

RESEARCH PAPER

Role of Glycated Albumin in Assessing Insulin Resistance and Insulin Sensitivity in Type 2 Diabetes Mellitus

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ABSTRACT

Background: Diabetes Mellitus, the most prevalent endocrine disorder worldwide, represents a major health concern. It results in either insufficient insulin production or ineffective insulin utilization. Vital organs are affected by persistent hyperglycemia.

Type 2 Diabetes Mellitus (T2DM) is a persistent, progressive metabolic condition marked by decreased insulin response in peripheral tissues. Primarily, the pancreas tries to compensate by producing more insulin, but gradually this response declines, leading to ongoing high blood glucose levels. As per the 2026 guidelines from the American Diabetes Association (ADA), T2DM diagnosis relies on measures such as HbA1c, fasting plasma glucose, postprandial plasma glucose and random plasma glucose. In recent years, Glycated Albumin (GA) has emerged as a valuable biomarker of short-term glycaemic control over the past 2-3 weeks.

This test is affected by variations in hemoglobin and doesn't require fasting, making it a convenient diagnostic option. Insulin Resistance (IR), a central aspect of T2DM, can be measured using indices like HOMA-IR and QUICKI, which analyze Fasting Blood Glucose and insulin levels to determine insulin resistance and sensitivity.

Conclusion: Understanding the relationships among Glycated Albumin, HOMA-IR and QUICKI can deepen our understanding of the disorder. This review highlights the significance of these parameters in improving the diagnosis and management of T2DM.

Keywords Glycated Albumin, Insulin Resistance, Insulin Sensitivity, Type 2 Diabetes Mellitus, HOMA-IR, QUICKI

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is one of the most common endocrine and metabolic disorders worldwide. According to the International Diabetes Federation, the global prevalence of diabetes is rising quickly, representing a major public health challenge [1]. T2DM is characterized by Insulin Resistance (IR), decreased insulin secretion, and continuous β -cell dysfunction, resulting in consistently high Blood Glucose Levels [2]. Monitoring glycaemic control is vital for preventing diabetes-related complications. Fasting plasma glucose, postprandial glucose and glycated haemoglobin (HbA1c) are commonly used to diagnose and monitor diabetes [3]. HbA1c reflects average blood glucose over the past 8-12 weeks, but factors such as anaemia, haemoglobinopathies, pregnancy and Chronic Kidney

Disease (CKD) can affect its interpretation [4].

Glycated Albumin (GA) has proven to be a helpful marker for evaluating glycaemic control over the past 2-3 weeks, due to albumin's shorter half-life compared to haemoglobin [5]. Recent research indicates that GA could also provide meaningful information about IR and insulin sensitivity.

PATHOPHYSIOLOGY OF TYPE 2 DIABETES MELLITUS

T2DM development is influenced by genetic factors, obesity, physical inactivity, and environmental factors. IR happens when tissues such as skeletal muscle, fat, and liver become less responsive to insulin [2].

Firstly, pancreatic β -cells respond by increasing insulin secretion. Over time, sustained metabolic stress causes β -

cell dysfunction and failure, resulting in chronic high Blood Glucose Levels [6]. Factors such as chronic inflammation, oxidative stress, lipotoxicity and glucotoxicity also exacerbate IR and the development of T2DM [7].

GLYCATED ALBUMIN

Glycated albumin (GA) forms through the nonenzymatic attachment of glucose to albumin, creating a ketone. It indicates short-term average blood sugar levels over about 2-3 weeks, owing to serum albumin's shorter half-life, unlike HbA1c, which reflects long-term glycaemic control over 2-3 months [8].

INSULIN RESISTANCE AND INSULIN SENSITIVITY

IR occurs when tissues have a diminished response to insulin despite having normal or high insulin levels. It is recognized as a key characteristic of T2DM [9]. Insulin sensitivity indicates how effectively insulin helps tissues absorb and use glucose. Decreased insulin sensitivity leads to high blood glucose levels and metabolic issues linked to diabetes. Assessment of IR and insulin sensitivity is important for early identification of high-risk individuals and disease progression.

The Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) is a widely accepted index used to assess and quantify insulin resistance [10].

HOMA-IR value is calculated by using fasting plasma insulin (μU/mL) and fasting plasma glucose (mg/dl), with the product of these two parameters divided by 405 [10].

$$HOMA-IR = \frac{FBI \times FBG}{405}$$

Quantitative Insulin Sensitivity Check Index (QUICKI) is a simple and accurate method for assessing insulin sensitivity in humans and is derived from the inverse of the sum of the logarithms of fasting insulin and fasting glucose [10].

$$QUICKI = \frac{1}{\text{Log}\left(\text{Fasting Insulin}\frac{\mu U}{mL}\right) + \text{log}\left(\text{Fasting Glucose}\frac{mg}{dl}\right)}$$

RELATIONSHIP BETWEEN GLYCATED ALBUMIN AND HOMA-IR

Multiple studies have shown a positive link between GA and IR. Higher IR causes increased post-meal hyperglycaemia and glycaemic variability, which in turn raises GA levels [11].

GA has demonstrated a positive correlation with HOMA-IR, suggesting it could serve as an indirect marker for IR. Its ability to reflect short-term glycaemic fluctuations makes it valuable for detecting metabolic disturbances early, before notable changes in HbA1c levels are evident.

RELATIONSHIP BETWEEN GLYCATED ALBUMIN AND QUICKI

Study have also shown an inverse relationship between GA and QUICKI: as insulin sensitivity decreases, QUICKI values drop while GA levels rise [12].

This negative correlation suggests that higher GA levels may indicate reduced insulin sensitivity. Consequently, GA might offer extra insights into metabolic regulation beyond traditional glycaemic indicators.

REVIEW OF LITERATURE

Table 1

Author	Title	Results	Conclusion
Marzi G. <i>et al.</i> (2025)	Glycated Albumin as a Diagnostic Tool for Diabetes Mellitus in Transfusion-Dependent Thalassemia Patients.	Glycated albumin showed a strong correlation with fasting plasma β-glucose and OGTT, with high diagnostic sensitivity and specificity.	GA is a promising biomarker for glycaemic assessment, particularly where HbA1c is unreliable.
Xie J. <i>et al.</i> (2025)	Adjusted Glycated Albumin is a Novel Indicator of Glycaemic Control in Patients with Macroalbuminuria in Diabetic Kidney Disease.	Adjusted glycated albumin correlated better with blood glucose than conventional GA in diabetic kidney disease.	Adjusted GA may improve glycaemic monitoring in patients with diabetic kidney disease.
Mubashni G. <i>et al.</i> (2025)	Utility of Glycated Albumin as a Biomarker for Glycaemic Variability in Diabetes Mellitus.	GA showed greater sensitivity for short-term glycaemic variability than HbA1c and better reflected recent glucose fluctuations.	GA may improve personalized diabetes management and should be considered a complementary marker to HbA1c.
Aliyu U. <i>et al.</i> (2025)	Assessment of Insulin Resistance Indices and Determination of Insulin Resistance Prevalence.	HOMA-IR and QUICKI effectively identified insulin resistance and demonstrated good clinical utility.	HOMA-IR and QUICKI remain reliable surrogate markers for assessing insulin resistance in clinical practice.
Kosmas C.E. <i>et al.</i> (2024)	Biomarkers of Insulin Sensitivity/Resistance.	The review compared HOMA-IR, QUICKI and other biomarkers used to assess insulin resistance and insulin sensitivity.	HOMA-IR and QUICKI continue to be practical, validated and widely used tools for metabolic assessment.
Chume	Glycated Albumin: A Potential	GA showed diagnostic accuracy	GA should be used as an additional

F.C. <i>et al.</i> (2019)	Biomarker in Diabetes Mellitus.	comparable to HbA1c.	diagnostic marker rather than a replacement for HbA1c.
Hamidou Zorome. <i>et al.</i> (2025)	Body Fat And Hand Grip Strength Among Patients With Type 2 Diabetes Mellitus.	Higher body fat percentage are linked to poor Glycaemic control.	Glycaemic control and overall health outcomes can be enhanced by reducing the body fat in T2DM.

CONCLUSION

Glycated Albumin is an important short-term marker for glycaemic control, showing promise for evaluating IR and sensitivity in T2DM patients. Research indicates positive links between GA and HOMA-IR, and negative links with QUICKI. Recent findings also highlight GA usefulness in assessing glycaemic fluctuations, especially when HbA1c results are uncertain. Thus, Glycated Albumin could be a helpful supplementary biomarker for diagnosing, monitoring, and managing diabetes.

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