SERUM 1,5-ANHYDRO-D-GLUCITOL'S DIAGNOSTIC CAPABILITY FOR TYPE 2 DIABETES MELLITUS IN NIGERIAN PATIENTS IN COMPARISON TO GLYCATED HAEMOGLOBIN A1C

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ABSTRACT

Background: **The diagnostic capability of 1,5-anhydro-D-glucitol (1,5-AG), a short-term glycaemic biomarker, for type 2 diabetes mellitus (T2DM), compared with glycated haemoglobin A1c (HbA1c), has yet to be documented among Nigerians.**

Aim: **Hence, the current study evaluated serum 1,5-AG's diagnostic capability for T2DM in Nigerian patients in comparison to HbA1c**

Methods: **This cross-sectional study was conducted at the Rivers State University Teaching Hospital and included 150 individuals with T2DM, recruited via simple random sampling. Laboratory parameters, including fasting plasma glucose, HbA1c, and serum 1,5-AG concentrations, were measured using standard methods. Descriptive statistics, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratios (PLR), negative likelihood ratios (NLR), diagnostic accuracy (DA), and receiver-operating characteristic (ROC) analysis, were used as statistical tools, at 95% confidence intervals and an alpha value of <0.05.**

Results: **HbA1c had an area under the curve (AUC) of 0.987 (95% CI: 0.975-0.999; $p<0.001$) with the best cut-off value of 6.40% with 88.4% sensitivity, 95.6% specificity, 98.4% PPV, 96.5% NPV, 89.7% DA, 89.7%, PLR of 20.1, and NLR of 0.12 for detecting T2DM. However, serum 1,5-AG also showed strong ROC performance with an AUC of 0.979 (95% CI: 0.966-0.993; $p<0.001$) at 61.8 µmol/L best cut-off value with 70.4% sensitivity, 93.8% specificity, 97.6% PPV, 95.4% NPV, 79.8% DA, PLR of 11.1, and NLR of 0.32 for detecting T2DM.**

Conclusion: **The diagnostic capability of 1,5-AG for T2DM diagnosis approximated that of HbA1c. Hence, 1,5-AG could complement HbA1c as a diagnostic tool in T2DM. However, further studies are recommended.**

Keywords: Type 2 diabetes mellitus, 1,5-Anhydro-D-Glucitol, 1,5-AG, FPG, HbA1c

INTRODUCTION

The global burden of type 2 diabetes mellitus (T2DM) demands timely diagnosis to prevent debilitating microvascular and macrovascular complications.[1] In resource-limited settings like Nigeria, identifying accurate markers is critical.[2] Standard diagnostic tests often fail to capture acute glycemic fluctuations, highlighting the need for sensitive markers capable of tracking short-term glycemic changes.[2-5] Effective clinical management relies on identifying these rapid shifts to allow for immediate therapeutic adjustments before irreversible tissue damage occurs.[3-5]

Currently, several T2DM diagnostic thresholds and monitoring techniques are utilized in clinical practice, each presenting distinct advantages and limitations.[6,7] The fasting plasma glucose test is inexpensive and widely available, yet it only reflects a single point in time and is highly susceptible to pre-analytical errors and patient non-compliance with fasting.[2] The random plasma glucose test is also inexpensive but highly unstable, prone to a high rate of false negatives, and lacks precision. The two-hour oral glucose tolerance test remains the diagnostic gold standard for T2DM; however, it is time-consuming, highly inconvenient for

patients, and poorly reproducible.[2,6,7] Glycated hemoglobin A1c (HbA1c) serves as the primary tool for long-term monitoring, offering a stable three-month glycemic average without requiring a fasting state.[2,6-9] Despite these strengths, HbA1c is costly, fails to reflect acute glucose excursions, and yields inaccurate results in patients with hemoglobinopathies, hemolytic anemias, or malaria—conditions highly prevalent in the Nigerian local population.[2,6-9]

To address these diagnostic gaps, 1,5-Anhydro-D-Glucitol (1,5-AG) has emerged as a promising biomarker.[2-5] Structurally resembling glucose, 1,5-AG is a naturally occurring monosaccharide derived primarily from dietary intake and is not metabolized within human tissues.[3-5] It maintains a constant steady-state concentration in the body, possesses a short half-life of approximately 1 to 2 weeks, and does not adhere to specific tissues, remaining freely filterable by the renal glomeruli.[3,4] Under normal physiological conditions, 1,5-AG is completely reabsorbed by the renal tubules.[2-5] However, when blood glucose levels exceed the renal threshold (approximately 10 mmol/L), excess glucose competitively inhibits 1,5-AG reabsorption, leading to massive urinary excretion of 1,5-AG and a rapid drop in serum levels.[3,4] Notably, serum 1,5-AG levels remain largely unaltered by hemoglobin variants or red blood cell lifespan, though they can be skewed by advanced renal failure, pregnancy, or severe liver cirrhosis.[3-5]

At present, no unified standard for 1,5-AG reference value has been issued by international authoritative organizations, including the World Health Organization; however, serum 1,5-AG reference value of 61.3-141.6 μmol/L has been categorized as either high-risk (<61.3 μmol/L) or low-risk (≥61.3 μmol/L) based on the likelihood of T2DM diagnosis and complications among Asian adults.[5,10,11] In developed nations, 1,5-AG is widely utilized as a complementary clinical tool to track postprandial glucose spikes and assess short-term treatment efficacy. Presently, clinicians in the United States and Japan regularly employ 1,5-AG assays to fine-tune insulin regimens and monitor rapid glycemic shifts in poorly controlled diabetic patients.[3-5] Conversely, there is a sparse availability and utilization of this biomarker in sub-Saharan Africa, particularly in Nigeria, where clinical reliance remains heavily tethered to conventional, and often flawed, testing modalities.[4]

Consequently, there is a profound justification for exploring alternative, intermediate-term biomarkers tailored to the local patient climate. Hence, there is a need to validate a reliable glycemic marker that circumvents the diagnostic interference caused by endemic hematological conditions in Nigeria.

Therefore, the primary objective of this study is to evaluate the diagnostic capability of serum 1,5-AG for T2DM in Nigerian patients, directly comparing its clinical utility, sensitivity, and specificity against the established standard of HbA1c.

MATERIALS & METHODS

Description of study area and site

This was a sub-study of a research project titled "Evaluation of the clinical value of 1,5-Anhydro-D-glucitol among newly diagnosed type 2 diabetes patients in Rivers State, Southern Nigeria. The study was conducted at the Endocrine and Metabolic Units of the Departments of Internal Medicine and Chemical Pathology, respectively, of the Rivers State University Teaching Hospital (RSUTH), Port Harcourt, Nigeria.

Study design & duration

This was a cross-sectional study designed to achieve its primary objective and conducted over 6-8 months (February to October, 2025).

Ethical approval/considerations

Before commencement, the study received ethical approval from the Health Research Ethics Committee of RSUTH (REC No: RSUTH/REC/2025/728) following a review of the study protocols. Informed and written consent were obtained from the participants; those who declined were excluded from the study. All protocols were adhered to by the Health Research Ethics Standards (autonomy, data confidentiality, beneficence/non-maleficence to participants, justice, and voluntariness), Good Clinical Practice, and in keeping with the tenets of the World Medical Association's Declaration of Helsinki of 1975, as revised in 2008.

Study population

The study population are the clinically, laboratory-defined, and eligible Nigerian T2DM patients diagnosed in RSUTH healthcare centre during the study period.

Eligibility status

Inclusion criteria: Inclusion criteria included adults ≥18 years, newly diagnosed, incident, and treatment-naïve T2DM patients diagnosed by the endocrinologists and/or chemical pathologists in RSUTH.

Exclusion criteria: Exclusion criteria were age under <18, pregnancy, any other diabetes variant including type 1 diabetes mellitus, other endocrinopathies, recent/current sodium-glucose cotransporter 2 inhibitor (SGLT2i) medications, previous gastrointestinal/renal surgeries, previous renal transplant donor/recipient, pre-existing/concurrent

chronic diseases including malignancy, sickle cell anaemia or other hemoglobinopathies, renal, liver, or heart conditions, and current (within 6 months) use of any form of steroid medications.

Sample size calculation

The sample size was determined using the Cochrane formula for sample size calculation for studying proportions in a population of greater than 10,000, using a 9.8% T2DM disease prevalence rate within the studied region, and a minimum sample size of 150 was obtained, with a 10% non-response rate included.[12,13]

Sampling technique

A simple random sampling technique, as described previously,[14] was employed in this study, such that all eligible study participants were recruited from the two units every week throughout the 6 to 8-month period to obtain a sampling frame of 224 T2DM cases. Each of these T2DM cases was assigned an individual number. Then, a table of random numbers was used to select at least 150 T2DM cases.

Data collections

Four junior residents and two senior residents from the Department of Internal Medicine and the Department of Chemical Pathology at RSUTH were recruited and trained to serve as research assistants during the entire study duration.

Socio-demographic data: Upon presentation as a new patient attendee at the Endocrine and Metabolic Units of the Departments of Internal Medicine and Chemical Pathology, those suspected of diabetes (DM) by the various consultants in these departments were identified and approached by these research assistants to grant consent to participate in the study. All consented participants who satisfied the eligibility criteria were recruited from these clinics. Following consent acquisition, the basic information questionnaire was administered to evaluate eligibility criteria and to obtain baseline socio-demographic, anthropometric, and other clinical data. Thereafter, all the eligible and fully consented participants were prepared to present for the acquisition of clinical data and specimen collection.

Clinical data: Arterial blood pressure (systolic/diastolic), weight, height, and calculated body mass index (BMI), were obtained using standard protocols. Systolic and diastolic blood pressure were measured using an oscillometric device (Omron Model HBP-1300, IL, USA) after a five-minute rest period while seated. The device has been validated and surpasses the basic standards set forth by the relevant international validation authorities.[15] Arterial blood pressure was measured 3 times, five minutes apart, and the average of the three measurements was recorded.

Laboratory data: 10 millilitres (10 mL) each of fasting venous whole blood and 5 mL of urine specimens were collected once per participant. Another 2 mL was emptied into fluoride oxalate tubes to obtain plasma for FPG analysis. Two (2) mL were emptied into an EDTA tube for HbA1c analysis, while the last 3 mL were put into a plain tube to obtain serum for 1,5-AG. After specimen acquisition, heparinized and fluoride-oxalate tube specimens were centrifuged immediately at 2500g for 10 minutes to obtain the supernatant plasma. The plain tubes of whole blood were allowed to clot undisturbed at room temperature for at least one hour. When fully retracted, the supernatant was separated into plain tubes and stored frozen at -80 ^{0}C until analysis.

HbA1c was determined in EDTA whole blood on an Ion-exchange HPLC system (D10 HPLC system, Bio-Rad, USA) based on the principle of ion-exchange chromatography. The HbA1c method is National Glycohemoglobin Standardization Program (NGSP) certified, standardized to the Diabetes Control and Complication Trial (DCCT) as recommended by the American Diabetes Association (ADA), and traceable to the International Federation of Clinical Chemistry (IFCC) quality assurance guidelines/certifications.[16] Serum was analysed for 1,5-AG using the ELISA assay methods with standard reagent kits (SunLong Biotech Company LTD, Zhejiang, China).

Quality assurance

All the analyses were done in duplicate, and the average was recorded for analysis. Three levels of in-house prepared quality control specimens with low, middle, and high concentrations were used to ascertain the intra-assay coefficient of variation (CV) and inter-assay CV, with <5% and <8% recorded, respectively. All laboratory analyses were carried out in the Department of Chemical Pathology of RSUTH.

Data categorizations & operational definitions

T2DM diagnosis: T2DM was defined on the recommendations of the World Health Organization (WHO) and the American Diabetes Association (ADA) as those having any of the f1ollowing laboratory/clinical characteristics:[17,18]

- Fasting venous plasma glucose (FPG) level e"7.0 mmol/L once in the presence of classic symptoms (frequency of micturition, polydipsia, polyphagia, weight loss, etc) of T2DM or twice in the absence of symptoms or

- Random venous plasma glucose (RPG) level of e"11.1 mmol/L in the presence of the classic symptoms of T2DM or
- HbA1c level e"6.5% with/without the classic symptoms of T2DM or
- 2-hour timeline oral glucose tolerance test (conducted for those with impaired FPG/HbA1c test values) value e"11.1 mmol/L with/without the classic symptoms of T2DM

1,5-AG categories: Plasma 1,5-AG (reference value: 61.3-141.6 μmol/L) was categorized as high-risk (<61.3 μmol/L) or low-risk (e"61.3 μmol/L) for T2DM complications, as previously documented.[10,11]

Statistical analysis plan

The Statistical Product and Service Solutions (SPSS) for Windows version 25.0 (IBM, Chicago, IL, USA) was used for statistical analysis. Tables and graphs were used to depict data. Continuous (non-categorical) data were initially evaluated for distribution patterns using the Shapiro-Wilk test before analysis, and those found to have violated normal distribution were log-transformed before analysis. The normally distributed data were expressed as mean ± two standard deviations. Categorical data presented as proportions with numbers/percentages. The receiver operating characteristic (ROC) curve was generated to identify and compare the cutoff points at which 1,5-AG and HbA1c maximize sensitivity and specificity for predicting T2DM. The optimal cut-off value was identified by Youden's J statistic (where the sum of the sensitivity and specificity reaches its maximum. Other diagnostic metrics, including positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratios (PLR), and negative likelihood ratios (NLR), and diagnostic accuracy, were determined for both biomarkers.

All analyses were conducted at a 95% confidence interval, and a p-value of <0.05 was considered statistically significant.

RESULTS

Table 1 depicts the demographic and clinical characteristics of the entire studied population (n=150). As shown in Table 1, the study population consisted of an equal population of males (n=75; 50%) and females (n=75;50%). The mean age of the overall study participants was 55.61 (SD: 4.13), with most study participants of middle-aged (Table 1). Most of the study population were hypertensive (n=70; 47.7%) and were mostly overweight (n=60; 40%) and obese (n=70; 46.7%) at the time of recruitment (Table 1). Most

Table 1: Distribution of demographic and clinical features of study population

Variables	Mean (SD)/ Range	Variable Categories	n (%)
Age, years	55.61 (4.13)/ 43-67	48-67 (males) 43-60 (females)	
Age categories, years, n (%)		≤44	2 (1.3)
		45-64	144 (96.0)
		≥65	4 (2.7)
Gender, n (%)		Males	75 (50.0)
		Females	75 (50.0)
SBP, mmHg	137.07 (8.60)/ 110-150		
DBP, mmHg	85.13 (8.35)/ 70-100		
ABP categories, n (%)		Normotensive	18 (12.0)
		Pre-hypertensive	62 (41.3)
		Hypertensive	70 (46.7)
BMI, kg/m²	29.07 (3.12)/ 24.36-38.20		
BMI categories, n (%)		Normal weight	20 (13.3)
		Overweight	60 (40.0)
		Obesity	70 (46.7)
T2DM risk factors, n (%)			
DM family history**		Positive	86 (57.3)
		Negative	64 (42.7)

*****First degree relatives (father, mother, brother, sister, uncle, cousin, etc); SD: Standard deviation, SBP: systolic blood pressure, DBP: diastolic blood pressure; ABP: Arterial blood pressure; BMI: body mass index; T2DM: type 2 diabetes mellitus; DM: diabetes mellitus*

Table 2: Potentials of serum 1,5-AG and HbA1c to detect T2DM using ROC analysis among

				Diagnostic Metrics							
Parameters	AUC	95% CI	p-value	Cut-off Value**	Sn. (%)	Sp. (%)	PPV (%)	NPV (%)	PLR	NLR	Acc. (%)
HbA1c, %	0.987	0.975-0.998	<0.001*	6.40	88.40	95.60	98.4	96.5	20.10	0.12	89.70
Serum 1,5-AG, µmol/L	0.979	0.966-0.993	<0.001*	61.80	70.40	93.80	97.6	95.4	11.10	0.32	79.80

**Statistically significant; **Youden J Index-determined; AUC: area under the curve; CI: confidence interval; 1,5-AG: 1,5-anhydro-D-glucitol; HbA1c: glycated haemoglobin A1c; Sn: sensitivity; Sp.: specificity; PPV: positive predictive value; NPV: negative predictive value; PLR: positive likelihood ratio; NLR: negative likelihood ratio; Acc: Accuracy*

T2DM patients (n=86; 57.3%) also affirmed having a positive family history of diabetes mellitus (Table 1). Table 2 depicts the potential of HbA1c and serum 1,5-AG to detect T2DM using the receiver-operating characteristic curve (ROC) analysis among the T2DM patients.

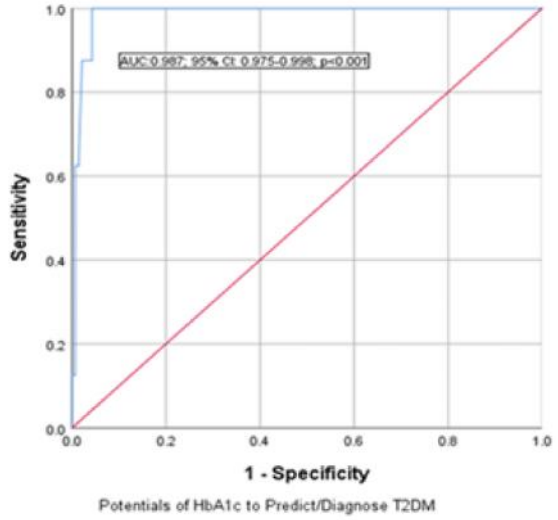


Figure 1: ROC potentials of HbA1c to predict/ diagnose T2DM

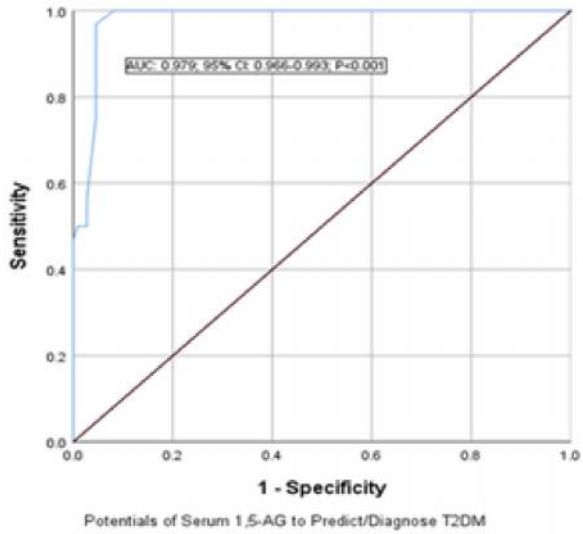


Figure 2: ROC potentials of serum 1,5-AG to predict /diagnose T2DM

As shown in Table, HbA1c had an area under the curve (AUC) of the receiver-operating characteristics curve (ROC) (FIG. 1 below) of 0.987 (95% CI: 0.975-0.999; p<0.001) with the best cut-off value of 6.40% determined using the Youden index at 88.4% sensitivity, 95.6% specificity, 98.4% PPV, 96.5% NPV, PLR of 20.1, NLR of 0.12, and 89.7% accuracy of detecting T2DM (Table 2). However, serum 1,5-AG had AUC (FIG. 2 below) of ROC of 0.979 (95% CI: 0.966-0.993; p<0.001) with the best cut-off value of 61.8 µmol/L determined using the Youden index at 70.4% sensitivity, 93.8% specificity, 97.6% PPV, 95.4% NPV, PLR of 11.1, NLR of 0.32, and 79.8% accuracy of detecting T2DM (Table 2).

DISCUSSION

Significant findings vis-à-vis the specific objectives

The current study determined the diagnostic potential of 1,5-AG for T2DM in comparison with the well-established diagnostic (HbA1c) among Nigerian patients with the disease, which highlighted significant research findings. In the current study, HbA1c had an AUC of 0.987 (95% CI: 0.975-0.999; p<0.001) with the best cut-off value of 6.40% with 88.4% sensitivity, 95.6% specificity, 98.4% PPV, 96.5% NPV, 89.7% DA, 89.7%, PLR of 20.1, and NLR of 0.12 for detecting T2DM diagnosis. However, serum 1,5-AG also showed strong ROC performance metrics, which approximates that of HbA1c performance metric, with an AUC of 0.979 (95% CI: 0.966-0.993; p<0.001) at 61.8 µmol/L best cut-off value with 70.4% sensitivity, 93.8% specificity, 97.6% PPV, 95.4% NPV, 79.8% DA, PLR of 11.1, and NLR of 0.32 for also detecting T2DM diagnosis.

Relationship of key findings with the literature

In the current study, both 1,5-AG and HbA1c displayed strong performance features for diagnosing T2DM. However, that of HbA1c (AUC of ROC: 0.987; 95% CI: 0.975-0.999; p<0.001) had insignificant superiority over serum 1,5-AG (AUC of ROC: 0.979; 95% CI: 0.966-0.993; p<0.001) at a cut-off point of 6.4%. The current findings align with the literature and underscore

the relevance of 1,5-AG in T2DM evaluation and management.[19,20] Gobor and colleagues demonstrated that the ROC curve analysis for 1,5-AG showed a sensitivity of 65.3% and a specificity of 91.1% to detect T2DM at a cut-off point of 92 ìmol/L among their study population of Brazilian T2DM patients without overt nephropathy. The results were similar to the groups' discrimination by glycemia (sensibility/specificity, 62.2%; 89.0%) at a cut-off point of 6.3 mmol/L. However, HbA1c was found to be the best discriminator (sensitivity/specificity, 87.4%; 94.2%) at a cut-off point of 5.8% (40 mmol/mol).[19] In contrast, some other studies have shown serum 1,5-AG to have superior potential in diagnosing T2DM over HbA1c.[18] Wang and colleagues observed that the optimal cutoff value of 1,5-AG for the diagnosis of T2DM was 71.18 μg/mL, with a sensitivity of 92.6%, higher than HbA1c (82.3%) and an area under the curve of 0.920, higher than the 0.887 obtained for HbA1c, which means 1,5-AG had a higher predictive value compared to HbA1c, as reported.[20] In addition, Mukai and colleagues found 1,5-AG and HbA1c to have similar thresholds for diagnosing T2DM based on the prevalence of retinopathy in community-dwelling Japanese subjects.[21] These findings indicate the potential of 1,5-AG to be a T2DM diagnostic biomarker that could complement other glycaemic biomarkers, such as HbA1c. Serum 1,5-AG concentration could offer complementary information, reflecting more recent glycaemic control due to its short-term responsiveness, while HbA1c reflects long-term glucose averages, as previously documented.[19] Studies have shown that 1,5-AG has the potential to diagnose T2DM because it is a short-term biomarker of glycaemic status that is sensitive to hyperglycaemia.[19,20]

Mechanistic consideration/biologic plausibility

HbA1c measures the glycation of haemoglobin in red blood cells, which have a lifespan of approximately three months. This makes it an excellent indicator of average glycaemic control over the preceding 2-3 months. In contrast, 1,5-AG reflects short-term glucose excursions and a naturally occurring polyol whose concentration remains stable in the body unless blood glucose levels exceed the renal threshold.[3-5] At that point, glucose competitively inhibits the reabsorption of 1,5-AG in the renal tubules, leading to its rapid excretion in the urine and a sharp decline in serum levels. Hence, 1,5-AG levels are sensitive to short-term blood glucose fluctuations and specifically reflect postprandial hyperglycaemia, an early sign of T2DM that can be missed by fasting plasma glucose tests and is also not well-captured by the long-term average provided by the HbA1c test alone.[3-5] HbA1c is a useful diabetes marker, but its limitations as a sole diagnostic criterion for T2DM include variability across age, ethnicity, and conditions like anaemia/kidney disease, potentially missing early cases (low sensitivity) compared to oral glucose tests, lack of universal standardization in some regions, and it doesn't reflect glucose spikes (glucose variability).[2-5,9] Factors like iron deficiency, pregnancy, or certain medications (e.g., dapsone, vitamin C) can also falsely elevate or lower readings, making it unreliable in some patients.[3-5]

Relevance of findings to clinical practice & future research

Serum 1,5-AG demonstrated a diagnostic capability for T2DM that closely approximated HbA1c, offering a reliable alternative biomarker. This finding is clinically significant for managing T2DM in regions with high hemoglobinopathy prevalence, providing a stable, short-term glycaemic marker for rapid therapeutic adjustments. To enhance clinical translation, the findings must be adapted to the infrastructure of resource-limited Nigerian settings while establishing clear pathways for future research. In low-resource clinics, 1,5-AG testing offers a pragmatic advantage due to its rapid turnaround time and minimal technical overhead compared to HbA1c. To implement this practically, point-of-care 1,5-AG testing kits should be integrated into primary healthcare centers. This requires developing localized, cost-effective diagnostic algorithms and training community health workers to utilize 1,5-AG specifically for identifying acute glycemic excursions. Future research directions must transition from this cross-sectional baseline to robust longitudinal studies. Tracking patient cohorts over extended periods will validate the prognostic value of 1,5-AG in predicting long-term diabetic complications. Furthermore, longitudinal data will help establish reliable, population-specific reference intervals that account for regional dietary habits and endemic comorbidities like hemoglobinopathies, which often distort HbA1c accuracy. Ultimately, combining immediate point-of-care implementation strategies with long-term cohort tracking will transform 1,5-AG from a validated biomarker into a cornerstone of sustainable, decentralized diabetes management.

Strengths & limitations

The strength of the current study lies in the fact that it is the first study to document the comparative potentials of 1,5-AG versus HbA1c to diagnose T2DM within the study region. Hence, it provided a source of primary data on which further studies will depend. However, the study was limited by some factors that may be areas of improvement in future research.

It was a hospital-based study, and hence, its findings may not be generalized to other populations and may

not be representative of other situations, limiting the broader applicability of the current findings. However, because the study centre is a tertiary referral hospital, our study population likely carries a higher burden of T2DM than the general public. Therefore, the established diagnostic 1,5-AG potential may be directly applicable to other specialty clinics across Nigeria, but requires cautious interpretation if applied to asymptomatic, community-level screenings. The study was also limited by a lack of a healthy, non-diabetic control population. Without a comparative baseline of healthy Nigerian subjects, we cannot definitively establish the optimal diagnostic cut-off values of serum 1,5-AG or calculate its relative specificity versus HbA1c. Therefore, while this study successfully profiles the capability of 1,5-AG in patients with existing T2DM, longitudinal, controlled multi-centre studies are required to validate these findings for general population screening

CONCLUSION

Serum 1,5-AG demonstrated diagnostic accuracy for T2DM comparable to HbA1c in ROC curve analysis. While HbA1c provides long-term glycaemic control data, 1,5-AG offers complementary insights into short-term glucose fluctuations and postprandial hyperglycaemia. It could serve as a valuable alternative when HbA1c is inaccurate, such as in cases of abnormal red blood cell turnover. Incorporating 1,5-AG into clinical practice can improve T2DM screening. However, further research is needed to standardize its reference ranges and assess its cost-effectiveness for routine clinical use among Nigerians.

ADDENDUM

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Data availability statement: The authors declare that all data supporting the findings of this study are available, and raw data can be obtained from the corresponding author (CA) upon request.

Authors' contributions: CA, LEE, CAA, ABE, and ESE conceived and designed the study; CA, ABE, and ESE acquired the data; LEE, CAA, ABE, and ESE supervised the data acquisition; CA, ABE, and ESE conducted the data analysis. CA, LEE, CAA, ABE, and ESE interpreted the data. CA, ABE, and ESE drafted the manuscript; CA, LEE, and CAA critically revised the manuscript for important intellectual content; and all the authors finally reviewed the draft of the manuscript, read, and approved the final version of it for publication.

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