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Original Research Article

Association Between Glycated Hemoglobin Levels and Fasting and Postprandial Plasma Glucose in Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Long-term exposure to elevated plasma glucose is the principal driver of chronic complications in type 2 diabetes mellitus. Glycated hemoglobin provides an integrated estimate of glycemic exposure over time, yet the relative contribution of fasting and postprandial plasma glucose to glycated hemoglobin remains variable across populations.

Objectives: The present study aimed to examine the relationship between glycated hemoglobin and fasting as well as postprandial plasma glucose levels and to evaluate which glycemic parameter demonstrates a stronger association with long-term glycemic status in patients with type 2 diabetes mellitus.

Methods: This cross-sectional study included 300 patients with diagnosed type 2 diabetes mellitus. Fasting and postprandial plasma glucose levels were measured using the glucose oxidase–peroxidase method, and glycated hemoglobin was estimated by a particle-enhanced immunoturbidimetric assay. Correlation analysis was performed to assess the association between glycated hemoglobin and plasma glucose parameters.

Results: Glycated hemoglobin showed a significant positive correlation with both fasting and postprandial plasma glucose levels. The association was marginally stronger for postprandial plasma glucose (r = 0.79) than for fasting plasma glucose (r=0.77), indicating a closer relationship between post-meal glycemic excursions and long - term glycemic exposure.

Conclusion: Glycated hemoglobin demonstrates a strong association with routinely measured plasma glucose parameters in patients with type 2 diabetes mellitus, with postprandial glucose showing the closest relationship. These findings highlight the importance of postprandial glycemic assessment alongside fasting measurements for comprehensive evaluation of glycemic control.

Keywords: Type 2 diabetes mellitus; Glycated hemoglobin; Fasting blood glucose; Postprandial blood glucose; Glycemic control.

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INTRODUCTION

Type 2 diabetes mellitus is characterized by chronic dysregulation of glucose metabolism resulting from a combination of insulin resistance and impaired insulin secretion.[1-3] Persistent hyperglycemia associated with this condition contributes to the development of both microvascular and macrovascular complications, which significantly affect long-term morbidity and mortality.[4,5] Effective prevention of diabetes-related complications depends largely on accurate assessment of glycemic exposure and timely therapeutic intervention.[6] Consequently, reliable markers of glycemic control are essential in routine clinical practice.[7]

Plasma glucose concentrations vary considerably throughout the day in response to food intake, physical activity, and hormonal influences.[8] Fasting plasma glucose reflects basal metabolic regulation, whereas postprandial plasma glucose represents glycemic responses following meals.[9] Both parameters contribute to overall glucose exposure, although their relative impact may differ depending on disease duration, treatment, and individual metabolic characteristics.[10,11]

Glycated hemoglobin serves as an indicator of average blood glucose levels over preceding weeks and provides a cumulative measure of glycemic exposure.[12] Unlike single plasma glucose measurements, it is less affected by short-term fluctuations and is therefore widely used to monitor long-term glycemic control.[13] However, the extent to which fasting and postprandial plasma glucose independently influence glycated hemoglobin remains an

area of ongoing investigation, with previous studies reporting varying results.[14]

Understanding the relationship between glycated hemoglobin and commonly measured plasma glucose parameters is important for optimizing strategies to monitor and manage type 2 diabetes mellitus.[15] The present study was undertaken to evaluate the association between glycated hemoglobin and fasting as well as postprandial plasma glucose levels in patients with type 2 diabetes mellitus and to identify which parameter shows a closer relationship with long-term glycemic exposure.

MATERIALS AND METHODS

This cross-sectional observational study included patients with a confirmed diagnosis of type 2 diabetes mellitus who attended the outpatient and inpatient departments of the institution during the study period.

A total of 300 adult patients were enrolled after meeting the eligibility criteria. Demographic details and relevant clinical information were recorded at the time of recruitment. All participants underwent biochemical evaluation as part of the study protocol. Laboratory investigations included estimation of fasting blood glucose, postprandial blood glucose, random blood glucose, and glycated hemoglobin levels. Blood glucose measurements were performed using the glucose oxidase–peroxidase enzymatic method on a fully automated analyzer. Glycated hemoglobin estimation was carried out using a particle-enhanced immunoturbidimetric assay on an automated chemistry analyzer. All analyses were performed in the central laboratory of the institution following standardized procedures to ensure reliability and consistency.

Inclusion Criteria

- Adults aged 18 years and above
- Patients diagnosed with type 2 diabetes mellitus
- Individuals undergoing routine evaluation for glycemic status
- Patients willing to participate and provide informed consent

Exclusion Criteria

- Patients with diabetes mellitus other than type 2
- Individuals with conditions known to affect red blood cell lifespan, such as hemoglobinopathies or hemolytic disorders
- Patients with acute illness or metabolic emergencies at the time of evaluation
- Individuals unwilling to provide informed consent

Table 1. Demographic Characteristics of the Study Population (n = 300)

Characteristic	Number of patients	Percentage (%)
Male	142	47.3
Female	158	52.7
Age ≤ 40 years	58	19.3
Age 41–50 years	82	27.3
Age 51–60 years	96	32.0
Age > 60 years	64	21.4

Table 2. Mean Values of Glycemic Parameters

Parameter	Mean ± Standard deviation
Fasting blood glucose	156.4 ± 42.8
Postprandial blood glucose	224.7 ± 56.3
Random blood glucose	198.6 ± 51.2
Glycated hemoglobin	8.2 ± 1.6

Table 3. Correlation Between Glycated Hemoglobin and Blood Glucose Parameters

Blood glucose parameter	Correlation coefficient	P value
Fasting blood glucose	0.77	< 0.001
Postprandial blood glucose	0.79	< 0.001
Random blood glucose	0.65	< 0.001

Table 4. Comparative Strength of Association with Glycated Hemoglobin

Blood glucose parameter	Strength of association	Interpretation
Fasting blood glucose	Strong	Reflects baseline glycemic status
Postprandial blood glucose	Strongest	Closest association with long-term glycemia
Random blood glucose	Moderate	Greater variability

RESULTS

A total of 300 patients with type 2 diabetes mellitus were included in the present cross-sectional study. All participants underwent biochemical evaluation for fasting blood glucose, postprandial blood glucose, random blood glucose, and glycated hemoglobin levels. Complete datasets were available for statistical analysis. The demographic profile of the study population is summarized in Table 1. The majority of patients belonged to the middle-aged and older age groups, with a slightly higher proportion of female participants compared to males. Mean values of the assessed glycemic parameters are presented in Table 2. Elevated mean fasting, postprandial, and random blood glucose levels were observed, along with increased glycated hemoglobin values, reflecting suboptimal glycemic control in the study population.

Correlation analysis demonstrated a statistically significant positive association between glycated hemoglobin and all measured blood glucose parameters. As shown in Table 3, glycated hemoglobin showed a strong correlation with fasting blood glucose and an even stronger correlation with postprandial blood glucose. Random blood glucose also demonstrated a significant association, although the strength of correlation was comparatively lower.

The relative strength of association between glycated hemoglobin and different glycemic measures is summarized in Table 4, highlighting postprandial blood glucose as the parameter most closely associated with long-term glycemic exposure.

Overall, the findings indicate that glycated hemoglobin correlates significantly with fasting, postprandial, and random blood glucose levels, with the strongest relationship observed for postprandial blood glucose.

DISCUSSION

The present study evaluated the relationship between glycated hemoglobin and routinely measured plasma glucose parameters in individuals with type 2 diabetes mellitus and demonstrated a strong association between long-term glycemic exposure and both fasting and postprandial glucose levels. Among these parameters, postprandial plasma glucose exhibited the strongest correlation with glycated hemoglobin, suggesting that post-meal glycemic excursions play a particularly important role in determining overall glycemic burden in this population.[7,8,10]

The observed association between fasting plasma glucose and glycated hemoglobin highlights the contribution of basal glycemic regulation to long-term glucose exposure.[7,10] Fasting glucose levels primarily reflect hepatic glucose production and overnight metabolic control, both of which influence average blood glucose concentrations.[10] However, reliance on fasting values alone may provide an incomplete representation of glycemic status, especially in patients whose fasting levels appear acceptable but who experience significant glucose elevations following meals.

Postprandial plasma glucose demonstrated a slightly stronger relationship with glycated hemoglobin than fasting glucose in the present study.[7,8] This finding indicates that repeated elevations in glucose following food intake may cumulatively exert a greater impact on glycated hemoglobin levels. Postprandial hyperglycemia reflects impaired insulin-mediated glucose disposal during periods of increased metabolic demand[2,3], and persistent post-meal elevations may substantially contribute to long-term glycemic exposure even when fasting glucose is relatively controlled.

Random plasma glucose measurements were also significantly associated with glycated hemoglobin, although the strength of this association was comparatively weaker.[10,11] This reduced correlation is likely attributable to the inherent variability of random measurements, which are influenced by factors such as meal timing, physical activity, stress, and pharmacologic therapy. Consequently, random glucose values may be less reliable indicators of cumulative glycemic exposure when interpreted in isolation.

Taken together, these findings emphasize the importance of incorporating postprandial glucose assessment into routine evaluation of patients with type 2 diabetes mellitus. Patients who fail to achieve target glycated hemoglobin levels despite acceptable fasting glucose values may benefit from closer monitoring and targeted management of post-meal hyperglycemia.[6,15] Addressing postprandial glycemic excursions may therefore represent a key strategy for improving overall glycemic control.

The results of this study support the continued clinical utility of glycated hemoglobin as a stable and integrative marker of long-term glycemic status.[12,13,15] At the same time, they underscore the limitations of relying on single-point glucose measurements to capture the complexity of daily glycemic patterns. A comprehensive approach that includes fasting and postprandial glucose assessment alongside glycated hemoglobin measurement is likely to provide a more accurate representation of glycemic control.

Certain limitations of the study should be acknowledged. The cross-sectional design precludes assessment of temporal relationships, and glucose measurements were obtained at single time points rather than through continuous monitoring. Additionally, factors such as dietary composition, treatment regimens, and duration of diabetes were not evaluated in relation to glycemic parameters. Future studies incorporating longitudinal follow-up or continuous glucose monitoring may offer further insight into the dynamic contributions of fasting and postprandial glucose to long-term glycemic exposure.

CONCLUSION

This study demonstrates that glycated hemoglobin reflects cumulative glycemic exposure in individuals with type 2 diabetes mellitus and shows a significant association with fasting, postprandial, and random blood glucose levels. Among these parameters, postprandial blood glucose exhibited the strongest relationship, suggesting that post-meal glucose excursions contribute substantially to long-term glycemic burden. These findings support the continued use of glycated hemoglobin as a reliable indicator of glycemic control and highlight the importance of incorporating postprandial glucose assessment for a more comprehensive evaluation of glycemic status.

REFERENCES

1. DeFronzo RA, Ferrannini E, Groop L, Henry RR, Herman WH, Holst JJ, et al. Type 2 diabetes mellitus. Nat Rev Dis Primers. 2015;1:15019.

2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014;37(Suppl 1):S81–90.

3. Kahn SE, Cooper ME, Del Prato S. Pathophysiology and treatment of type 2 diabetes: perspectives on the past, present, and future. Lancet. 2014;383(9922):1068–83.

4. Fowler MJ. Microvascular and macrovascular complications of diabetes. Clin Diabetes. 2008;26(2):77–82.

5. Stratton IM, Adler AI, Neil HAW, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes. BMJ. 2000;321(7258):405–12.

6. Saudek CD, Brick JC. The clinical use of hemoglobin A1c. J Diabetes Sci Technol. 2009;3(4):629–34.

7. Monnier L, Lapinski H, Colette C. Contributions of fasting and postprandial plasma glucose increments to overall diurnal hyperglycemia in type 2 diabetic patients. Diabetes Care. 2003;26(3):881–5.

8. Monnier L, Colette C, Dunseath GJ, Owens DR. The loss of postprandial glycemic control precedes stepwise deterioration of fasting with worsening diabetes. Diabetes Care.2007;30(2):263–9.
9. Bonora E, Calcaterra F, Lombardi S, Bonfante N, Formentini G, Bonadonna RC, et al. Plasma glucose levels throughout the day and hemoglobin A1c interrelationships in type 2 diabetes. Diabetes Care. 2001;24(12):2023–9.
10. Avignon A, Radauceanu A, Monnier L. Nonfasting plasma glucose is a better marker of diabetic control than fasting plasma glucose. Diabetes Care. 1997;20(12):1822–6.
11. Nathan DM, Kuenen J, Borg R, Zheng H, Schoenfeld D, Heine RJ. Translating the hemoglobin A1c assay into estimated average glucose values. Diabetes Care. 2008;31(8):1473–8.
12. Sacks DB. Measurement of hemoglobin A1c: a new twist on the path to harmony. Diabetes Care. 2012;35(12):2674–80.
13. Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL, Powe NR, et al. Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med. 2004;141(6):421–31.
14. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. Lancet. 1998;352(9131):837–53.
15. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HAW. 10-year follow-up of intensive glucose control in type 2 diabetes. N Engl J Med. 2008;359(15):1577–89.
16. Riddle MC. Effects of intensive glucose lowering in the management of type 2 diabetes mellitus. Endocrinol Metab Clin North Am. 2010;39(3):641–54.

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