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Effectiveness of Prenatal Screening for Gestational Diabetes: A Narrative Review

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Abstract

Gestational diabetes mellitus (GDM) is a common metabolic disorder of pregnancy associated with adverse maternal and neonatal outcomes. Despite its clinical importance, considerable variation remains in approaches to prenatal screening, including the timing, diagnostic strategy, and criteria used to identify affected pregnancies. The expansion of screening also raises concerns regarding unnecessary diagnosis, healthcare utilization, and patient burden. This narrative review of the available literature was conducted to examine different approaches to prenatal GDM screening. The review considered variations in screening timing, screening strategies, diagnostic thresholds, and their associations with maternal and neonatal outcomes. Particular attention was given to the clinical implications of identifying milder degrees of dysglycemia and to the economic and practical consequences of different screening approaches. This review concluded that prenatal GDM screening should aim to achieve clinically meaningful detection while minimizing unnecessary intervention and patient burden. Future research should focus on standardized outcomes, simplified and accessible screening approaches, and context-specific strategies that integrate clinical effectiveness, economic considerations, and healthcare resources.

Categories: Obstetrics/Gynecology
Keywords: gestational diabetes, maternal, narrative, pregnancy, prenatal

Introduction And Background

Gestational diabetes mellitus (GDM) is known as impaired glucose tolerance that is initially diagnosed or recognized in pregnancy, ranking as one of the most frequent medical disorders that complicate pregnancy [1]. Its worldwide prevalence is escalating in line with growing rates of maternal obesity and older maternal age, impacting about 14-25% of pregnancies globally, with notable variations among populations and the diagnostic criteria applied [2]. GDM is more than a temporary concern; it causes significant short-term and long-term effects. Affected mothers face an elevated likelihood of complications such as preeclampsia, cesarean delivery, and subsequent development of type 2 diabetes [3]. For the neonate, exposure to intrauterine hyperglycemia leads to many consequences, including macrosomia, birth injuries, neonatal hypoglycemia, and a higher probability of childhood obesity and metabolic disorders [4].

The pathophysiology of GDM relies on progressive insulin resistance, induced by human placental lactogen, progesterone, and cortisol, which reach their peak in the late second and third trimesters [5]. In pregnant women with inadequate pancreatic β-cell reserve to compensate, this leads to hyperglycemia.

The rationale for antenatal GDM screening is to detect hyperglycemia to allow for early management to reduce these related risks [6]. However, there is notable international controversy regarding its implementation. Guidelines disagree on crucial questions such as whether screening should be universal or selective according to the condition and risk factors; whether it is more effective when done early (≤20 weeks) or at 24-28 weeks; which method of diagnosis and threshold values are ideal; and, importantly, which maternal or neonatal outcomes are to be used for the screening to be considered successful [7,8]. This issue highlights a core tension in obstetrics: while screening aims to prevent adverse events, the expansion of screening and diagnostic criteria risks leading to excessive medical intervention.

This involves considering GDM in more pregnant women without definite evidence that this diagnosis translates into significantly better health outcomes for the mother and infant [9]. Research indicates that early or more precise screening identifies milder cases of impaired glucose regulation where the gain of treatment may be of limited advantage, thus increasing medical costs and patient distress and anxiety without corresponding clinical benefit [10]. Consequently, the central issue shifts from determining screening approaches to assessing their efficacy.

This narrative review aims to evaluate and consolidate the current evidence on the effectiveness of prenatal screening methods for GDM. Specifically, it aims to examine the diagnostic precision of different screening methods; their effect on important short- and long-term clinical outcomes for both the mother and newborn; and the growing evidence on cost-effectiveness and the risk-benefit ratio. This review will not

concentrate on the treatment of GDM after diagnosis but will focus on the evidence connecting the screening process to subsequent clinical outcomes to inform both clinical practice and future research. We conducted this narrative review to summarize the literature that does not have enough data to conduct a systematic review and meta-analysis.

Review

Methodology

In December 2025, a comprehensive search of the available literature was conducted across PubMed, Scopus, and Web of Science databases. The search strategy used the following Boolean combinations of key terms and MeSH to identify relevant studies: ((“Gestational Diabetes Mellitus” OR GDM) AND (“Screening” OR “Diagnosis” OR “Early Detection”)) AND (“One-Step” OR IADPSG OR “Two-Step” OR “Carpenter and Coustan”) AND (“Effectiveness” OR “Outcome” OR “Cost-Effective” OR “Recommendation” OR “Guideline”). To guarantee comprehensiveness, no limitations were applied to the study design to include the available evidence for this narrative review. However, the search was limited to English-language articles concerning human subjects and published through 2025. In this narrative review, we synthesized evidence descriptively, and therefore, we did not perform a standardized risk of bias assessment or data analysis [1,2].

Evolution and rationale for gestational diabetes mellitus screening

The rationale for GDM screening has evolved significantly. Historically, screening for GDM concentrated on high-risk patients, such as patients with obesity or a family history of diabetes mellitus [11]. This selective method seeks to distribute resources effectively. However, evidence shows its major weakness because of an increased risk of missed diagnoses. For instance, research on a large Portuguese population showed nearly 30% of GDM cases would have been missed with a screening method based on risk factors [12]. In addition, another study showed that 12.7% of GDM diagnoses are made in patients who are considered low-risk. Therefore, clinical practice has moved toward non-selective screening for all pregnant women at 24-28 weeks of pregnancy [13].

Screening modalities and diagnostic criteria

One-Step Versus Two-Step Screening Methods

The principal strategies for GDM screening are the one-step and the two-step diagnostic protocols, which notably vary in procedure, diagnostic criteria, and prevalence of GDM identified. The ongoing debate is whether to implement these tests universally for all pregnant women or selectively depending on the risk profile. Table *1* shows the key variations between these two diagnostic methods [14,15].

Feature	One-step (IADPSG/WHO) approach	Two-step (C&C/NDDG) approach
Procedure	A single 75 g OGTT with measurements at fasting, one hour, and two hours	Step 1: A non-fasting 50 g GCT. Step 2: A diagnostic 100 g, three-hour OGTT only if the GCT is positive
Diagnostic criteria	Diagnosis made if one or more values meet or exceed thresholds (e.g., fasting ≥92 mg/dL)	Diagnosis made if two or more values on the 100 g OGTT exceed thresholds (e.g., C&C: fasting ≥95 mg/dL; NDDG: fasting ≥105 mg/dL)

TABLE 1: Comparison of one-step (IADPSG/WHO) and two-step (C&C/NDDG) diagnostic approaches for GDM [14,15].

C&C: Carpenter and Coustan criteria; GCT: glucose challenge test; GDM: gestational diabetes mellitus; IADPSG: International Association of the Diabetes and Pregnancy Study Groups; NDDG: National Diabetes Data Group; OGTT: oral glucose tolerance test; WHO: World Health Organization

Although the one-step method is adopted globally by organizations such as the World Health Organization (WHO), the two-step method remains most common in the United States [16]. The two-step approach is supported by the American College of Obstetricians and Gynecologists (ACOG), mainly because of the concerns that the one-step approach would raise GDM prevalence, possibly by three times, without conclusive evidence that treating the large number of mild cases results in enhanced pregnancy outcomes [17]. Additionally, the U.S. recommendations are cautious about the associated surge in healthcare costs and resources linked to the increased rate of diagnosis [18].

The most direct and notable variation between the two approaches is the number of pregnant women diagnosed. The one-step approach, utilizing a single 75 g oral glucose tolerance test (OGTT) and lower glycemic cutoffs, detects a significantly higher number of cases. Evidence reports that using the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria (one-step) raises GDM prevalence two to threefold in comparison to traditional two-step approaches [19]. A study of

approximately 39,000 patients in China reported that lower IADPSG thresholds resulted in a 2.53-fold increase in the rate of diagnosis compared to higher thresholds [20]. This rise is mainly attributed to the lower cutoffs of the IADPSG criteria, which seek to detect milder cases of hyperglycemia shown in the HAPO study to be linked to adverse outcomes [21]. Consequently, a notable number of cases diagnosed only by the one-step approach have glucose levels that would be classified as "normal" or below the threshold under two-step criteria, so they are called the "mild" GDM population. It is crucial to note that this group faces a significantly elevated long-term risk; a meta-analysis determined that patients with GDM diagnosed by IADPSG were 6.43 times more likely to develop type 2 diabetes mellitus later in life in comparison to those without GDM [22].

Universal Versus Selective Screening

Universal and risk-based screening strategies for GDM continue to be evaluated in light of their diagnostic yield, clinical effectiveness, and resource requirements. Although risk-based screening may reduce screening burden, it may fail to identify some women with GDM who do not have established risk factors. Recent evidence and contemporary clinical guidelines should therefore be considered when determining the most appropriate screening strategy [23,24].

Advocates argue that the missed cases are generally milder. Evidence shows that patients with GDM without risk factors often have lower fasting glucose levels and a lower need for insulin [23]. It remains debated whether the benefits of universal screening and subsequent management justify the expenses and efforts of screening an entire population.

Timing of screening

The ideal timing for screening for GDM is centered on a clinical discussion: adhering to the conventional window of 24 to 28 weeks of pregnancy or implementing it earlier in pregnancy for all or high-risk patients. Although universal screening in the late second trimester is a widely accepted practice, the evidence supporting earlier screening is complex.

Early Pregnancy Screening

Performing screening in the first or early second trimester (⩽20 weeks) seeks to identify elevated blood glucose before standard timing. Proponents suggest that early diagnosis permits longer management duration, potentially limiting fetal overgrowth and other risks [25]. Research shows that hyperglycemia before 20 weeks is a notable risk indicator. A large study in China demonstrated that women with high fasting blood glucose or HbA1c in early pregnancy faced triple the risk of later diagnosis of GDM and a notably increased risk of complications such as gestational hypertension and macrosomia [26].

Nevertheless, the issue is whether detecting and managing early GDM leads to better health results. A recent systematic review showed that while early screening identifies more cases (15.0% versus 12.0%), it offers no significant clinical benefit in improving maternal or neonatal outcomes, such as the rate of preeclampsia, cesarean section, or neonatal complications [25]. Similar findings were reported by a large quasi-experimental study involving over 220,000 deliveries, which demonstrated that when routine early screening was not performed, there was no harm to mothers or infants. Therefore, current guidelines do not recommend this approach [27]. The U.S. Preventive Services Task Force highlights that current evidence is inadequate to recommend routine early screening before (⩽20 weeks), and the ACOG also does not recommend it [28].

Routine Screening at 24-28 Weeks

Testing at 24-28 weeks is still the international standard as it coincides with the period of maximal physiological insulin resistance, mainly caused by placental hormones. This period is consistent with the pathophysiology of true GDM, because hyperglycemia identified earlier may frequently represent previously undiagnosed dysglycemia before pregnancy [29]. Global consensus strongly recommends universal screening in this period [30]. The aim is to detect glucose intolerance when it is most likely to impact fetal growth and pregnancy outcomes, permitting intervention during the trimester of greatest risk. Table *2* summarizes the key variations between the two timings.

Aspect	Early screening (≤20 weeks)	Routine screening (24–28 weeks)
Primary aim	Identify pre-existing dysglycemia or early-onset GDM for prolonged intervention	Target peak physiological insulin resistance of pregnancy
Recommendation	Selectively for high-risk individuals; not for routine use	Universally recommended
Effect on GDM diagnosis	Increases the GDM diagnosis rate	GDM diagnoses at the standard, validated time point
Evidence and practical consideration	No clear advantage reported in RCTs for maternal or neonatal health. May lead to added interventions without clear benefit	The established advantage of the intervention started in the late second trimester. Also aligns with standard prenatal care visits and pathways

TABLE 2: Comparison of early pregnancy and standard gestational diabetes mellitus screening timings [25-30].

GDM: gestational diabetes mellitus; RCT: randomized controlled trial

Comparative effectiveness of screening strategies for gestational diabetes mellitus

Impact on Maternal Outcomes

Recent studies offer answers to whether managing the additional, milder population results in valuable benefits, especially regarding key maternal outcomes such as cesarean delivery rates and gestational hypertension with its related complications.

The ScreenR2 trial, a large randomized controlled trial (RCT), directly compared the one-step and two-step approaches in more than 23,000 patients [31]. The analysis showed no significant difference in the risk of gestational hypertension or preeclampsia between the two groups. This highlights that the more sensitive one-step approach and subsequent intervention did not provide extra protection against preeclampsia [19,31]. These results are corroborated by another RCT by Davis et al., which also showed no statistically significant difference in a composite measure of maternal complications between the two groups [32].

In addition, the GDM2 study showed that while the IADPSG criteria diagnosed more than triple the number of women with GDM (14.4% versus 4.5%), it did not limit the incidence of large for gestational age (LGA) infants or other maternal or neonatal complications [33].

However, other trials have shown a benefit. Harper et al. reported that the advantages of GDM management on outcomes such as gestational hypertension and macrosomia were consistent for patients detected by more sensitive criteria, as it increased GDM diagnosis by 30-50% [34]. Tahmina et al. observed a significantly higher prevalence using IADPSG versus Carpenter and Coustan (C&C) criteria (22.78% versus 7.2%, $p = 0.000$), and reported statistically significant benefits in neonatal respiratory distress and hyperbilirubinemia ($p = 0.000$) [35]. Another trial supported using the IADPSG criteria if the cost of screening and management can be afforded and controlled, and if lifestyle can be improved to minimize the possibility of future diabetes mellitus [36].

Impact on Neonatal Outcomes

The main reason to prefer a more sensitive screening tool lies in its potential utility in improving neonatal health outcomes by minimizing the risk factor of fetal hyperglycemia.

In the ScreenR2 study, per-protocol analysis showed a marginally lower incidence of LGA in the one-step strategy (8.4% versus 9.2%), with a relative risk of 0.89 [19]. However, they explained that confidence intervals (CIs) were not adjusted for multiple comparisons, and they did not show a statistically significant reduction in perinatal complications in the primary intention-to-treat analysis [19,31]. Cao et al. performed a surrogate target trial analysis, which did not show a significant difference in the risk of LGA in lower compared with higher diagnostic criteria, as they found the incidence of LGA infants was 7.12% under lower glycemic criteria versus 8.26% under higher criteria (risk ratio (RR) = 0.96, 95% CI = 0.90 to 1.02) [20]. A recent meta-analysis found that, despite a significantly increased risk of adverse neonatal outcomes such as macrosomia (odds ratio (OR) = 1.61), respiratory distress (OR = 1.60), hypoglycemia (OR = 4.84), and neonatal intensive care unit admission (OR = 1.68) in GDM patients regardless of diagnostic criteria, this risk remained comparably small among different diagnostic methods [37]. This highlights that although GDM

itself is a risk factor, detecting milder cases using the one-step method may not gradually limit the possibility of these complications at a population level in comparison to the two-step method.

Cost-effectiveness and healthcare burden of gestational diabetes mellitus screening

A thorough evaluation of prenatal screening for GDM needs not only evaluation of the efficacy but also the economic impact and burden on patients. The process of selecting a proper approach needs a balance between the costs of diagnosis and treatment, with the possible long-term savings from averting complications for both the mother and child.

Economic Effect of Diagnostic Approaches: One-Step Versus Two-Step

The economic comparison between diagnostic approaches depends on balancing the detection rate, subsequent treatment costs, and clinical benefit. The one-step approach, utilizing a single 75 g OGTT, generally detects notably more patients with GDM. A meta-analysis of RCTs found that the one-step method led to double the detection rate in comparison to the two-step method [38]. This resulted in greater aggregate expenses for management and monitoring for this larger cohort. On the other hand, the two-step method, starting with a 50 g glucose challenge test, led to a lower overall diagnosis rate and lower management costs but required more clinic visits for each case diagnosed and carried the risk of some missed cases [38].

Deciding which strategy offers better economic value depends on the advantages shown in long-term results. A 2021 systematic review of cost-effectiveness assessments yielded that screening is typically cost-effective in comparison to no screening, and the one-step method is more likely to be cost-effective compared to the two-step when the economic models incorporate the prevention of long-term complications [39]. Nevertheless, other studies focused only on short-term outcomes may find the two-step approach more economically efficient, as further management of milder cases may not result in proportional advantages in perinatal results [38].

Therefore, the most cost-effective screening method for GDM depends on the context. The one-step method may be suitable for a healthcare system preferring better long-term health outcomes, while the two-step approach can be chosen when considering short-term budgets.

Economic Implications of Screening Timing: Early Versus Routine

The cost-effectiveness of early screening, starting before the 20th week, compared to the standard 24-28 weeks, has not been fully established and does not favor the strategy of early universal screening. The rationale behind early screening is to recognize hyperglycemia, possibly indicative of undiagnosed prevalent dysglycemia. However, current evidence, including a large-scale meta-analysis, has shown that early universal screening does not lead to better pregnancy outcomes than early screening in those at risk and routine screening in the later stages of gestation [38]. Early screening, from an economic model, is more expensive due to the costs of investigations and the resulting costs of disease management in those identified, in the absence of the clinical benefit that would justify the economic outlays. Therefore, evidence recommends the standard 24-28-week screening or selective early screening for only high-risk patients as a better cost-effective method [39,40].

Patient burden and barriers to access

All economic analysis would be incomplete without factoring in the considerable non-financial burden that patients assume and how they might impact patient compliance and the practical success of screening protocols. The diagnostic OGTT procedure involves fasting for 8-14 hours, which may aggravate pregnancy-related morning sickness [41]. The procedure also requires a medical office visit of two to three hours with blood draws, representing a considerable time commitment. Additionally, this amount of time often involves taking leave from work, childcare arrangements for other children, and transportation costs, which fall heavily on those from socioeconomically disadvantaged backgrounds and could act as a barrier to completing screening processes [42].

Research has been conducted to uncover methods that could alleviate this burden. A 2024 study showed that a strategy using the triage of fasting plasma glucose results could maintain the detection rate of pregnancies at risk for poor outcomes while reducing the necessity for performing an OGTT by greater than 80% [43]. Innovations like this are important for improving the acceptability of GDM testing.

Comparison of major international guidelines

The international approach to screening for GDM shares fundamental principles but notable variations in specific diagnostic thresholds and methods used. There is consensus on the importance of screening, but guidelines vary in their recommended methods, reflecting ongoing conflict about diagnostic criteria and

resource allocation [44].

American Diabetes Association

The 2023 American Diabetes Association (ADA) standards of care advocate for universal screening for all patients between 24 and 28 weeks of pregnancy using the one-step 75 g OGTT. Diagnostic cutoffs are fasting glucose ⩾92 mg/dL, a one-hour level ⩾180 mg/dL, and a two-hour level ⩾153 mg/dL [45]. For high-risk patients (e.g., obesity, previous GDM, previous LGA child, previous family history), screening for overt diabetes is recommended at the initial prenatal appointment [45].

World Health Organization

The WHO is closely in line with the ADA and the IADPSG, recommending universal evaluation with a one-step 75 g OGTT at 24-28 weeks. Its diagnostic cutoffs are similar to the ADA/IADPSG cutoffs for fasting and two-hour values [46].

National Institute for Health and Care Excellence

The UK's National Institute for Health and Care Excellence (NICE) guidelines also endorse universal screening between 24-28 weeks of pregnancy with a 75 g OGTT [47]. Although the timing is similar, the specific diagnostic cutoffs utilized in the NICE recommendations (women were diagnosed if fasting plasma glucose level ⩾101 mg/dL and/or two-hour value ⩾140 mg/dL) vary from those of the ADA/WHO, leading to differences in GDM prevalence rates across several systems [48].

International Federation of Gynecology and Obstetrics

The International Federation of Gynecology and Obstetrics (FIGO) is a strong advocate of universal screening for GDM in all pregnant women [7]. Although its initiatives support using the one-step method, FIGO also notes that choosing between one-step and two-step methods may depend on regional resource constraints [7].

Special considerations: screening in specific populations

A universal screening approach is insufficient for GDM because of the different risk profiles. Targeted and selective early screening is essential for high-risk patients to identify glucose intolerance before it progresses [49]. This is particularly crucial for patients with a history of GDM, who face an 8- to 10-fold greater risk of developing type 2 diabetes mellitus after delivery and require diligent monitoring and follow-up [50]. Other groups include those with pre-pregnancy obesity (body mass index ⩾30 kg/m^2), a strong family history of diabetes mellitus, or a previous history of giving birth to a macrosomic infant. Furthermore, patients from specific ethnic backgrounds, such as South Asian, Hispanic, African American, and Native American populations, have a notably greater inherent possibility of developing GDM even in the absence of other factors [44].

In these high-risk groups, it is recommended to screen early in pregnancy (even before 15 weeks) to detect pre-existing dysglycemia. This permits early management, which may enhance glucose control and potentially limit the possibility of complications. In addition, a previous history of GDM mandates a long-term health strategy, with structured postpartum screening and other approaches to mitigate the long-term risk of type 2 diabetes mellitus [49].

The role and effectiveness of telemedicine in gestational diabetes mellitus care

Traditional prenatal screening for GDM faces notable application issues that can impede access and delay care. The traditional method needs repeated clinic visits for testing, dietary and lifestyle counseling, and monitoring, creating burdens such as time commitments, transportation expenses, and the need to work [51]. These obstacles disproportionately impact patients from disadvantaged socioeconomic backgrounds and can lead to health inequities [52]. In addition, maintaining continuing patient engagement and follow-up between clinic visits is still complex. Therefore, telemedicine has arisen as a potentially transformative method to deliver necessary GDM care.

Telemedicine for GDM includes utilizing digital tools (platforms with secure messaging, video counselling and consultation, and remote assessment and monitoring) to allow easy care without the need for traditional clinic visits. A recent meta-analysis showed that telemedicine care was better than traditional in-person care in achieving glycemic control, as shown by notable reductions in fasting blood glucose and HbA1c values [53]. Additionally, these approaches result in improvements in mother and child health. A meta-analysis of 32 RCTs indicated that telemedicine notably minimizes the need for cesarean section, preterm labor, macrosomia, and the need for neonatal intensive care unit [54]. Munda et al. highlighted in their trial that telemedicine management could effectively substitute a notable part of standard clinic visits

without adversely affecting glycemic levels or pregnancy outcomes [55].

Integrating telemedicine into gestational diabetes mellitus healthcare involves multiple key methods

Remote Glucose Monitoring

This cornerstone program uses a Bluetooth-connected glucose monitor that automatically sends the readings to a secure portal to allow the healthcare team to review, permitting timely feedback and management plan changes without the need for a clinic visit. This method results in improved glycemic control and better patient satisfaction in comparison to the traditional approach [56].

Digital Risk Assessment

This is a validated risk assessment questionnaire that can be administered using mobile applications and web-based platforms to facilitate the detection of patients who are candidates for an early screening program. Clinical decision-support tools can further assist healthcare providers to apply consistent screening guidelines [57].

Virtual Clinical Consultations

Video consultations and secure messaging services can replace or support traditional visits. This method helps maintain continuity of patient care while eliminating distance and transportation obstacles, which offers patients convenience [58].

Future directions: integration, innovation, and equity

The future of GDM screening is anticipated to use a hybrid, individualized approach that integrates conventional and innovative methods [59]. Currently, research continues into innovative, less intrusive approaches. These involve continuous glucose monitoring systems for high-risk patients and artificial intelligence models that are capable of predicting GDM risk by analyzing electronic health records to make screening more efficient [59]. Extensive cost-benefit analyses from the viewpoints of healthcare systems and societies are also important. Future research should determine the ideal balance between in-person and virtual visits to optimize resource use [28]. Future research should also aim to design telemedicine approaches that proactively minimize the digital divide, including resolving barriers associated with technology availability, technology use experience, and language to ensure all pregnant patients are capable of benefiting from innovations in GDM care [52].

Conclusions

Prenatal GDM screening requires balancing sensitive diagnosis with resource-efficient care. The one-step IADPSG and two-step approaches should be selected according to healthcare priorities, while universal screening at 24-28 weeks remains the most evidence-supported strategy. Future practice should emphasize simplified testing, hybrid telemedicine, and guidelines tailored to local resources. These approaches can improve accessibility, efficiency, and equity in GDM screening and management.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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