



# Evaluation of Poor Glycemic Control Among Diabetic Patients in Lafia Metropolis Using Glycated Haemoglobin (HbA1c) Levels

<sup>1</sup>Tanimu H., <sup>2</sup>Ugwueze A. C., and <sup>2</sup>Itakure A. U

<sup>1</sup>Science Laboratory Technology Department, School of Science and Technology, Isa Mustapha Agwai I Polytechnic, P.M.B 109, Lafia, Nasarawa State, Nigeria

<sup>2</sup>Department of Medical Laboratory Science Faculty of Health Science, Federal University of Lafia,

<sup>1</sup>Science Laboratory Technology Department

<sup>1</sup>Science Laboratory Technology Department, School of Science and Technology, Isa Mustapha Agwai I Polytechnic, P.M.B 109, Lafia, Nasarawa State, Nigeria

## Abstract

Glycated haemoglobin (HbA1c) is a reliable and widely used biomarker for assessing long-term glycemic control in diabetic patients. Glycated Haemoglobin (HbA1c) provides a reliable long-term index of glycemic control and is critical in monitoring diabetic patients. This study assessed the prevalence of poor glycemic control using glycated Haemoglobin (HbA1c) levels among diabetic patients in Lafia Metropolis, Nasarawa State, Nigeria. A cross-sectional study involving 127 participants (85 diabetic and 42 non-diabetic controls) was conducted across multiple healthcare centers in Lafia. Blood samples were analyzed using a fluorescence immunoassay to determine HbA1c levels. Statistical analysis was conducted using one-way ANOVA with Tukey's post hoc test. Diabetic participants had significantly higher HbA1c levels ( $p < 0.001$ ) compared to non-diabetic controls, indicating poor glycemic control. Both male and female diabetic subgroups showed elevated HbA1c levels compared to their non-diabetic counterparts. No significant difference was observed in HbA1c levels between non-diabetic males and females. The study revealed a concerning prevalence of poor glycemic control among diabetic individuals in Lafia Metropolis. These findings underscore the need for enhanced diabetes management strategies, awareness campaigns, and improved healthcare access.

Keywords: - Glycated haemoglobin, Diabetes mellitus, Glycemic control, Biomarker, Prevalence

## INTRODUCTION

Diabetes is one of the most frequently occurring chronic metabolic diseases globally and is considered a major public health challenge (Dubale et al., 2023). The ninth edition of the International Diabetes Federation reported a prevalence of 9% (463 million adults) in 2019, indicating that the global prevalence of diabetes had reached pandemic levels. It is expected that by 2030, prevalence of diabetes will reach 10.2% (578 million) and by 2045, 10.9% (700 million). Urban areas (10.8%) and high-income countries (10.4%) have greater prevalence rates than rural areas (7.2%) and low-income countries (4.0%) respectively. One in two (50.1%) people with diabetes is unaware that they have the disease. Impairment in glucose tolerance is predicted to affect 7.5% (374 million) people worldwide in 2019, 8.0% (454 million) people by 2030 and 8.6% (548 million) people by 2045 (Sun *et al.*, 2022 and Saeedi et al., 2019). Nigeria, in particular, is witnessing a rapid rise in the prevalence of diabetes. In 1963, a study reported the disease prevalence as  $< 1\%$ , a figure that has now escalated to 5.5% in 2018 (Amaeshi et al 2024).

One of the common indicators used to assess glycemic control in diabetes patients is glycated Haemoglobin (HbA1C) which was functional since 1976 but incorporated in the standard practice of medicine in 1984. Glycated Haemoglobin Level (HbA1c) testing is part of the routine care for patients with Diabetes Mellitus (DM) diagnosed for  $> 2$  months and currently on oral or injectable hypoglycemic agents. The American Diabetes Association recommends achieving HbA1C  $< 7\%$  (53mmol/mol) (Mekonnen Abebe *et al.*, 2015).

Different assay techniques have been employed for the estimation of glycated Haemoglobin, including ion exchange, high performance liquid chromatography (HPLC), electrophoresis, affinity chromatography, immunoturbidimetric assay and colorimetric assays, which measure different glycated products and report using different units. Unlike conventional blood glucose tests that capture

a single-time reading, HbA1c provides an average measure of blood glucose levels over time, making it a valuable tool for assessing long-term glycemic control and predicting diabetes-related complications (ADA, 2022). Other advantages of HbA1c over fasting Blood Glucose (FPG) for diagnosis and monitoring of DM, including lack of effect by diet, exercise, infection, and medications, and more convenience as it does not require overnight fasting.

One recent study, conducted in South Ethiopia among 338 diabetic patients, revealed that the prevalence of poor glycemic control was 63.1% (Mekonnen Abebe *et al.*, 2015). Another study on factors associated with glycemic control among South African adult residents of Mkhondo municipality living with diabetes mellitus revealed that almost six out of ten diabetes mellitus patients had uncontrolled glycated Haemoglobin (HbA1c), showing poor glycemic control (Masilela *et al.*, 2020). Uncontrolled HbA1c was notably higher among the unemployed, overweight or obese, and history of diabetic complications patients, while it was not associated with other personal, lifestyle-related, and diabetes management factors. Studies have indicated that maintaining HbA1c level below seven percent can decrease microvascular complications in diabetic patients (Bijelic *et al.*, 2021; Kim *et al.*, 2021).

Despite the advancement of therapeutic options, most diabetic patients are poorly controlled and discordance in treatment goals is exacerbated by the lack of access to essential medicines and discontinuation of prescribed medication, unavailability and high costs of necessary blood tests and poor referrals (Dubale *et al.*, 2023).

This study has evaluated the prevalence of poor glycemic control using HbA1c levels among diabetic patients in Lafia Metropolis.

## MATERIALS AND METHODS

### Study design

This is a cross-sectional study design involving a representative sample of diabetic patients attending healthcare facilities in Lafia metropolis.

### Study Area

The study area includes Dalhatu Araf Specialist Hospital, Lafia, Comprehensive health care Center Kwandare, and selected Primary health Care (PHC) centers around Lafia metropolis.

### Study population

A total of one hundred and twenty-seven (127) participant were recruited for the study. Eighty-five (85) were diabetic while forty-two (42) were non diabetic control. A structured questionnaire was administered to participants to collect relevant data for this research, ensuring comprehensive and systematic gathering of information

### Sample size Calculation

The sample size was determined using the formula (Ajayi *et al.*, 2023)

$$N = \frac{Z^2 pq}{d^2}$$

Where: - N= Calculated sample size

Z= Level of confidence according to the standard normal distribution (for a level of confidence of 95%, Z = 1.96)

P= Prevalence of diabetes mellitus 5.5% (Amaeshi *et al* 2024)

Q=1-p

D=tolerated margin of error (5%)

$$N = \frac{1.96^2 \times 0.055 \times (1-0.055)}{(0.05)^2}$$

N=80

Actual sample size = Calculated sample size + 10% attrition rate

10% attrition rate is =8

Actual sample size =80 + 8 = 88

### Ethical Approval

Ethical clearance for this study was obtained from the National Health Research Ethics Committee (NHREC) in the Nasarawa State Ministry of Health, Lafia (NHREC Protocol No: 18/06/2017)

### Sample collection

The test was performed with whole blood sample collected into EDTA container through venipuncture aseptically. The sample was tested immediately after collection while others which were not tested immediately were stored at 2<sup>o</sup>C-8<sup>o</sup>C ensuring maximum of two days storage to avoid deterioration of the sample.

### Method of glycated haemoglobin estimation

Anbio fluorescence immunoassay analyzer was used, which is based on the principle of detection of fluorescence emitted during an immunoassay with antigen -antibody interaction. The device is capable of examination of human samples with specific *in-vitro* diagnostic test units including inflammation markers, tumor markers, diabetes, endocrinology etc.

### Sample Processing/Analysis

- i. The integrated circuit card information to the equipment was checked and swiped
- ii. 10µL of whole blood sample was transferred using a pipette into the buffer tube
- iii. It was mixed for 1 minute inverting the tube gently
- iv. 50µL of mixed sample was loaded into the sample well of the test cartridge
- v. The test cartridge was inserted into the test cartridge holder and the timer was timed,
- vi. 5 minutes later, the result was shown in the display.

### Statistical Analysis

Statistical analysis was performed using GraphPad Prism, and differences in mean values among groups were evaluated using a one-way ANOVA followed by Tukey's post hoc test. Results were expressed as mean ± standard error of mean (SEM), with a significance level set at  $p < 0.05$ .

## RESULTS

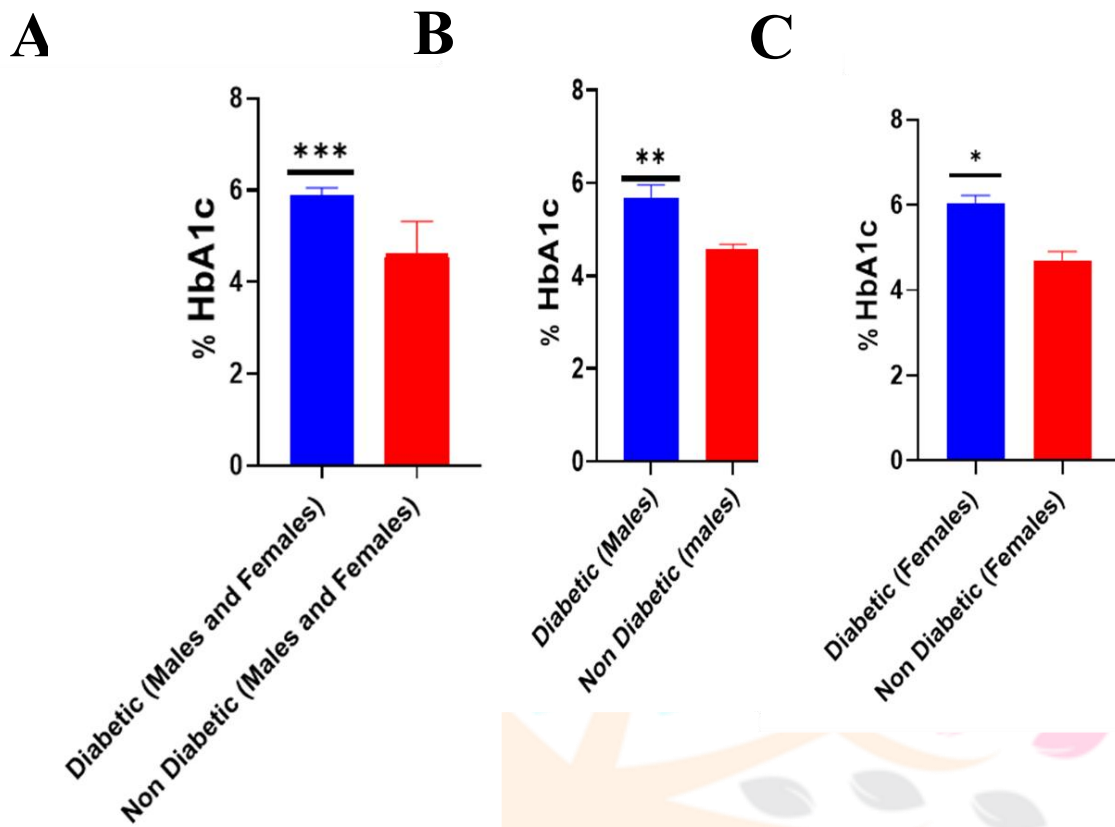
*Total of one hundred and twenty-seven (127) participants were recruited for the study and eighty-five (85) were diabetic while forty-two (42) were non diabetic (control), Results are presented in tables and charts as follows;*

**Table 1. Sociodemographic variables of the participants**

	Frequency	Percent (%)
Gender		
Male	62	48.8
Female	65	51.2
Status		
Non-Diabetic	42	33.1
Diabetic	85	66.9
Age group		
Under 18	0	0.0
18-30	3	2.4
31-45	61	48.0
46-60	50	39.4
Above 60	13	10.2
Total	127	100.0

Results are presented as mean± SEM, p value < 0.05 is considered significant.

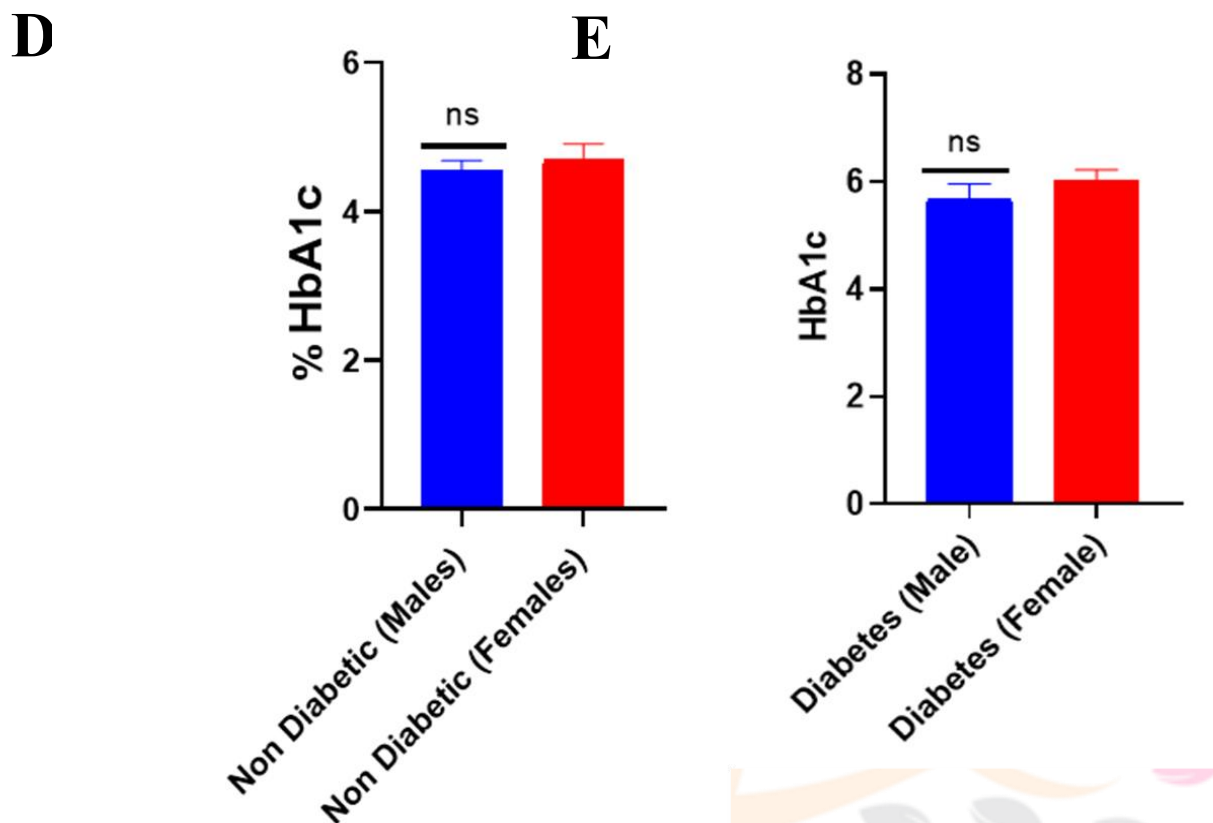
**Fig 1. Percentage Glycated Haemoglobin levels in Male and Female Patients**



**Legend:** -A. show the comparison of Glycated Haemoglobin levels of all the males and females patients used for this research. B. Showing Glycated haemoglobin levels of diabetic males compared to non diabetic males. C. Showing glycated haemoglobin levels of diabetic females compared to non-diabetic females. Results are presented as mean  $\pm$  SEM, p value < 0.05 is considered significant.



Fig 2. Comparison between Glycated Haemoglobin levels in Male and Female



**Legend:** - D. show the comparison of Glycated Haemoglobin levels of all the non-diabetic males compared to the non-diabetic females. E. Showing Glycated haemoglobin levels of diabetic males compared to diabetic females. Results are presented as mean  $\pm$  SEM, p value < 0.05 is considered significant.

## DISCUSSION

This study was designed to analyze and compare glycated haemoglobin levels in diabetic patients attending Dalhatu Araf Specialist Hospital, Lafia, Comprehensive Health care Center Kwandare, and selected Primary Health Care (PHC) centers around Lafia metropolis of Nasarawa State, Nigeria.

Understanding the prevalence of the problem enables the establishment of standards that allow for an analysis of the community's response. Preventive measures and educational programs ought to be directed toward risk groups to achieve the greatest result. This investigation aims to determine the magnitude of poor glycemic control using HbA1c in Lafia metropolis of Nigeria's Nasarawa state (Lomboro Dimore et al., 2023).

A total 127 participants were recruited for this study. This comprises of 62 males which accounts for 48.8% of the total population and 65 females, accounting for 51.2% of the participants in this study. For this comparative study, the diabetic patients were 85(66.9%), while the non-diabetic patients recruited for this study were 42(33.1%).

Table 1. Present Sociodemographic variables of the participants. Participants between the age of 18-30 accounts for 2.4% of the total participants, those between 31-45 years were 48.0%, while those between the age of 46-60 years and those above 60 years account for 39.4% and 10.2% respectively.

This study assessed glycated Haemoglobin (HbA1c) levels and revealed a significant disparity in glycemic control between diabetic and non-diabetic individuals. Consistent with studies conducted in Ethiopia and South Africa, this investigation confirms a high

prevalence of poor glycaemic control among diabetic patients, with HbA1c levels exceeding the American Diabetes Association's recommended threshold of <7% (Mekonnen Abebe et al., 2015; Masilela et al., 2020; ADA, 2022).

The significant difference in HbA1c levels ( $p < 0.001$ ) observed between diabetic and non-diabetic participants highlights the persistent hyperglycemia in diabetics Fig. 1A. Elevated HbA1c among diabetic males and females compared to their respective non-diabetic counterparts reinforces the utility of HbA1c as a marker of chronic glycaemic status. These findings are consistent with James et al. (2023), who also observed poor glycaemic control in a similar cross-sectional study.

Further comparison to establish the differences in the glycosylated Haemoglobin (HbA1c) levels among diabetic males and their non-diabetic counterpart as well as that of diabetic females and their non-diabetic counterpart (fig. 1B and 1C) respectively showed that all the diabetic males and females exhibited significantly elevated HbA1c level. The p-values for each category are statistically significant, indicating that the differences in HbA1c levels between males and females are unlikely to be due to chance. The differences in HbA1c levels between males and females may be attributed to various lifestyle factors, physiological and hormonal factors.

Interestingly, this study found no statistically significant difference in HbA1c levels between non-diabetic males and females (fig. 2D and 2E), suggesting that gender does not influence glycaemic status in non-diabetics. However, diabetic males and females both showed significantly higher HbA1c levels, indicating poor metabolic control irrespective of sex. These observations are in line with prior reports which associate poor glycaemic outcomes with factors such as obesity, hypertension, and lack of access to consistent care (Bijelic et al., 2021; Dubale et al., 2023).

Despite the diagnostic utility of HbA1c, this study's cross-sectional nature limits the ability to assess long-term glycaemic control or predict future complications. Additionally, the sample size, while adequate for a preliminary study, may not fully capture the heterogeneity of the diabetic population in Lafia including those who are newly diagnosed and have not yet received treatment. Larger, longitudinal studies are warranted to assess trends and treatment outcomes over time.

Furthermore, systemic barriers such as high costs of diagnostic tests, limited access to medications, and inadequate public health interventions continue to impede effective diabetes management in low-resource settings like Nigeria (Amaeshi et al., 2024; Lomboro Dimore et al., 2023). Addressing these challenges through healthcare policy reform and community education is crucial.

## CONCLUSION

The findings of this study indicate that approximately 24.0% of the individuals had HbA1c levels exceeding the recommended threshold of <7%, with diabetic individuals demonstrating significantly poor glycaemic control ( $p < 0.001$ ). This highlights a concerning prevalence of inadequate blood glucose regulation, which may increase the risk of long-term diabetes complications. To address this issue, targeted awareness campaigns, educational programs, and lifestyle modifications are essential. Additionally, further research is recommended to validate these findings and provide a broader perspective on glycaemic control within the general population in Lafia.

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