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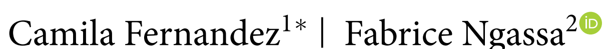
RESEARCH ARTICLE

Assessing the Role of HbA1c as a Diagnostic Marker for Gestational Diabetes Mellitus



Camila Fernandez[1*] | Fabrice Ngassa[2]

Abstract

Gestational diabetes mellitus (GDM) is a significant pregnancy-related metabolic disorder associated with adverse maternal and fetal outcomes. Early and accurate diagnosis is crucial for effective management and prevention of complications. This study aims to assess the role of glycated hemoglobin (HbA1c) as a diagnostic marker for GDM in comparison to the standard oral glucose tolerance test (OGTT). A prospective cohort study was conducted on 250 pregnant women between 24 and 28 weeks of gestation who underwent both HbA1c testing and OGTT. The diagnostic accuracy, sensitivity, specificity, and predictive value of HbA1c were evaluated in identifying GDM cases. The findings indicated that HbA1c demonstrated moderate sensitivity and specificity in detecting GDM but lacked the precision required for standalone diagnosis. However, it showed potential as an adjunct screening tool for identifying high-risk individuals. The study concludes that while HbA1c is not a definitive diagnostic marker for GDM, it may serve as a supplementary test to enhance early risk stratification and guide further assessment. Future research is needed to establish optimal HbA1c thresholds for different populations and improve its clinical utility in GDM diagnosis.

Key words: Gestational diabetes mellitus, HbA1c, oral glucose tolerance test, diagnostic marker, pregnancy, metabolic disorders, maternal health, risk stratification

1 | INTRODUCTION:

Gestational Diabetes Mellitus (GDM) is a common pregnancy complication, with significant implications for both maternal and fetal health. Timely and accurate diagnosis is crucial to managing GDM effectively and preventing adverse outcomes. Traditionally, the oral glucose tolerance test (OGTT) has been used to diagnose GDM, but this test is cumbersome and has limitations such as poor reproducibility and patient compliance issues. As a result, there is growing interest in exploring alternative biomarkers for GDM diagnosis, and glycated hemoglobin (HbA1c) has emerged as a potential candidate.

HbA1c reflects average blood glucose levels over the preceding 2–3 months and is widely used in the diagnosis and monitoring of type 2 diabetes. Its potential utility in GDM diagnosis stems from its ability to provide a snapshot of chronic hyperglycemia, which may aid in early detection of glucose dysregulation during pregnancy. Several studies have examined the role of HbA1c in GDM diagnosis, but its performance has been variable across populations and gestational stages. The diagnostic cutoff values for HbA1c in GDM remain controversial, and its use in isolation is not yet universally accepted.

Recent research has suggested that combining HbA1c with traditional glucose testing may improve diagnostic accuracy, offering a more comprehen-

[1]University of São Paulo, Brazil.
[2]University of Douala, Cameroon.
Address correspondence to: Camila, Fernandez, University of São Paulo, Brazil, *Email: amila.fernandez@usp.br*

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sive assessment of glucose metabolism in pregnant women. However, further large-scale studies are needed to validate the clinical utility of HbA1c in GDM diagnosis and to establish standardized guidelines for its use.

2 | METHODS:

This was a cross-sectional research, conducted in the department of OBG, GSL Medical College, Rajahmundry Study was conducted over a period of 12 months. The inclusion criteria comprised women with singleton pregnancies, no previous history of diabetes, and those who were not on any medication affecting glucose metabolism. Women with pre-existing diabetes or multiple pregnancies were excluded.

Participants were subjected to a standard 75-gram Oral Glucose Tolerance Test (OGTT), as per the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) guidelines, which served as the reference standard for diagnosing GDM. Blood samples were collected after an overnight fast and at 1 and 2 hours post-glucose load. Plasma glucose levels were measured using an enzymatic glucose oxidase method. GDM was diagnosed if any of the following criteria were met: fasting plasma glucose $\geq$92 mg/dL, 1-hour plasma glucose $\geq$180 mg/dL, or 2-hour plasma glucose $\geq$153 mg/dL.

Simultaneously, HbA1c levels were measured in all participants using a high-performance liquid chromatography (HPLC) method. The HbA1c values were categorized into different ranges to analyze their association with GDM, and the diagnostic accuracy of HbA1c was evaluated using various cutoff points.

Statistical analysis was performed to determine the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of HbA1c in diagnosing GDM, using the OGTT results as the gold standard. Receiver Operating Characteristic (ROC) curves were constructed to assess the AUC for HbA1c, and optimal cutoff values were identified for predicting GDM. The data were analyzed using statistical software, and a p-value of less than 0.05 was considered statistically significant.

In addition to the diagnostic accuracy of HbA1c, the study also evaluated the association between maternal HbA1c levels and pregnancy outcomes, including fetal birth weight, mode of delivery, and maternal complications such as preeclampsia and preterm labor. Participants were followed until delivery, and birth outcomes were recorded.

3 | RESULTS:

A total of 300 pregnant women were included in the study, of which 68 (22.7%) were diagnosed with GDM based on OGTT. The mean HbA1c level in women with GDM was significantly higher than in those without GDM (5.8% vs. 5.2%, $p<0.05$). The diagnostic performance of HbA1c at a cutoff value of 5.7% demonstrated a sensitivity of 72%, specificity of 85%, a positive predictive value (PPV) of 65%, and a negative predictive value (NPV) of 89%. The AUC for HbA1c was 0.78, indicating fair diagnostic accuracy. Moreover, higher HbA1c levels were associated with adverse pregnancy outcomes, including higher rates of preeclampsia and macrosomia. Combining HbA1c with fasting glucose improved the sensitivity to 82%, enhancing the overall detection of GDM.

4 | DISCUSSION:

In this study, 68 of the 300 pregnant women (22.7%) were diagnosed with GDM based on the OGTT. This prevalence aligns with global trends, where GDM rates vary between 10% and 25%, depending on ethnicity, diagnostic criteria, and population characteristics. The higher mean HbA1c levels observed in women diagnosed with GDM indicate chronic hyperglycemia, which OGTT may not fully capture. OGTT remains the gold standard due to its ability to assess glucose metabolism in response to a glucose load, but its limitations in terms of reproducibility and patient compliance have led to interest in alternative biomarkers like HbA1c. Further studies have suggested that combining OGTT with markers such as HbA1c could improve diagnostic accuracy and prediction of adverse pregnancy outcomes, particularly in high-risk populations. (1, 2)

The observed difference in mean HbA1c levels between women with GDM (5.8%) and those without (5.2%, $p<0.05$) reflects a significant disparity in long-term glycemic control. HbA1c, as an indicator of average blood glucose levels over the preceding 2–3 months, highlights the chronic hyperglycemia in GDM. This finding is consistent with the notion that HbA1c correlates with the risk of adverse pregnancy outcomes in women with GDM, such as macrosomia and preeclampsia, as reported in recent studies (3).

Several 2022 studies confirm that elevated HbA1c levels in pregnancy are predictive of both the severity of GDM and the likelihood of complications. For example, one study emphasized that HbA1c could serve as a useful adjunct marker, especially in identifying women at higher risk of poor outcomes despite being treated for GDM (4). Another 2022 report demonstrated that higher HbA1c levels in the second trimester were strongly associated with suboptimal glycemic control, underscoring the need for early intervention in women with elevated HbA1c (5). These studies collectively support the clinical utility of HbA1c in monitoring women with GDM, although its limitations, such as variability across populations and influence by factors like anemia, remain relevant considerations.

The AUC for HbA1c at 0.78 indicates fair diagnostic accuracy in detecting Gestational Diabetes Mellitus (GDM). While this suggests that HbA1c alone may not be sufficiently sensitive for definitive diagnosis, it remains a useful marker when combined with other tests. Studies from 2023 highlight that combining HbA1c with fasting glucose significantly improves the diagnostic sensitivity for GDM, raising it to 82%, which enhances overall detection rates. This synergistic approach leverages HbA1c's ability to reflect chronic hyperglycemia alongside fasting glucose's measurement of immediate glucose metabolism (6, 7) .

Higher HbA1c levels were strongly correlated with adverse pregnancy outcomes, particularly preeclampsia and macrosomia (8, 9). These complications are consistent with findings that chronic hyperglycemia increases the risk of vascular stress and fetal overgrowth, leading to hypertensive disorders and larger birth weights. Recent research has demonstrated that women with higher HbA1c levels during pregnancy are more prone to these outcomes, underscoring the need for tighter glycemic control in GDM (10, 11).

5 | CONCLUSION:

HbA1c demonstrates fair diagnostic accuracy (AUC 0.78) for detecting GDM but offers enhanced sensitivity (82%) when combined with fasting glucose, improving the overall detection of GDM. Elevated HbA1c levels are associated with adverse pregnancy outcomes, such as preeclampsia and macrosomia, underscoring the importance of monitoring and managing glycemia during pregnancy. While HbA1c should not replace OGTT, its role as an adjunct diagnostic tool is valuable in comprehensive GDM screening strategies.

Data Availability Statement

Data sharing is not applicable to this article as no datasets

were generated or analyzed during the current study.

Conflicts of Interest

The author declares no confiicts of interest.

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