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The Causes, Risk Factors, Difficulties in Diagnosis, Preventive Measures, and Multidisciplinary Care of Gestational Diabetes Mellitus

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Abstract: This article provides a comprehensive review of the etiology, risk factors, diagnostic approaches, prevention strategies, and management of gestational diabetes mellitus, with particular emphasis on early detection and multidisciplinary care. Current screening methods, including oral glucose tolerance testing and emerging molecular biomarkers, are discussed. Preventive interventions before and during pregnancy, as well as postpartum follow-up strategies, are evaluated. The role of healthcare professionals, especially nurses, in patient education, glycemic monitoring, and long-term risk reduction is highlighted. Effective management of GDM requires an integrated, patient-centered approach aimed at improving pregnancy outcomes and preventing intergenerational transmission of metabolic disease.

Keywords: Gestational diabetes mellitus; pregnancy; insulin resistance; risk factors; screening; prevention; nursing care; maternal and fetal outcomes.

Introduction

A kind of glucose intolerance known as gestational diabetes mellitus is initially identified during pregnancy, usually in the second or third trimester. Hyperglycemia, which is caused by inadequate insulin secretion to meet the elevated metabolic demands of pregnancy, is its hallmark. Placental hormone synthesis causes physiological insulin resistance to naturally rise throughout pregnancy; however, gestational diabetes develops when pancreatic β-cells are unable to sufficiently compensate. Due to its increasing global incidence and its immediate and long-term effects on both the mother and the child, GDM is a significant public health concern. GDM represents an underlying metabolic vulnerability and is a powerful predictor of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD), even though it is frequently temporary and goes away after delivery. The majority of the negative consequences linked to GDM can be avoided or greatly decreased with proper screening, early diagnosis, and multidisciplinary care. About 7% of pregnancies worldwide are complicated by gestational diabetes, while prevalence varies greatly based on demographic risk profiles, geographic location, ethnicity, and diagnostic standards[1].

The primary aim of this study is to comprehensively analyze the causes, risk factors, diagnostic challenges, preventive strategies, and multidisciplinary management of gestational diabetes mellitus (GDM). The research seeks to examine the underlying pathophysiological mechanisms of GDM, with particular emphasis on pregnancy-induced insulin resistance, genetic predisposition, hormonal changes, and environmental and lifestyle-related factors contributing to the development of the disease. Additionally, the study aims to evaluate current diagnostic approaches to GDM, including oral glucose

tolerance testing, early pregnancy screening strategies, and emerging biomarkers, in order to identify existing limitations and challenges in timely diagnosis[2]. Special attention is given to the comparison between universal and risk-based screening methods and their impact on maternal and fetal outcomes. Another important objective of this research is to assess preventive measures implemented before, during, and after pregnancy, including lifestyle modification, nutritional interventions, physical activity, and postpartum follow-up, with the goal of reducing the incidence of GDM and preventing long-term metabolic complications such as type 2 diabetes mellitus and cardiovascular disease. Furthermore, the study aims to highlight the role of multidisciplinary care in the effective management of gestational diabetes mellitus, emphasizing the contributions of obstetricians, endocrinologists, nurses, nutritionists, and primary care physicians. Particular focus is placed on nursing care, patient education, glycemic monitoring, psychological support, and long-term risk reduction strategies. By synthesizing current evidence and national healthcare practices, this research aims to provide evidence-based recommendations to improve early detection, optimize management strategies, and enhance both short-term pregnancy outcomes and long-term health prospects for mothers and their offspring[3].

Globally, the incidence of GDM is rising due to a number of factors, including changes in dietary habits, sedentary lifestyles, increased obesity rates, and older mothers. Due to untreated dysglycemia before to or early in pregnancy, the true frequency is probably underestimated in many cultures. Genetic predisposition, hormone fluctuations, and environmental variables interact intricately in the multifactorial pathophysiology of GDM. Human placental lactogen, progesterone, estrogen, cortisol, and placental growth hormone are among the placental hormones that play a major role in the developing insulin resistance linked to pregnancy. By opposing the effects of insulin, these hormones guarantee sufficient glucose availability for embryonic development. Women with GDM experience hyperglycemia because their pancreatic β-cell activity cannot make up for their increased insulin resistance[4]. Abnormalities in insulin secretion, insulin signalling pathways, and inflammatory mediators have been shown by molecular and metabolic studies. Additionally, there is growing evidence that the development of GDM is associated with placental dysfunction, altered extracellular vesicle signalling, microRNA expression, and proteomic alterations. One known risk factor for GDM is advanced maternal age, especially pregnancy after the age of 35. Pregnancy-related glucose intolerance is more likely due to age-related declines in β-cell reserve and insulin sensitivity. One of the best indicators of GDM is obesity. Insulin resistance and chronic low-grade inflammation are linked to excess fat tissue. The risk of developing GDM is greatly increased by higher pre-pregnancy BMI and severe gestational weight gain. The chance of recurrence in subsequent pregnancies is significantly increased if GDM was present during a prior pregnancy. Early screening and careful metabolic monitoring are necessary for these women[5]. A genetic predisposition that affects insulin secretion and glucose regulation is shown in a family history of type 2 diabetes, especially in first-degree relatives. Insulin resistance and hyperandrogenism are linked to PCOS and raise the risk of GDM. Increased glucose monitoring is necessary for PCOS-affected pregnant women. Pregnancy-related hypertensive diseases, such as preeclampsia, often coexist with GDM and have similar vascular and metabolic processes. Chronic stress, poor eating habits, physical inactivity, and mental health issues all have a detrimental impact on insulin sensitivity and glycemic control, which can lead to the development of GDM. Increased metabolic needs from twin or higher-order pregnancies raise the likelihood of insulin resistance and GDM. An oral glucose tolerance test (OGTT) administered between weeks 24 and 28 of pregnancy is typically used to identify GDM[6]. A one-step 75-g OGTT with particular fasting, one-hour, and two-hour glucose levels is recommended by international standards from the IADPSG, WHO, and FIGO. Early testing is increasingly advised to rule out pre-existing diabetes because to rising prevalence of obesity and undiagnosed pre-pregnancy dysglycemia. Research has challenged conventional testing windows by demonstrating a significant detection of GDM in the early stages of pregnancy. Since risk-factor-based methods overlook a sizable percentage of GDM patients, there is strong evidence in favour of universal screening. Large cohort studies and cost-effectiveness assessments show that universal testing enhances pregnancy outcomes and detection. The best preventive approach is still to optimize maternal health before to conception through physical exercise, a good diet, and

weight control. Early pregnancy lifestyle changes, especially before 15 weeks, may somewhat lower the risk of GDM. There is, however, little data supporting therapies initiated later in pregnancy. Despite being widely used to treat GDM and PCOS, metformin has not consistently shown a preventative benefit in randomized trials[7]. Supplementing with myoinositol and vitamin D shows promise in some individuals, especially those with baseline inadequacies, but further research is needed. The three main strategies for managing GDM are diet, exercise, and glucose monitoring. When lifestyle changes fail to meet glycemic goals, insulin is still the gold standard. Oral hypoglycemic medications are used sparingly based on patient characteristics and clinical recommendations. Through patient education, glucose monitoring training, dietary counselling reinforcement, psychological support, and adherence monitoring, nurses play a crucial role in the management of GDM. Good communication between nurses and patients optimizes treatment outcomes, lowers anxiety, and promotes self-management. The way that women view GDM varies greatly, from underestimating the risk to feeling afraid and stigmatized. Successful management requires addressing myths, encouraging empowerment, and cultivating collaborative care[8]. Type 2 diabetes and cardiovascular disease are about ten times more likely to occur in women with a history of GDM. Although it is advised to use OGTT for postpartum glucose testing at 6–12 weeks, compliance is still low. Breastfeeding improves metabolic results and dramatically lowers the chance of developing diabetes in the future. The developmental origins of health and illness concept is supported by the fact that offspring exposed to intrauterine hyperglycemia are more likely to acquire obesity, impaired glucose tolerance, metabolic syndrome, and cardiovascular disease in later life.

Materials and Methods (Methodology).

This study was designed as a comprehensive narrative and analytical review focusing on the causes, risk factors, diagnostic challenges, preventive strategies, and multidisciplinary management of gestational diabetes mellitus (GDM). The methodology integrates analysis of current scientific literature, international clinical guidelines, and national healthcare practices to provide an evidence-based overview of GDM. The research employed a descriptive and analytical review methodology. Peer-reviewed articles, clinical guidelines, and national and international recommendations published in reputable medical journals and official sources were systematically analyzed. The review focused on studies addressing the epidemiology, pathophysiology, diagnosis, prevention, and management of gestational diabetes mellitus. Scientific literature was obtained from international medical databases, including publications from the World Health Organization (WHO), the International Association of Diabetes and Pregnancy Study Groups (IADPSG), the International Federation of Gynecology and Obstetrics (FIGO), and leading peer-reviewed journals. National scientific publications and clinical guidelines from Uzbekistan were also included to reflect regional healthcare practices. Inclusion criteria comprised studies and guidelines published in English and Russian that addressed gestational diabetes mellitus in relation to pregnancy outcomes, diagnostic methods, prevention strategies, and multidisciplinary care. Exclusion criteria included non-peer-reviewed sources, case reports with limited clinical relevance, and studies lacking clear diagnostic criteria. The study analyzed maternal, genetic, metabolic, and lifestyle-related risk factors associated with the development of GDM. Particular attention was paid to advanced maternal age, obesity, family history of diabetes, polycystic ovary syndrome, previous gestational diabetes, multiple pregnancies, and psychosocial factors. Hormonal and molecular mechanisms underlying pregnancy-induced insulin resistance were examined based on current endocrinological and metabolic research. Diagnostic strategies were assessed with a focus on oral glucose tolerance testing (OGTT) performed between 24 and 28 weeks of gestation, as recommended by international guidelines. The advantages and limitations of universal versus risk-based screening were analyzed. Emerging diagnostic approaches, including early pregnancy testing and novel biomarkers, were reviewed to identify challenges in early detection. Preventive measures before and during pregnancy, including lifestyle modification, nutritional counseling, physical activity, and weight management, were evaluated. Pharmacological interventions, including insulin therapy and selected oral hypoglycemic agents, were reviewed based on clinical effectiveness and safety during pregnancy. Postpartum follow-up strategies aimed at reducing the long-term risk of type 2 diabetes mellitus were also analyzed. The role of multidisciplinary care involving obstetricians, endocrinologists, nurses, nutritionists, and primary care

physicians was examined. Special emphasis was placed on nursing interventions, including patient education, self-monitoring of blood glucose, adherence support, psychological counseling, and postpartum follow-up. National healthcare initiatives and pilot programs aimed at improving GDM management at the primary care level were also reviewed. As this study was based on the analysis of previously published data and clinical guidelines, no direct patient involvement was required. Ethical principles of academic integrity and proper citation were strictly observed.

Our country has also been putting systematic procedures in place in recent years to detect, treat, and lessen the problems of gestational diabetes. National clinical guidelines and recommendations on hormonal and metabolic diseases, including pregnancy-related glucose metabolism problems, are currently being developed by health authorities. In order to create a cohesive strategy in medical practice, these publications specify the classification of gestational diabetes using coding based on the International Classification of Diseases, diagnostic criteria, and clinical management algorithms. There are more opportunities for early disease detection and efficient treatment because national recommendations are being created in accordance with international guidelines. Expanding screening procedures and bolstering the primary health care system are two crucial areas of endeavour connected to gestational diabetes. In cooperation with the World Health Organization and other international partners, integrated diabetes initiatives are being carried out in Uzbekistan. Early disease detection, ongoing patient monitoring, and efficient primary treatment planning particularly at the rural and regional levels are the goals of these projects. In certain areas, pilot programs targeted at enhancing diabetes care in primary healthcare facilities are in operation, which is assisting in expanding the capabilities of family physicians and nurses. Determining the incidence of gestational diabetes in the nation through regional research and pilot projects is crucial from both a scientific and practical standpoint. Regional research by Uzbek experts and healthcare facilities has revealed a comparatively high prevalence of this illness and verified that maternal age, body mass index, and lifestyle factors are significant contributors to its development. These scientific findings provide a foundation for identifying risk groups and enhancing regional screening methods. According to estimates, the country's prevalence of gestational diabetes is rising in keeping with worldwide trends. Increasing gestational age, the high rate of overweight and obesity among women, a decline in physical activity, and poor nutrition are some of the causes of this. Gestational diabetes affects a considerable percentage of the nation's population, according to regional surveys and medical journals, creating new difficulties for the healthcare system.

Uzbekistan is following national and international guidelines when it comes to diagnostics. Midway through pregnancy, the oral glucose tolerance test—which is commonly considered as the primary tool for identifying gestational diabetes—is carried out. Simultaneously, the necessity of enhanced screening and early testing for women with risk factors is highlighted. The most suitable answer at the primary care level is the widespread use of glucometers that enable blood glucose levels to be measured at home. These devices are easy to use and reasonably priced.

Globally, gestational diabetes has been successfully managed with the use of contemporary technologies, such as remote medical monitoring capabilities and continuous glucose monitoring devices. These technologies are still not widely used in Uzbekistan, despite scientific discussion and knowledge about them in medical publications. In essence, these technologies are being tested in scientific pilot programs or specialized centres. In the meanwhile, local studies are being conducted to investigate how mobile apps and digital health tools might be used to remotely monitor patients and determine the risk of gestational diabetes. This strategy may make it easier for patients and healthcare providers to communicate in the future, but before it is widely used, problems with system integration and quality assurance must be resolved. The battle against gestational diabetes is largely dependent on the practical effort of physicians and nurses. Pregnant women are being screened more frequently by family physicians and perinatal centres, who also regularly do glucose tolerance tests and promptly refer pregnant women who are at risk to specialist facilities. In clinical management, gynecologists collaborate with obstetricians, endocrinologists, nutritionists, and nurses. Each patient is given a customized treatment plan that includes regular glucose control, increased physical activity, food therapy, and insulin

therapy if needed. When working with patients who have gestational diabetes, nurses have a unique role to play. They can help patients self-monitor their blood glucose levels, give advice on how to take medications correctly, discuss food and good lifestyle choices, and offer psychological support. Within the context of international programs, special training is being arranged for primary-level nurses to enhance their professional abilities.

Result and discussion

The analysis of international and national scientific literature demonstrated that gestational diabetes mellitus (GDM) is a multifactorial metabolic disorder closely associated with pregnancy-induced insulin resistance and insufficient pancreatic β-cell compensation. Placental hormones, including human placental lactogen, progesterone, estrogen, cortisol, and placental growth hormone, play a central role in the development of physiological insulin resistance during pregnancy. In women with GDM, impaired β-cell function prevents adequate metabolic adaptation, resulting in persistent hyperglycemia[9].

The findings identified several maternal risk factors consistently associated with an increased risk of GDM. Advanced maternal age, particularly pregnancy after 35 years, was a significant determinant due to reduced insulin sensitivity and diminished β-cell reserve. Pre-pregnancy obesity and excessive gestational weight gain were among the strongest predictors, reflecting adipose tissue–related insulin resistance and chronic inflammation. A history of GDM markedly increased recurrence risk, highlighting the importance of early screening and close metabolic monitoring. Additional contributing factors included a family history of type 2 diabetes mellitus, polycystic ovary syndrome, hypertensive disorders of pregnancy, and multiple gestations. Evaluation of diagnostic strategies confirmed that the oral glucose tolerance test (OGTT) performed between 24 and 28 weeks of gestation remains the most reliable and widely accepted diagnostic method. Evidence showed that the one-step 75-g OGTT recommended by the WHO, IADPSG, and FIGO provides higher detection rates than risk-based screening alone. Several studies demonstrated that reliance solely on risk-factor-based screening leads to underdiagnosis, as many women with GDM lack classical risk factors. Early pregnancy screening was effective in identifying previously undiagnosed dysglycemia, particularly in high-risk populations. The results indicated that universal screening strategies improve GDM detection and pregnancy outcomes compared with selective screening. Cost-effectiveness analyses and large cohort studies supported universal OGTT testing as a means of reducing maternal and fetal complications. Assessment of preventive strategies showed that lifestyle modification before conception and during early pregnancy is the most effective preventive approach. Regular physical activity, balanced nutrition, and weight optimization were consistently associated with reduced GDM risk. Lifestyle interventions initiated before 15 weeks of gestation demonstrated moderate effectiveness, whereas later interventions showed limited benefit. Pharmacological prevention with metformin yielded inconsistent results, while myoinositol and vitamin D supplementation showed potential benefits in selected populations, requiring further investigation. Management findings confirmed that diet therapy, physical activity, and regular glucose monitoring form the foundation of GDM treatment. Insulin therapy remained the gold standard when lifestyle measures were insufficient and was associated with a significant reduction in perinatal complications, including macrosomia, shoulder dystocia, and neonatal hypoglycemia. The results underscored the importance of multidisciplinary care in optimizing outcomes for women with GDM. Collaboration among obstetricians, endocrinologists, nurses, nutritionists, and primary care physicians improved treatment adherence, glycemic control, and patient satisfaction. Nursing care played a key role in patient education, self-monitoring of blood glucose, dietary counseling, psychological support, and postpartum follow-up. Postpartum follow-up remained a major challenge, with low adherence to recommended glucose testing at 6–12 weeks. However, evidence consistently showed that women with a history of GDM face a substantially increased risk of type 2 diabetes mellitus and cardiovascular disease. Breastfeeding was associated with improved maternal metabolic outcomes and reduced long-term diabetes risk. Offspring exposed to intrauterine hyperglycemia demonstrated increased risks of obesity, impaired glucose tolerance, metabolic syndrome, and cardiovascular disease, supporting the concept of developmental origins of health and disease[10].

Conclusion

A complex metabolic condition, gestational diabetes mellitus has significant long-term effects on the health of both mothers and their offspring. Its increasing frequency is a reflection of greater changes in diet, lifestyle, and reproduction in society. Perinatal problems are greatly decreased by early detection, universal screening, and evidence-based treatment. A multidisciplinary strategy involving obstetricians, endocrinologists, nurses, nutritionists, and primary care physicians is necessary for effective GDM therapy. In terms of long-term follow-up, behavioural support, and patient education, nurses are essential. One of the most important ways to stop metabolic disease from being passed down through generations is through postpartum care. To enhance long-term outcomes for mothers and their children, future research should concentrate on enhancing post-partum follow-up systems, optimizing preventative efforts, and confirming early biomarkers.

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