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Research Article

Independent Predictors of Diabetes Outcomes: A Binary Logistic Regression Analysis of Sociodemographic and Clinical Factors at Specialist Hospital Yola, Adamawa State, Nigeria

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ABSTRACT
Diabetes mellitus is a growing public health crisis in Nigeria; however, facility-level epidemiological data from the northeastern region are critically lacking. This retrospective cross-sectional study investigated the sociodemographic and clinical factors associated with diabetes among 5,288 patients at the Specialist Hospital Yola, Adamawa State, Nigeria. Data extracted from clinical records were analyzed using chi-square tests and binary logistic regression. The prevalence of diabetes in the study population was 6.5% (342/5,288). Bivariate analysis revealed significant associations between diabetes and age group, blood glucose level, body mass index, hypertensive history, and stroke history ($p < 0.05$). The logistic regression model was statistically significant ($\chi^2 = 563.186$, $p < 0.001$) with adequate fit (Hosmer–Lemeshow $p = 0.386$). Blood glucose level emerged as the strongest independent predictor; compared to patients with glucose >6.9 mmol/L, those with levels 5.6–6.9 mmol/L had 57.3% lower odds (OR = 0.427, $p < 0.001$), and those with <5.6 mmol/L had 110.9% higher odds (OR = 2.109, $p < 0.001$) of diabetes. Diastolic blood pressure was also a significant positive predictor (OR = 1.031 per mmHg; $p < 0.001$). Patients aged >50 years had significantly higher odds than those aged <30 years (OR = 2.339, $p = 0.040$). A history of hypertension showed a strong positive association (OR = 10.362, $p < 0.001$), consistent with established comorbidity. The study concluded that elevated fasting plasma glucose and raised diastolic blood pressure are key indicators for diabetes risk stratification at the Specialist Hospital Yola. Routine glucose screening for all outpatients and integrated hypertension–diabetes management protocols are recommended.

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1.0 INTRODUCTION

Diabetes mellitus (DM) has emerged as one of the most widespread non-communicable diseases globally, with a particularly concerning and accelerating increase in developing countries, including Nigeria (World Health

Organization [WHO], 2021). This condition arises from a deficiency or ineffective production of insulin by the pancreas, resulting in chronically elevated blood glucose concentrations that progressively damage multiple organ systems, particularly the blood vessels, eyes, kidneys, heart, and nerves (Ismail, 2009). Type 2 diabetes mellitus (T2DM) is the dominant form of diabetes, accounting for approximately 90% of all diabetes cases globally, and is primarily caused by insulin resistance associated with excess body weight and a sedentary lifestyle (WHO, 2019). The global burden of diabetes has reached alarming proportions, with the WHO reporting that more than 420 million people are living with diabetes worldwide, and projections indicate that this figure could rise to 700 million by 2045 (WHO, 2021). According to the International Diabetes Federation (IDF, 2023), an estimated 3.6 million adults in Nigeria alone were living with diabetes as of 2021, making Nigeria the country with the highest diabetes burden on the African continent; however, approximately two-thirds of Nigerians living with diabetes remain undiagnosed (WHO, 2016). In 2015, diabetes was estimated to have caused the deaths of more than 40,000 Nigerians, a toll largely attributed to inadequate and ineffective healthcare services (Muanya, 2016).

The rising prevalence of T2DM in Nigeria and globally has been closely linked to modifiable risk factors, including being overweight and obese, physical inactivity, unhealthy diet, and urbanization. Approximately 90% of T2DM cases are attributable to excess body weight, and obese individuals face up to a 300% greater risk of mortality compared to those with a normal body mass index (Abdullah et al., 2010; Hossain et al., 2007). The WHO (2016) reported obesity rates of 5.3% among Nigerian men and 14.3% among Nigerian women, reflecting a rapid nutritional transition accompanying urbanization and globalization (Wild et al., 2004). Beyond obesity, other key risk factors identified in the Nigerian literature include advancing age, family history of diabetes, a sedentary lifestyle, and urban residence (Uloko *et al.,* 2018). The relationship between diabetes and comorbid conditions, such as hypertension and stroke, is well established and clinically significant, as hypertension and diabetes share common pathophysiological mechanisms, including insulin resistance and endothelial dysfunction, and their co-occurrence substantially amplifies the risk of cardiovascular and renal complications (Cheung & Li, 2012). Elevated diastolic blood pressure has been associated with insulin resistance and metabolic dysregulation, whereas hyperglycemia promotes atherosclerosis and increases the risk of cerebrovascular events (Shou *et al.,* 2020).

Adamawa State, situated in northeastern Nigeria, is one of the country's geographically vast but economically underserved states. Yola, the state capital, is a fast-growing urban center undergoing rapid demographic and socioeconomic transformation, including changes in dietary practices, increasing sedentary behavior, and limited access to specialist healthcare all of which are established correlates of rising non-communicable disease burdens (Ogah & Rayner, 2013). The Specialist Hospital Yola, as the premier tertiary health facility in the state, serves as the primary referral center for patients with diabetes across Adamawa State and its surrounding regions. Despite the documented increase in diabetes prevalence across Nigeria, there remains a critical paucity of state- and facility-level data from Adamawa State that characterizes the sociodemographic and clinical profiles of patients with diabetes or quantifies the independent associations between known risk factors and diabetes outcomes in this context. The economic dimension of diabetes management in Nigeria further compounds the public health challenge, as the Diabetes Association of Nigeria has reported that the price of insulin has risen by approximately 200% in recent years, placing an existential financial burden on millions of Nigerians living with the condition (Lara, 2024). The increasing prevalence of diabetes mellitus in Nigeria represents a mounting public health emergency that is inadequately reflected in the available research literature, particularly at the subnational and facility levels. In Adamawa State and its capital, Yola, the epidemiological profile of diabetes, including the sociodemographic and clinical characteristics of affected patients and independent predictors of a positive diabetes outcome, has not been systematically documented in the peer-reviewed literature.

This study aimed to identify and examine the sociodemographic and clinical factors associated with diabetes outcomes among patients receiving treatment at the Specialist Hospital Yola, Adamawa State, Nigeria, using chi-square tests of association and binary logistic regression analysis. The specific objectives were as follows: to assess the bivariate association between each independent variable and diabetes outcome; to evaluate the baseline predictive accuracy of the null logistic regression model and compare it with the classification performance of the full model incorporating all predictor variables; to assess the overall statistical significance and goodness of fit of the binary logistic regression model; and to identify the independent predictors of a positive diabetes outcome. The findings of this study have substantial implications for public health policy, clinical practice, and academic research in Adamawa State and across Nigeria by generating empirically rigorous, locally derived evidence on the independent predictors of diabetes outcomes at the Specialist Hospital Yola, thereby equipping the hospital's clinical teams and the Adamawa State Ministry of Health with the data needed to develop targeted, context-specific prevention and management strategies. Existing epidemiological studies on diabetes in Nigeria have been heavily concentrated in the southern states and the Federal Capital Territory, leaving northeastern Nigeria, including Adamawa State, chronically under-represented in the evidence base. This study addresses that gap by providing the first systematic, multivariate analysis of diabetes outcomes among patients at the Specialist Hospital Yola.

MATERIALS AND METHODS

This section presents the research design and methodology employed in this study. It provides a detailed account of the study area, characteristics of the target population, procedures used for data collection, variables of interest, and statistical methods applied to analyze the data.

Area of Study

This retrospective cross-sectional study was conducted at the Specialist Hospital Yola, Adamawa State, Nigeria. Yola is the capital city of Adamawa State, located in the northeastern geopolitical zone of the country at approximately 8.8836° N and 11.3730° E. The Specialist Hospital Yola, is the premier tertiary health institution in Adamawa State and the principal referral center for complex and chronic medical conditions across the state and its surrounding areas. It operates a dedicated diabetes and endocrinology clinic that provides outpatient and inpatient services, including outcome, pharmacological management, dietary counselling, and complication monitoring.

Target Population

The study population comprised adult patients (aged 18 years and older) who had documented diabetes test results at Specialist Hospital Yola. Using a retrospective cross-sectional design, the study examined the relationships between selected independent variables and a diabetes-related health outcome.

Method of Data Collection

Secondary data were extracted from the medical records and clinics of the Specialist Hospital Yola from January 2021 to December 2025. Ethical approval for the use of patient records was obtained from the relevant institutional authority at the Specialist Hospital Yola, prior to the data extraction.

Data Collection Procedure and Variables of Interest

Data were extracted from the medical records of patients with diabetes registered at the Specialist Hospital Yola, covering the designated study period. The extraction focused on patients with laboratory-confirmed diabetes. The dependent variable for this study was diabetes outcome, coded as a binary variable: 0 for patients who tested negative for diabetes and 1 for those with a confirmed diabetes outcome. The following independent variables were extracted from patient records:

Age Group: Patients were categorized into three groups based on their age at the time of clinical assessment: below 30 years, 30–50 years, and above 50 years.

Sex: recorded as male or female.

Blood Glucose Level: Fasting blood glucose measurements were categorized as below 5.6 mmol/L (normal range), 5.6–6.9 mmol/L (prediabetic range), and above 6.9 mmol/L (diabetic range), consistent with the WHO (2019) diagnostic thresholds.

Body Mass Index (BMI): calculated from recorded height and weight measurements and categorized as underweight (< 18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), and obese (≥ 30 kg/m²), in accordance with the WHO (2021) classification.

Systolic Blood Pressure: recorded in millimeters of mercury (mmHg) and analyzed as a continuous variable.

Diastolic Blood Pressure: recorded in mmHg and analyzed as a continuous variable.

Family History of Diabetes: A binary variable indicating whether the patient had a first-degree relative with a documented outcome of diabetes mellitus (yes/no).

Hypertension History: A binary variable indicating whether the patient had a prior or current clinical outcome of hypertension (yes/no)

History of Stroke: A binary variable indicating whether the patient had a prior clinical outcome of stroke (yes/no).

Data Analysis

Data extracted from patient records were entered, cleaned, and coded using IBM SPSS Statistics (Version 27.0). Two complementary statistical methods were used. First, chi-square tests of independence were conducted to examine the bivariate association between each independent variable and diabetes outcome, with a p-value of less than 0.05 as the threshold for statistical significance.

Binary Logistic Regression Analysis

The mean of the response variable Y in terms of an explanatory variable X_i is modeled relating Y and X through the equation $Y = \beta_0 + \beta_i X_i$.

For a binary response variable Y (diabetes outcome) and an explanatory variable X (age group, gender, glucose level, body mass index, family history of diabetes, hypertensive history, history of stroke), let

$$\pi\left(x\right) = P\left(Y = 1 / X = x\right) \tag{1}$$

The Logistic regression model is

$$\pi\left(x\right) = \frac{\exp\left(\beta_0 + \beta_i x_i\right)}{1 + \exp\left(\beta_0 + \beta_i x_i\right)} = \frac{e^{\beta_0 + \beta_i x_i}}{1 + e^{\beta_0 + \beta_i x_i}} \tag{2}$$

For more details see Agresti (2018)

In this study, the probability of outcome of diabetes under the logistic model is

$$Logit\left(\pi\left(x\right)\right) = \log\left(\frac{\pi\left(x\right)}{1 - \pi\left(x\right)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_p X_p \tag{3}$$

Where:

$\beta_0 = Intercept$

$\beta_i = Slope\left(Coefficient\ of\ the\, Explanatory\ Variables\right)\ \ i = 1, 2, \ldots, p$

Statistical Software

The Statistical Package for Social Sciences (SPSS Version 27) was used to compute the descriptive statistics of the sociodemographic data. In addition, the data collected for this study was fitted to the model using a Logistic Regression Model and Chi-Square Test.

Ethical considerations

This research was based on diabetes data that were made available at the Specialist Hospital Yola. The ethical processes were the responsibility of the institutions that commissioned, funded, or oversaw the treatment of diabetes patients.

RESULTS AND DISCUSSION

This section presents the results of the statistical analyses conducted to investigate the factors associated with diabetes outcomes in the study population. The analyses were performed in two sequential stages: In the first stage, chi-square tests of independence were employed to examine the bivariate associations between diabetes outcome and each of the selected independent variables, namely age group, gender, blood glucose level, body mass index (BMI), family history of diabetes, hypertensive history, and history of stroke. In the second stage, binary logistic regression analysis was applied to determine the independent predictors of a positive diabetes outcome while simultaneously controlling for the confounding variables.

Bivariate Analysis: Chi-square Tests of Association

Prior to fitting the logistic regression model, chi-square tests of independence were conducted to assess the bivariate association between diabetes outcomes and each independent variable. The results of these analyses are presented in

Table 1: Contingency Table Showing Observed Counts, Percentage Distributions, Chi-square Values and P-values of Diabetes Patients by Selected Independent Variables

Factors	Diabetes Outcome		Total	χ^2 value	p-value
	Negative n (%)	Positive n (%)			
Age group					
< 30 years	397 (98.3%)	7 (1.7%)	404		
30–50 years	2,958 (94.7%)	167 (5.3%)	3,125	49.139	0.001*
Above 50 years	1,591 (90.5%)	168 (9.5%)	1,759		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
Gender					
Male	1,422 (90.8%)	144 (9.2%)	1,566	3.260	0.071
Female	3,524 (94.7%)	198 (5.3%)	3,722		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
Glucose level					
< 5.6 mmol/L	766 (95.1%)	39 (4.9%)	805	102.545	0.001*
5.6–6.9 mmol/L	1,765 (97.7%)	42 (2.3%)	1,807		
> 6.9 mmol/L	2,415 (90.2%)	261 (9.8%)	2,676		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
Body mass index (BMI)					
< 18.5 (Underweight)	766 (97.0%)	24 (3.0%)	790		0.001*
18.5–24.9 (Normal)	3,117 (94.1%)	197 (5.9%)	3,314	47.828	
25–29.9 (Overweight)	822 (89.7%)	94 (10.3%)	916		
≥ 30 (Obese)	241 (89.9%)	27 (10.1%)	268		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
Family history of diabetes					
No	4,783 (93.4%)	336 (6.6%)	5,119	2.456	0.117
Yes	163 (96.5%)	6 (3.5%)	169		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
Hypertensive history					
No	4,543 (96.6%)	158 (3.4%)	4,701	675.593	0.001*
Yes	403 (68.6%)	184 (31.4%)	587		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		
History of stroke					
No	4,930 (93.6%)	338 (6.4%)	5,268	6.078	0.014*
Yes	16 (80.0%)	4 (20.0%)	20		
Total	**4,946 (93.5%)**	**342 (6.5%)**	**5,288**		

Note. Percentages are row percentages (within each category). Total row percentages are calculated out of the overall sample (N = 5,288). * Significant at p < 0.05.

Age Group and Diabetes Outcome

As presented in Table 1, age group was found to be significantly associated with diabetes outcomes (χ^2 = 49.139, p < 0.001). Among patients aged < 30 years, 397 (98.3%) tested negative and only 7 (1.7%) tested positive, representing the lowest positivity rate across age groups. In comparison, patients in the 30–50-year category had a positivity rate of 5.3% (167 positive cases), while those above 50 years of age recorded the highest positivity rate of 9.5% (168 positive cases).

Gender and Diabetes Outcome

The association between sex and diabetes outcomes did not reach statistical significance (χ^2 = 3.260, p = 0.071). Female patients constituted a larger portion of the sample, with 3,524 (94.7%) testing negative and 198 (5.3%) testing positive, compared with 1,422 (90.8%) negative and 144 (9.2%) positive among male patients. Although the absolute number of positive cases was higher among females, the positivity rate was actually higher in males (9.2% vs. 5.3%), but this difference was not statistically significant at the conventional 0.05 threshold.

Blood Glucose Level and Diabetes Outcome

Blood glucose level demonstrated the strongest statistically significant bivariate association with diabetes outcomes among all variables examined (χ^2 = 102.545, p < 0.001). Patients with glucose levels > 6.9 mmol/L recorded the highest proportion of positive diabetes outcomes (9.8%), accounting for 261 of the 342 total positive cases. In contrast, those with glucose levels below 5.6 mmol/L had a positivity rate of 4.9% (39 cases), and those in the intermediate range of 5.6–6.9 mmol/L had the lowest rate of 2.3% (42 cases).

Body Mass Index and Diabetes Outcome

Body mass index was significantly associated with diabetes outcomes (χ^2 = 47.828, p < 0.001). The normal weight category (BMI 18.5–24.9) contributed the highest absolute count of positive cases (197, representing 5.9% of that category). However, a clear trend of increasing positivity rates was observed across higher BMI classifications: the overweight category (BMI 25–29.9) recorded a 10.3% positivity rate (94 cases), and the obese category (BMI ≥ 30) had a 10.1% positivity rate (27 cases). The lowest positivity rate was seen in the underweight category (BMI < 18.5) at 3.0% (24 cases).

Family History of Diabetes and Diabetes Outcome

Family history of diabetes was not significantly associated with diabetes outcomes in this sample (χ^2 = 2.456, p = 0.117). The overwhelming majority of patients with no family history (4,783, 93.4%) tested negative, while 336 (6.6%) with no family history tested positive. Among those with a documented positive family history, 163 (96.5%) tested negative and only 6 (3.5%) tested positive for diabetes.

Hypertensive History and Diabetes Outcome

Hypertensive history yielded the largest chi-square statistic among all bivariate associations (χ^2 = 675.593, p < 0.001), indicating a highly significant association with diabetes outcome. Patients without a history of hypertension accounted for 4,543 (96.6%) negative and 158 (3.4%) positive cases. In contrast, among those with a history of hypertension, 403 (68.6%) tested negative and 184 (31.4%) tested positive, demonstrating a markedly higher positivity rate.

History of Stroke and Diabetes Outcome

A history of stroke was significantly associated with diabetes outcomes (χ^2 = 6.078, p = 0.014). The proportion of stroke patients in this sample was small, with 16 (80.0%) testing negative and 4 (20.0%) testing positive. Despite the low absolute numbers, the relative positivity rate among patients with a history of stroke (20.0%) was notably higher than that among patients without stroke (6.4%).

Binary Logistic Regression Analysis

To identify the independent predictors of a positive diabetes outcome while controlling for all other variables simultaneously, a binary logistic regression model was fitted. The dependent variable was diabetes outcome (0 =

negative, 1 = positive). The independent variables entered into the model were age group, gender, blood glucose level, body mass index, systolic blood pressure, diastolic blood pressure, family history of diabetes, hypertensive history, and history of stroke. The adequacy of the model was assessed using the classification table, the Omnibus Test of Model Coefficients, model summary statistics (−2 Log Likelihood, Cox & Snell R^2, Nagelkerke R^2), and the Hosmer–Lemeshow goodness-of-fit test. The results of these diagnostic procedures are presented in Tables 4.2 through 4.7.

Baseline Classification Accuracy (Null Model)

Table 2 presents the classification performance of the null (intercept-only) logistic regression model, which serves as the baseline against which the improvement attributable to the predictor variables is evaluated.

Table 2: Classification Table: Null Model Predicting Diabetes Outcome without Predictor Variables

Observed	Predicted: No	Predicted: Yes	% Correct
Diabetes — No	4,946	0	100.0
Diabetes — Yes	342	0	0.0
Overall Percentage			**93.5**
Sensitivity (True Positive Rate)			**0.0% (0/342)**
Specificity (True Negative Rate)			**100.0% (4,946/4,946)**

In the absence of any predictor variables, the null model classified all 5,288 observations as negative for diabetes — the modal category. This resulted in perfect classification of the 4,946 non-diabetic patients (100.0%) but complete failure to identify any of the 342 diabetic patients (sensitivity = 0.0%). The overall accuracy of 93.5% reflects nothing more than the natural class imbalance in the dataset — specifically, the fact that non-diabetic patients constitute 93.5% of the sample — and does not reflect any genuine discriminatory ability. This deceptively high accuracy underscores the inadequacy of overall accuracy as an evaluative criterion when the outcome of primary clinical interest (diabetes positive) represents the minority class.

Classification Accuracy of the Full Model

The classification accuracy of the full logistic regression model, incorporating all nine predictor variables, is presented in Table 3.

Table 3: Classification Table: Full Model Predicting Diabetes Outcome with Predictor Variables

Observed	Predicted: No	Predicted: Yes	% Correct
Diabetes — No	4,924	22	99.6
Diabetes — Yes	319	23	6.7
Overall Percentage			**93.6**
Sensitivity (True Positive Rate)			**6.7% (23/342)**
Specificity (True Negative Rate)			**99.6% (4,924/4,946)**

With the inclusion of all predictor variables, the full model correctly classified 4,924 of 4,946 non-diabetic patients (specificity = 99.6%) but identified only 23 of 342 diabetic patients correctly, yielding a sensitivity of just 6.7%. The overall accuracy improved only marginally from 93.5% (null model) to 93.6% (full model), a negligible gain that is attributable almost entirely to the model's near-perfect classification of the majority (non-diabetic) class rather than to any meaningful ability to detect true diabetic cases. The critically low sensitivity of 6.7% means that 319 of the 342 confirmed diabetic patients — approximately 93.3% — were misclassified as non-diabetic by the model. This represents a severe limitation of the model's predictive utility for the clinically important task of identifying patients with diabetes. The high overall accuracy is therefore misleading and should not be interpreted as evidence of good predictive performance; it is a well-documented artefact of class imbalance in which the dominant class (non-diabetic) overwhelms classification metrics. The logistic regression model in this study should therefore be interpreted primarily as a tool for identifying statistically significant independent associations between predictors and diabetes outcome — not as a clinical classification or screening instrument. The predictor coefficients and odds ratios reported in Table 7 retain their inferential value for identifying risk factors, but the model's classification output should be interpreted with extreme caution and is not suitable for clinical decision-making without further methodological refinement, such as threshold adjustment, resampling techniques, or alternative modelling approaches designed for imbalanced outcome data.

Omnibus Test of Model Coefficients

The statistical significance of the overall logistic regression model was evaluated using the Omnibus Test of Model Coefficients, the results of which are displayed in Table 4.

Table 4: Omnibus Tests of Model Coefficients

	χ^2	df	Sig.
Step 1 — Step	563.186	11	0.001*
Step 1 — Block	563.186	11	0.001*
Step 1 — Model	563.186	11	0.001*

*Note. * Significant at p < 0.05.*

The Omnibus Test evaluates whether the full model provides a statistically significant improvement in fit relative to the null model. As shown in Table 4, the model chi-square value is 563.186 (df = 11, $p < 0.001$). This highly significant result confirms that, taken collectively, the predictor variables included in the model contribute meaningfully to explaining variability in diabetes outcomes. The result is consistent across the Step, Block, and Model levels reflecting the simultaneous entry of all predictors and provides sufficient statistical justification to proceed with the interpretation of individual regression coefficients.

Model Summary

The pseudo-R^2 measures and the −2 Log Likelihood value for the fitted model are presented in Table 5.

Table 5: Model Summary

Step	-2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2
1	1971.257	0.101	0.265

The −2 Log Likelihood value of 1,971.257 reflects the discrepancy between the observed data and the values predicted by the model. Lower values are indicative of a better fitting model relative to the saturated model. The Cox & Snell R^2 of 0.101 suggests that the model explains approximately 10.1% of the total variance in diabetes outcomes; however, this statistic is mathematically constrained to a maximum below 1.0, limiting its interpretability. The Nagelkerke R^2, which rescales the Cox & Snell index to range between 0 and 1, yielded a value of 0.265, indicating that the model accounts for approximately 26.5% of the variability in diabetes outcome. This represents a moderate level of explanatory power and is consistent with values commonly observed in epidemiological logistic regression models involving complex, multi-factorial health outcomes (Hosmer *et al.,* 2013).

Hosmer–Lemeshow Goodness-of-Fit Test

The overall fit of the logistic regression model to the observed data was assessed using the Hosmer–Lemeshow goodness-of-fit test. The results are presented in Table 6.

Table 6: Hosmer and Lemeshow Test

Step	χ^2	df	Sig.
1	8.501	8	0.386

Note. The null hypothesis is that the model fits the data adequately. A non-significant result (p > 0.05) supports good model fit.

The Hosmer–Lemeshow test partitions the sample into decile-based risk groups and compares the observed frequencies with those predicted by the model. A non-significant chi-square value indicates that the model predictions do not significantly deviate from the observed outcomes, thereby confirming adequate fit. As presented in Table 4.6, the test statistic was χ^2 = 8.501 (df = 8, p = 0.386). Since p > 0.05, the null hypothesis of good model fit is retained, confirming that the logistic regression model fits the data well across the full spectrum of predicted probabilities.

Variables in the Equation: Logistic Regression Coefficients

Table 7 presents the logistic regression coefficients (B), standard errors (S.E.), Wald statistics, p-values, and exponentiated coefficients (odds ratios, OR) for each predictor variable included in the model. The odds ratio quantifies the change in the odds of a positive diabetes outcome associated with each predictor, holding all other variables constant. Values greater than 1.0 indicate an increased likelihood of a positive outcome, while values less than 1.0 indicate a protective effect.

Table 7: Variables in the Equation — Binary Logistic Regression Coefficients for Predictors of Diabetes Outcome

Variables	B	S.E.	Wald	p-value	OR	95% CI for B
Age group ***[Ref: < 30 years]***						
30–50 years	0.650	0.403	2.598	0.107	1.915	(−0.140, 1.439)
> 50 years	0.850	0.414	4.213	0.040*	2.339	(0.038, 1.661)
Gender ***[Ref: Female]***						
Male	−0.243	0.135	3.215	0.073	0.784	(−0.508, 0.023)
Glucose level ***[Ref: > 6.9 mmol/L]***						
< 5.6 mmol/L	0.746	0.191	15.253	0.001*	2.109	(0.372, 1.121)
5.6–6.9 mmol/L	−0.850	0.240	12.524	0.001*	0.427	(−1.321, −0.379)
Body mass index (BMI) — continuous						
BMI (per unit)	0.079	0.042	3.510	0.061	1.082	(−0.004, 0.161)
Blood pressure — systolic (continuous)						
Systolic BP (per mmHg)	−0.005	0.004	1.577	0.209	0.995	(−0.013, 0.003)
Blood pressure — diastolic (continuous)						

Diastolic BP (per mmHg)	0.030	0.007	19.672	0.001*	1.031	(0.017, 0.043)
Family history of diabetes ***[Ref: No]***						
Yes	−0.278	0.450	0.381	0.537	0.757	(−1.161, 0.605)
Hypertensive history ***[Ref: No]***						
Yes	2.338	0.140	280.786	0.001*	10.362	(2.065, 2.612)
History of stroke ***[Ref: No]***						
Yes	−0.543	0.623	0.759	0.384	0.581	(−1.765, 0.679)
Constant	−6.149	0.617	99.200	0.001*	0.002	(−7.359, −4.939)

Note. B = logistic regression coefficient. S.E. = standard error. Wald = Wald chi-square statistic. OR = odds ratio [Exp(B)]. 95% CI for B = confidence interval for the coefficient (B ± 1.96 × S.E.). * $p < 0.05$. Ref = reference category. N = 5,288. Pseudo R^2 = 0.2222.

Age group

Age emerged as a significant independent predictor of diabetes outcome. Using patients under 30 years as the reference category, those aged 30–50 years had higher odds of a positive diabetes outcome (*B = 0.650, Wald = 2.598, p = 0.107, OR = 1.915, 95% CI [−0.140, 1.439]*), representing approximately 91.5% higher odds compared with the youngest group, though this did not reach statistical significance. The confidence interval for the coefficient crossed zero, further confirming the absence of a statistically significant effect. Patients above 50 years had significantly higher odds of a positive outcome (*B = 0.850, Wald = 4.213, p = 0.040, OR = 2.339, 95% CI [0.038, 1.661]*), translating to approximately 133.9% higher odds compared with those under 30 years, after adjusting for all other covariates. The confidence interval entirely excluded zero, confirming the statistical significance of this effect. The overall pattern is consistent with the well-established age-related trajectory of diabetes risk, whereby older age confers progressively greater susceptibility to the condition.

Gender

Gender was not a statistically significant predictor of diabetes outcome in the multivariable model (*B = −0.243, Wald = 3.215, p = 0.073, OR = 0.784, 95% CI [−0.508, 0.023]*). Male patients had approximately 21.6% lower odds of a positive outcome compared with female patients, after adjusting for other covariates. The confidence interval for the coefficient marginally crossed zero, consistent with the borderline p-value (p = 0.073), suggesting a modest sex-based differential in diabetes risk that does not attain conventional statistical significance once metabolic variables — particularly glucose level and blood pressure — are controlled.

Blood glucose level

Blood glucose level was a highly significant predictor of diabetes outcome. Using patients with glucose above 6.9 mmol/L as the reference, those with levels below 5.6 mmol/L had significantly higher odds of a positive outcome (*B = 0.746, Wald = 15.253, p < 0.001, OR = 2.109, 95% CI [0.372, 1.121]*), corresponding to approximately 110.9% higher odds. The confidence interval for the coefficient was entirely above zero, confirming the robustness of this association. Patients in the 5.6–6.9 mmol/L range had significantly lower odds compared with the high-glucose reference group (*B = −0.850, Wald = 12.524, p < 0.001, OR = 0.427, 95% CI [−1.321, −0.379]*), representing approximately 57.3% lower odds, with the confidence interval entirely below zero. These results confirm that blood glucose level is a powerful independent predictor of diabetes outcome, consistent with its central role in the diagnostic criteria of the disease (American Diabetes Association, 2022).

Body mass index

Body mass index entered the model as a continuous predictor and showed a positive but statistically borderline association with diabetes outcome (*B = 0.079, Wald = 3.510, p = 0.061, OR = 1.082, 95% CI [−0.004, 0.161]*). Each one-unit increase in BMI was associated with an 8.2% increase in the odds of a positive diabetes outcome, adjusting for all other predictors in the model. The confidence interval marginally crossed zero, consistent with the borderline p-value, though the near-exclusion of zero indicates a clinically plausible positive association worthy of further investigation.

Systolic and Diastolic Blood pressure

Systolic blood pressure was not a significant predictor of diabetes outcome (*B = −0.005, Wald = 1.577, p = 0.209, OR = 0.995, 95% CI [−0.013, 0.003]*), with the confidence interval spanning both negative and positive values and encompassing zero. By contrast, diastolic blood pressure was a statistically significant positive predictor (*B = 0.030, Wald = 19.672, p < 0.001, OR = 1.031, 95% CI [0.017, 0.043]*), with the confidence interval entirely above zero. Each one-unit increase in diastolic blood pressure was associated with a 3.1% increase in the odds of a positive diabetes outcome after adjustment, suggesting that elevated diastolic pressure is an independent contributor to diabetes risk beyond other metabolic factors.

Family history of diabetes

Family history of diabetes was not a statistically significant predictor of diabetes outcome (*B = −0.278, Wald = 0.381, p = 0.537, OR = 0.757, 95% CI [−1.161, 0.605]*). Patients with a positive family history had approximately 24.3% lower odds of a positive outcome compared with those without. The wide confidence interval spanning a broad range of negative and positive coefficient values reflects considerable imprecision in this estimate, consistent with the non-significant Wald statistic. This may reflect insufficient statistical power or confounding by other variables in the model.

Hypertensive history

Hypertensive history was the most statistically dominant individual predictor in the regression model (*Wald = 280.786, p < 0.001*). Patients with a history of hypertension had significantly higher odds of a positive diabetes outcome compared with those without (*B = 2.338, OR = 10.362, 95% CI [2.065, 2.612]*), representing approximately 936.2% higher odds. The narrow confidence interval entirely above zero underscores the precision and strength of this association. This finding is consistent with the established comorbidity between hypertension and type 2 diabetes, which share common pathophysiological pathways including insulin resistance, endothelial dysfunction, and chronic low-grade inflammation.

History of stroke

History of stroke was not a significant independent predictor of diabetes outcome (*B = −0.543, Wald = 0.759, p = 0.384, OR = 0.581, 95% CI [−1.765, 0.679]*). The wide confidence interval spanning both negative and positive values, combined with the large standard error (0.623), indicates considerable imprecision in this estimate, likely attributable to the very small number of patients with a documented stroke history in the sample. The result should therefore be interpreted with considerable caution.

DISCUSSION OF FINDINGS

The present study examined the sociodemographic and clinical factors associated with diabetes outcomes among 5,288 patients at the Specialist Hospital, Yola, Adamawa State, Nigeria, using chi-square tests of independence and binary logistic regression analysis.

The overall sample positivity rate of 6.5% is consistent with comparable studies in the Nigerian literature. Nwafor et al. (2024) reported a prevalence of 6.53% in Port Harcourt, while Nascimento et al. (2023) documented a rate of 6.5% in a Brazilian population-based survey. Given that the International Diabetes Federation (2023) estimates that approximately two-thirds of Nigerians with diabetes remain undiagnosed, the facility-based positivity rate observed at the Specialist Hospital, Yola, should be regarded as a conservative estimate of the true burden in Adamawa State.

Age group was significantly associated with diabetes outcome at the bivariate level ($\chi^2 = 49.139, p < 0.001$) and in the logistic regression model. Using patients below 30 years as the reference category, those aged 30–50 years had 91.5% higher odds of a positive diagnosis, though this did not reach statistical significance (*B = 0.650, Wald = 2.598, p = 0.107, OR = 1.915, 95% CI [−0.140, 1.439]*). Patients above 50 years had significantly higher odds of a positive diagnosis compared with the youngest group (*B = 0.850, Wald = 4.213, p = 0.040, OR = 2.339, 95% CI [0.038, 1.661]*), representing approximately 133.9% higher odds, with the confidence interval entirely excluding zero. This finding aligns with the well-established age-related trajectory of Type 2 diabetes mellitus, driven by declining insulin sensitivity and beta-cell function with advancing age (Mordarska & Godziejewska-Zawada, 2017). Comparable age-related patterns have been reported by Adewumi et al. (2022) in Lagos, Nascimento et al. (2023), who found that adults aged 60 years and above had 6.67 times higher odds of diabetes, and Pirzado et al. (2021), who similarly found that individuals aged 45 years and above had 2.90 times higher odds of developing diabetes compared to younger age groups.

Gender was not a statistically significant predictor of diabetes outcome at either the bivariate level ($\chi^2 = 3.260$, $p = 0.071$) or in the regression model (*B = −0.243, Wald = 3.215, p = 0.073, OR = 0.784, 95% CI [−0.508, 0.023]*). Male patients had approximately 21.6% lower odds of a positive outcome compared with female patients, with the confidence interval marginally crossing zero, consistent with the borderline p-value. This is consistent with Adewumi et al. (2002), who reported no significant sex-based difference in diabetes prevalence in Lagos ($p = 0.195$), Anthony et al. (2020), who found no statistical difference in blood sugar levels between males and females in South East Nigeria, and Niyikora et al. (2015), who similarly found gender to be non-significant in logistic regression modelling of diabetes risk.

Blood glucose level was the strongest independent predictor of diabetes outcome in both the bivariate analysis ($\chi^2 = 102.545$, $p < 0.001$) and the logistic regression model. Relative to patients with glucose above 6.9 mmol/L, those in the 5.6–6.9 mmol/L prediabetic range had 57.3% lower odds of a positive diagnosis (*B = −0.850, Wald = 12.524, p < 0.001, OR = 0.427, 95% CI [−1.321, −0.379]*), with the confidence interval entirely below zero. By contrast, patients with glucose below 5.6 mmol/L had significantly higher odds compared with the high-glucose reference group (*B = 0.746, Wald = 15.253, p < 0.001, OR = 2.109, 95% CI [0.372, 1.121]*), corresponding to approximately 110.9% higher odds. This pattern reflects the known non-linear relationship between glucose screening thresholds and recorded clinical diagnoses in a facility-based sample, where patients with very low glucose are unlikely to have been managed for diabetes, while the high-glucose group constitutes the primary diagnostic target. The concentration of 261 of 342 positive cases (76.3%) in the highest glucose category underscores the critical importance of systematic blood glucose screening at the Specialist Hospital, Yola. These findings corroborate Lai et al. (2019), who identified fasting blood glucose as the most significant diabetes predictor in a large Canadian cohort, and Rastogi and Singh (2019), who confirmed blood glucose-related indicators as significant predictors of diabetes across urban and rural India.

Body mass index was significantly associated with diabetes outcome at the bivariate level ($\chi^2 = 47.828$, $p < 0.001$) but did not achieve significance in the multivariate model (*B = 0.079, Wald = 3.510, p = 0.061, OR = 1.082, 95% CI [−0.004, 0.161]*). The confidence interval marginally crossed zero, consistent with the borderline p-value, though the near-exclusion of zero indicates a clinically plausible positive association. Each unit increase in BMI was associated with an 8.2% increase in the odds of a positive diagnosis. This is consistent with Hossain et al. (2007), who attributed approximately 90% of Type 2 diabetes cases globally to excess body weight, and Balasooriya and Liyanage (2019), who reported a significant association between BMI and diabetes prevalence ($\chi^2 = 31.041$, $p < 0.001$). The attenuation of the BMI effect following multivariate adjustment suggests partial mediation through blood glucose and diastolic blood pressure, consistent with the known pathway by which excess adiposity promotes insulin resistance and hyperglycaemia (Kolb & Mandrup-Poulsen, 2010).

Hypertensive history was significantly associated with diabetes outcome at the bivariate level ($\chi^2 = 675.593$, $p < 0.001$) and was the most statistically dominant predictor in the regression model (*Wald = 280.786, $p < 0.001$*). Patients with a history of hypertension had 936.2% higher odds of a positive diabetes diagnosis compared with non-hypertensive patients (*B = 2.338, OR = 10.362, 95% CI [2.065, 2.612]*), with the narrow confidence interval entirely above zero underscoring the precision and strength of this association. This finding is consistent with the established comorbidity between hypertension and type 2 diabetes, which share common pathophysiological pathways including insulin resistance, endothelial dysfunction, and chronic low-grade inflammation. This is supported by Ukah et al. (2023), who reported hypertension as the most prevalent comorbid condition among diabetes patients (67.9%), and Onyenekwe et al. (2019), who found that 74% of their diabetes clinic sample had coexistent hypertension, confirming the expected positive epidemiological co-occurrence of both conditions at the population level. The role of certain antihypertensive agents in modifying glucose metabolism further complicates this association (Chobanian et al., 2003) and warrants longitudinal investigation.

History of stroke was significantly associated with diabetes outcome at the bivariate level ($\chi^2 = 6.078$, $p = 0.014$), consistent with the established bidirectional relationship between hyperglycaemia and cerebrovascular disease (Shou et al., 2020). However, it did not emerge as a significant independent predictor in the multivariate model (*B = −0.543, Wald = 0.759, p = 0.384, OR = 0.581, 95% CI [−1.765, 0.679]*). The wide confidence interval spanning both negative and positive values reflects considerable imprecision in this estimate, likely due to confounding by blood glucose and diastolic blood pressure, and the small number of stroke patients in the sample ($n = 20$). This result should not be interpreted as evidence of no clinical relationship between stroke and diabetes, but rather reflects the limitation of small subgroup sizes in retrospective datasets (Hosmer et al., 2013).

Family history of diabetes was not significantly associated with diabetes outcome at the bivariate level ($\chi^2 = 2.456$, $p = 0.117$) or in the logistic regression model (*B = −0.278, Wald = 0.381, p = 0.537, OR = 0.757, 95% CI [−1.161, 0.605]*). Patients with a positive family history had approximately 24.3% lower odds of a positive outcome, though the wide confidence interval spanning both negative and positive coefficient values reflects considerable imprecision. This is consistent with Niyikora et al. (2015) and Stella (2012), who similarly found family history to be non-significant in logistic regression analyses of diabetes predictors. The small proportion of patients with a documented positive family history in the present sample (3.2%) likely constrained statistical power, and systematic underreporting of family history in routine clinical records — a known limitation of retrospective studies in Nigerian settings — may have further contributed to this result.

Diastolic blood pressure was a significant positive independent predictor of diabetes outcome (*B = 0.030, Wald = 19.672, p < 0.001, OR = 1.031, 95% CI [0.017, 0.043]*), with the confidence interval entirely above zero and each unit increase associated with a 3.1% rise in the odds of a positive diagnosis after full adjustment. By contrast, systolic blood pressure was not significant (*B = −0.005, Wald = 1.577, p = 0.209, OR = 0.995, 95% CI [−0.013, 0.003]*), with its confidence interval spanning zero. The specific significance of diastolic over systolic blood pressure is consistent with evidence linking elevated diastolic blood pressure to insulin resistance and metabolic dysregulation (Cheung & Li, 2012), and aligns with findings by William et al. (2024), who identified systolic blood pressure as a predictor of microvascular complications in elderly Nigerian diabetes patients, suggesting that the two blood pressure components exert distinct outcome-specific effects. The independent predictive value of diastolic blood pressure at the Specialist Hospital, Yola, supports its integration into routine diabetes risk stratification protocols, particularly given the high and growing burden of hypertension documented in Nigeria (Adeloye et al., 2021).

Overall, the logistic regression model was statistically significant ($\chi^2 = 563.186$, $df = 11$, $p < 0.001$) with acceptable goodness of fit (Hosmer–Lemeshow: $\chi^2 = 8.501$, $df = 8$, $p = 0.386$) and explained approximately 26.5% of the variance in diabetes outcome (Nagelkerke R^2

= 0.265), consistent with values typically reported in epidemiological logistic regression models for complex health outcomes (Hosmer et al., 2013).

CONCLUSION

This study identified sociodemographic and clinical factors associated with diabetes among 5,288 patients at Specialist Hospital Yola, Nigeria, using chi-square tests and binary logistic regression. The prevalence of diabetes in the study population was 6.5%. Bivariate analysis revealed significant associations between diabetes and age group, blood glucose level, body mass index, hypertensive history, and stroke history ($p < 0.05$), while gender and family history were not significant. The logistic regression model was statistically significant ($\chi^2 = 563.186$, $p < 0.001$) and demonstrated adequate fit (Hosmer–Lemeshow $p = 0.386$), explaining approximately 26.5% of the variance in diabetes outcomes (Nagelkerke $R^2 = 0.265$).

Blood glucose level emerged as the strongest independent predictor. Compared to patients with glucose >6.9 mmol/L, those with levels between 5.6–6.9 mmol/L had 57.3% lower odds (OR = 0.427, $p < 0.001$), while those with <5.6 mmol/L had 110.9% higher odds (OR = 2.109, $p < 0.001$) of diabetes. Diastolic blood pressure was also a significant positive predictor; each 1 mmHg increase was associated with a 3.1% increase in the odds of diabetes (OR = 1.031, $p < 0.001$). Patients aged >50 years had significantly higher odds than those aged <30 years (OR = 2.339, $p = 0.040$). Hypertensive history showed a strong positive association (OR = 10.362, $p < 0.001$), consistent with established comorbidity.

Nevertheless, the independent associations observed suggest that elevated blood glucose and diastolic blood pressure may serve as useful risk stratification markers at Specialist Hospital Yola. These findings support the need for prospective longitudinal studies to evaluate whether routine glucose screening for outpatients or integrated hypertension–diabetes protocols improves clinical outcomes in this setting.

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