β-cell function, which become more pronounced during pregnancy (Priyadarshini et al., 2024).

Adipose tissue also plays an important role in the pathophysiology of GDM. Increased adiposity leads to the release of various inflammatory cytokines and adipokines, such as tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and leptin, which contribute to systemic insulin resistance. At the same time, levels of adiponectin, a hormone that enhances insulin sensitivity, are often reduced in women with gestational diabetes. These changes in adipokine balance further impair insulin action and contribute to hyperglycaemia (Bellamy et al., 2009).

Another important mechanism involved in GDM is increased hepatic glucose production. Due to insulin resistance, the liver continues to produce glucose through processes such as gluconeogenesis and glycogenolysis, even when blood glucose levels are already elevated. This excessive glucose production contributes to fasting hyperglycaemia observed in some women with gestational diabetes (Misra et al., 2025).

Maternal hyperglycaemia has direct effects on the foetus. Glucose freely crosses the placenta, leading to increased fetal blood glucose levels. In response, the fetal pancreas secretes large amounts of insulin, a condition known as fetal hyperinsulinemia. Insulin acts as a growth-promoting hormone in the foetus, resulting in increased fat deposition and excessive fetal growth, commonly referred to as macrosomia. This condition increases the risk of complications during delivery and may predispose the child to obesity and metabolic disorders later in life (Plows et al., 2018).

In summary, the pathophysiology of gestational diabetes involves a complex interaction between pregnancy-induced insulin resistance, inadequate pancreatic β-cell compensation, genetic susceptibility, and metabolic disturbances. These factors lead to maternal hyperglycaemia, which can have significant consequences for both maternal and fetal health. Understanding these mechanisms is essential for developing effective strategies for the prevention, early detection, and management of gestational diabetes.

5. Maternal and Fetal Complications

Gestational diabetes can lead to several short-term and long-term complications affecting both the mother and the foetus.

5.1 Maternal Complications

Women with GDM are at increased risk of:

- Preeclampsia
- Pregnancy-induced hypertension
- Caesarean delivery
- Polyhydramnios
- Development of type 2 diabetes later in life

Studies indicate that nearly 50% of women with gestational diabetes may develop type 2 diabetes within 5–10 years after pregnancy (McIntyre et al., 2019c).

5.2 Fetal and Neonatal Complications

Maternal hyperglycaemia leads to increased glucose transfer to the fetus, stimulating excessive insulin production by the fetal pancreas. This condition results in several complications, including:

- Macrosomia (excessive fetal growth)
- Neonatal hypoglycaemia
- Respiratory distress syndrome
- Preterm birth
- Increased risk of childhood obesity and diabetes(Desoye& Nolan, 2016)

6. Diagnosis and Screening of GDM in India

Early detection of gestational diabetes is essential for preventing complications. Several international diagnostic criteria are used for screening GDM.

Common Diagnostic Guidelines

1. World Health Organization (WHO) criteria
2. American Diabetes Association (ADA) guidelines
3. International Association of Diabetes and Pregnancy Study Groups (IADPSG)
4. Diabetes in Pregnancy Study Group India (DIPSI) guidelines

In India, the DIPSI single-step procedure is widely recommended due to its simplicity and cost-effectiveness. It involves administering a 75 g oral glucose tolerance test (OGTT) irrespective of fasting status and measuring plasma glucose after two hours.

Recent research also indicates increasing detection of early GDM during the first trimester, highlighting the need for early screening programs (“Diagnostic Criteria and Classification of Hyperglycaemia First Detected in Pregnancy: A World Health Organization Guideline,” 2014; “International Association of

Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy," 2010; ElSayed et al., 2024).

7. Management of Gestational Diabetes

Effective management of gestational diabetes requires a multidisciplinary approach involving obstetricians, endocrinologists, nutritionists, and diabetes educators.

7.1 Medical Nutrition Therapy

Dietary modification is the cornerstone of GDM management. Recommended strategies include:

- Balanced carbohydrate intake
- High-fibre diet
- Avoidance of refined sugars
- Regular meal patterns(Bellamy et al., 2009)

7.2 Physical Activity

Moderate exercise such as walking or prenatal yoga improves insulin sensitivity and helps maintain normal glucose levels (Chakraborty & Yadav, 2024).

7.3 Glucose Monitoring

Regular monitoring of fasting and postprandial glucose levels is essential to ensure adequate glycaemic control (Chakraborty & Yadav, 2024).

7.4 Pharmacological Treatment

If lifestyle modification fails to control blood glucose levels, pharmacological therapy may be required. Common treatments include:

- Insulin therapy
- Oral hypoglycaemic agents such as metformin (Chakraborty & Yadav, 2024)

8. Current Research Trends in India

Recent research on gestational diabetes in India focuses on several emerging areas:

Early Detection

Increasing evidence suggests that GDM may develop earlier in pregnancy than previously thought, emphasizing the need for early screening (Chakraborty & Yadav, 2024).

Genetic Studies
Researchers are investigating genetic markers associated with insulin resistance and gestational diabetes in South Asian populations.

Nutritional Interventions
Studies are evaluating the role of micronutrients, dietary patterns, and lifestyle modifications in preventing GDM.

Digital Health Technologies
Mobile health applications and continuous glucose monitoring systems are being explored to improve diabetes management during pregnancy.

9. Public Health Challenges in India

Despite increasing awareness, several challenges remain in controlling gestational diabetes in India.

Limited Screening in Rural Areas
Many rural healthcare centres lack adequate facilities for diabetes screening during pregnancy.

Lack of Awareness
Many pregnant women are unaware of the risks associated with gestational diabetes.

Variation in Diagnostic Criteria
Different diagnostic criteria used by healthcare providers lead to inconsistencies in diagnosis and prevalence estimates.

Healthcare Infrastructure
Limited availability of trained healthcare professionals and diabetes education programs remains a significant barrier (Chakraborty & Yadav, 2024).

10. Prevention Strategies

Preventive strategies for gestational diabetes should focus on lifestyle modification and early screening.
Key preventive measures include:

- Maintaining healthy body weight before pregnancy
- Balanced diet and regular exercise
- Early antenatal screening for high-risk women
- Public health awareness programs
- Integration of GDM screening into maternal healthcare services (Mantri et al., 2024)

11. Future Directions

Future research and public health strategies should focus on:

- Nationwide screening programs for GDM
- Development of standardized diagnostic criteria
- Implementation of lifestyle intervention programs
- Improved maternal healthcare infrastructure
- Integration of digital health technologies for diabetes management

Addressing these challenges will help reduce the burden of gestational diabetes and improve maternal and neonatal health outcomes.

12. Conclusion

Gestational diabetes mellitus is emerging as a major public health problem in India. The prevalence of GDM has increased significantly over the past two decades due to lifestyle changes, urbanization, rising obesity, and genetic susceptibility among South Asians. Recent national studies suggest that nearly one-fourth of pregnancies in India may be affected by gestational diabetes (Nguyen et al., 2018).

The condition poses serious risks for both mother and child, including pregnancy complications and long-term metabolic disorders. Early diagnosis, lifestyle modification, and effective management are essential for reducing these risks (Plows et al., 2018; Yuen et al., 2025).

Strengthening antenatal screening programs, improving healthcare infrastructure, and increasing public awareness are critical steps toward addressing the growing burden of gestational diabetes in India (McIntyre et al., 2019c). By implementing comprehensive preventive strategies, it is possible to improve maternal health outcomes and reduce the intergenerational transmission of diabetes in future generations.

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