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Original Article

Profile of Cardiovascular Risk Factors among Patients with Type 2 Diabetes in Zaria, Northwestern Nigeria

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Abstract

Background: Cardiovascular disease is the leading cause of morbidity and mortality among individuals with type 2 diabetes mellitus (T2DM). In Nigeria, the burden of diabetes-related cardiovascular disease is rising, yet data on the prevalence and clustering of cardiovascular risk factors remain limited. The study objective is to determine the prevalence and clustering of major cardiovascular risk factors among adults with T2DM in Northwestern Nigeria.

Methodology: We retrospectively reviewed medical records of 396 adults with T2DM at Ahmadu Bello University Teaching Hospital, Zaria, to assess hypertension, dyslipidaemia, obesity, proteinuria, and renal function.

Results: The mean age was 53.3 ± 11.3 years, and 49.2% were male. Dyslipidaemia (80.1%), hypertension (69.7%), and truncal obesity (61.9%) predominated. General obesity occurred in 32.6%, proteinuria in 26.3%, and reduced estimated glomerular filtration rate in 33.1%. Women had higher prevalences of hypertension, truncal obesity, and metabolic syndrome, whereas dyslipidaemia was more common in men. Renal abnormalities increased with age. High-risk clustering (≥4 factors) occurred in 64.7% of women and 40.0% of men. Truncal obesity predicted high-risk clustering, while older age and longer diabetes duration predicted reduced renal function.

Conclusions: Cardiovascular risk factors are highly prevalent and clustered among adults with T2DM in Northwestern Nigeria. Truncal obesity is a key driver of clustering, underscoring the need for integrated cardiovascular risk assessment and targeted interventions.

Keywords: Type 2 diabetes mellitus; cardiovascular risk factors; hypertension; dyslipidaemia; obesity; Northwestern Nigeria

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Introduction

Type 2 diabetes mellitus (T2DM) has become a major public health challenge in low- and middle-income countries (LMICs), including Nigeria. An estimated 589 million adults worldwide currently live with diabetes, and this number is projected to rise substantially by 2050, with the fastest growth occurring in sub-Saharan Africa[1]. In Nigeria, urbanisation, dietary change, physical inactivity, and population ageing are expected to drive a more than twofold increase in diabetes prevalence over the same period[2].

Cardiovascular disease remains the leading cause of morbidity and mortality among individuals with T2DM, reflecting the coexistence and clustering of key risk factors such as hypertension, dyslipidaemia, and obesity[3,4].Despite the rapid epidemiological transition in Northern Nigeria, data on the burden and clustering of cardiovascular risk factors among adults with T2DM are limited. This study, therefore, examined the cardiovascular risk profile of adults with T2DM attending a tertiary diabetes clinic in Northwestern Nigeria.

Methods

Study Design, Setting, and Population

This was a hospital-based retrospective cross-sectional study conducted at the Endocrine and Diabetes Clinic of Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Northwestern Nigeria, between January 2019 and December 2021. ABUTH is a federal tertiary referral centre serving Kaduna State and neighbouring states.

Medical records of adults (≥18 years) with documented T2DM attending the clinic during the study period were reviewed. Of 424 identified records, 28 were excluded due to type 1 or gestational diabetes or missing key variables, leaving 396 records for analysis.

Data Collection and Variables

Data were extracted from routine clinical records using a standardized pro forma. Variables included age, sex, duration of diabetes, hypertension status, body mass index (BMI), waist circumference, and laboratory parameters.

Mean fasting plasma glucose and 2-hour postprandial glucose over the preceding three months were calculated using at least two measurements; records with fewer values were excluded from glycaemic analyses. The most recent lipid profile, serum creatinine, and urine protein result within the same period were used.

Definitions of Variables

T2DM was defined by fasting plasma glucose ≥7.0 mmol/L, 2-hour glucose ≥11.1 mmol/L, HbA1c ≥6.5%, or use of glucose-lowering medication[5]. Hypertension was defined as blood pressure ≥140/90 mmHg or antihypertensive use[6]. General obesity was BMI ≥30 kg/m², and truncal obesity was waist circumference ≥94 cm (men) or ≥80 cm (women)[7,8].

Dyslipidaemia was defined by total cholesterol ≥5.2 mmol/L, LDL-cholesterol ≥2.6 mmol/L, triglycerides ≥1.7 mmol/L, or HDL-cholesterol <1.0 mmol/L (men) or <1.3 mmol/L (women)[9]. Non-HDL cholesterol ≥3.37 mmol/L and atherogenic index of plasma >0.24 were considered elevated[10,11]. Proteinuria was ≥1+ on dipstick, and renal impairment was eGFR <60 mL/min/1.73 m² (CKD-EPI)[12,13]. Metabolic syndrome was classified using International Diabetes Federation criteria [8].

A composite cardiovascular risk factor burden score (0–7) summed hypertension, dyslipidaemia, general and truncal obesity, metabolic syndrome, proteinuria, and reduced eGFR; the score was exploratory, unvalidated, and equally weighted[14,15].

Statistical Analysis

Data were analysed using STATA 14. Continuous variables are presented as means (SD) or medians (IQR), and categorical variables as frequencies and percentages. Group comparisons used χ^2 or Fisher's exact tests.

Multivariable logistic regression identified predictors of high-risk factor clustering (≥4 factors), dyslipidaemia, and renal abnormalities. Models included age, sex, and diabetes duration a priori. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) are reported. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the ABUTH Health Research Ethics Committee (ABUTH/HREC/TRG/36; 16 October 2018). Informed consent was waived due to the retrospective design. Data were anonymised and confidentiality maintained.

Results

Baseline Characteristics

A total of 396 adults with T2DM were analysed (Table 1). The mean age was 53.3 ± 11.3 years, with 49.2% male. Median diabetes duration was 4 years (IQR 2–8), and median hypertension duration was 5 years (IQR 2–9). Participants were overweight (BMI 27.6 ± 6.3 kg/m²; waist circumference 92.5 ± 13.6 cm) with suboptimal glycaemic control (fasting glucose 7.9 ± 3.2 mmol/L; 2-hour glucose 10.9 ± 3.8 mmol/L).

Lipid indices showed an adverse profile, with mean total cholesterol 5.1 ± 1.2 mmol/L, LDL-cholesterol 2.7 ± 1.3 mmol/L, and non-HDL cholesterol 3.7 ± 1.3 mmol/L. Mean AIP was 0.1 ± 0.3, and mean eGFR was 74.8 ± 31.4 mL/min/1.73 m².

Prevalence of Cardiovascular Risk Factors

Cardiovascular risk factors were highly prevalent (Table 2). Dyslipidaemia (80.1%) and hypertension (69.7%) were the most common, followed by truncal obesity (61.9%), general obesity (32.6%), and metabolic syndrome (27.3%). Renal abnormalities were frequent, with proteinuria in 26.3% and reduced eGFR in 33.1%.

Among lipid abnormalities, elevated non-HDL cholesterol (64.1%) and LDL-cholesterol (54.3%) predominated; 50.0% had hypercholesterolaemia, 40.7% hypertriglyceridaemia, and 38.9% low HDL-cholesterol. A high atherogenic index was present in 43.7%.

Sex- and Age-Specific Distribution

Women had higher prevalences of hypertension (75.1% vs. 64.1%; $p = 0.017$), truncal obesity (88.6% vs. 34.4%; $p < 0.001$), and metabolic syndrome (40.8% vs. 13.3%; $p < 0.001$), whereas dyslipidaemia was more prevalent in men (98.0% vs. 62.7%; $p < 0.001$). Men also had higher prevalences of elevated non-HDL cholesterol and atherogenic index (both $p < 0.001$). No sex differences were observed for proteinuria or reduced eGFR. Across age groups, most risk factors did not vary significantly, although renal abnormalities increased with advancing age.

Clustering of Cardiovascular Risk Factors

Risk factor clustering was common (Table 4). Few participants had ≤1 risk factor, while a high-risk profile (≥4 factors) was more frequent in women than men (64.7% vs. 40.0%; $p < 0.001$).

In multivariable analysis (Table 5), truncal obesity was the only independent predictor of high-risk clustering, conferring more than fivefold higher odds. Sex, age, diabetes duration, and glycaemic status were not independently associated.

For renal outcomes (Table 6), older age (≥60 years) and longer diabetes duration (>10 years) independently predicted reduced eGFR. For dyslipidaemia (Table 7), male sex and general obesity were independent predictors, whereas age, hypertension, and diabetes duration were not.

Discussion

In this retrospective study of adults with T2DM attending a tertiary clinic in Northwestern Nigeria, we observed a high and overlapping burden of cardiovascular risk factors, including dyslipidaemia, hypertension, truncal obesity, renal abnormalities, and marked clustering. These findings indicate a substantial cardiometabolic risk profile and an increased likelihood of future cardiovascular morbidity.

Dyslipidaemia was the most prevalent risk factor, affecting over four-fifths of participants, exceeding estimates from many global and African populations but consistent with Nigerian clinic-based studies[16-19].This reflects diabetes-related metabolic disturbances, including insulin resistance and altered lipoprotein metabolism[20,21]. The high prevalence of elevated non-HDL cholesterol and atherogenic index suggests a substantial residual atherogenic burden beyond LDL-cholesterol alone[10,11]. These markers are increasingly recognised as strong predictors of cardiovascular disease and indicate that reliance on LDL-cholesterol may underestimate risk.

Pronounced sex differences were observed, with dyslipidaemia and adverse atherogenic indices more prevalent among men. Although this contrasts with some reports[16-18], the findings should be interpreted cautiously, as differences in referral patterns, healthcare utilisation, and treatment exposure may contribute. These results highlight the importance of sex-sensitive cardiovascular risk assessment.

Hypertension affected nearly 70% of participants, consistent with global and regional evidence[22-27]. The frequent coexistence of diabetes and hypertension reflects shared mechanisms, including endothelial dysfunction, arterial stiffness, sympathetic activation, and renin–angiotensin–aldosterone system upregulation[28,29]. This combination markedly increases the risk of stroke, coronary artery disease, and heart failure, underscoring the importance of routine blood pressure screening and control in diabetes care.

Truncal obesity predominated and was nearly twice as common as general obesity. This pattern of central fat distribution is a stronger predictor of cardiovascular disease than body mass index and reflects adverse adiposity associated with insulin resistance and atherogenic dyslipidaemia[30,31]. In multivariable analysis, truncal obesity was the only independent predictor of high-risk clustering, underscoring its pivotal role in cumulative cardiometabolic risk. The higher prevalence among women suggests sex-specific vulnerability influenced by sociocultural factors, physical inactivity, postmenopausal changes, and diagnostic criteria emphasising waist circumference.

Renal abnormalities were common, with over one-quarter exhibiting proteinuria and one-third reduced eGFR, consistent with regional evidence of early diabetic kidney disease[32-38]. Increasing age and longer diabetes duration predicted renal dysfunction, reflecting disease progression. In resource-limited settings, delayed diagnosis and limited access to renoprotective therapy may accelerate injury, while genetic susceptibility, including APOL1 variants, may contribute[39]. Renal dysfunction also represents a major amplifier of cardiovascular risk.

Clustering of cardiovascular risk factors was pronounced, with most participants exhibiting multiple abnormalities and a substantial proportion meeting high-risk criteria. Such clustering confers multiplicative risk and has been linked to adverse outcomes. The higher burden among women, driven largely by truncal obesity and metabolic syndrome, is consistent with Nigerian and regional studies and supports assessing cardiovascular risk factors collectively rather than in isolation[40,41].

Implications for Clinical Care and Public Health

These findings highlight the limitations of glucose-centred diabetes care in sub-Saharan Africa. The high prevalence and clustering of non-glycaemic risk factors underscore the need for integrated cardiovascular risk reduction within routine diabetes management. In low-resource settings, underdiagnosis and undertreatment remain common due to cost constraints and limited diagnostic capacity.

Without intervention, projections indicate a rising cardiovascular disease burden among people with diabetes in Africa, with major health-system and economic consequences[42-44]. The relatively young age of participants further heightens concern, as prolonged exposure to multiple risk factors is likely to result in earlier complications. Strengthening comprehensive risk assessment, improving access to essential medications, and prioritising lifestyle interventions are therefore critical.

Strengths and Limitations

This study provides a comprehensive profile of cardiovascular risk factors and clustering in a real-world clinical setting. However, its retrospective cross-sectional design limits causal inference and relies on routine records. Behavioural factors, HbA1c, and medication use were not consistently available, and the hospital-based setting may limit generalisability.

Conclusion

Adults with T2DM in Northwestern Nigeria exhibit a high prevalence and pronounced clustering of cardiovascular risk factors, with important sex- and age-related patterns. The frequent coexistence of dyslipidaemia, hypertension, truncal obesity, and renal dysfunction underscores the need to move beyond glucose-focused care toward integrated cardiovascular prevention strategies to reduce premature morbidity and mortality.

Table 1. Sociodemographic and Clinical Characteristics of Study Participants (N = 396)

Characteristic	**Value**
Age (years), mean ± SD	53.3 ± 11.3
Male Sex, n (%)	195 (49.2)
Duration of Diabetes (years), median (IQR)	4 (2 – 8)
Duration of Hypertension (years), median (IQR)	5 (2 – 9)
BMI (kg/m²)	27.6 ± 6.3
Waist Circumference (cm)	92.5 ± 13.6
Mean Fasting Blood Glucose (mmol/L)	7.9 ± 3.2
Mean 2-hr Postprandial Glucose (mmol/L)	10.9 ± 3.8
TC (mmol/L)	5.1 ± 1.2
LDL (mmol/L)	2.7 ± 1.3
TG (mmol/L)	1.6 ± 0.8
HDL (mmol/L)	1.4 ± 0.8
Non-HDL (mmol/L)	3.7 ± 1.3
Atherogenic Index	0.1 ± 0.3
eGFR (mL/min/1.73m²)	74.8 ± 31.4
SD = Standard Deviation; IQR = Interquartile Range; TC = Total Cholesterol; LDL = Low Density Lipoprotein; TG = Triglycerides; HDL = High Density Lipoprotein; eGFR = Estimated Glomerular Filtration Rate	

Table 2. Prevalence of Cardiovascular Risk Factors among Study Participants (N = 396)

Risk Factor	**Prevalence, n (%)**
Hypertension	276 (69.7)
Dyslipidemia	317 (80.1)
– High total cholesterol	198 (50)
– High LDL-C	215 (54.3)
– Low HDL-C	154 (38.9)

– High TG	161 (40.7)
High non-HDL-C	254 (64.1)
High atherogenic index	173 (43.7)
Obesity (BMI ≥ 30 kg/m²)	129 (32.6)
Truncal obesity (≥ 80women, ≥ 94 men)	245 (61.9)
Metabolic syndrome	108 (27.3)
Proteinuria (≥ 1+ on dipstick)	104 (26.3)
Reduced eGFR (< 60 mL/min/1.73m²)	131 (33.1)
LDL = Low Density Lipoprotein; TG = Triglycerides; HDL = High Density Lipoprotein; BMI = Body Mass Index; eGFR = Estimated Glomerular Filtration Rate	

Table 3. Distribution of Cardiovascular Risk Factors by Sex and Age Group

Variable	**Male (n =195)**	**Female (n= 201)**	**p-value**	**< 40 yrs (n= 41)**	**40 – 59 yrs (n= 233)**	**≥ 60 yrs (n= 122)**	**p-value**
Hypertension, n (%)	125(64.1)	151 (75.1)	0.017	27 (65.9)	165 (70.8)	84 (68.9)	0.792
Dyslipidemia, n (%)	191 (98.0)	126 (62.7	0.000	33 (80.5)	183 (78.5)	101 (82.8)	0.636
High non-HDL-cholesterol	195 (100)	59 (29.4)	0.000	27 (65.9)	150 (64.4)	77 (63.1)	0.945
High atherogenic index	106 (54.4)	67 (33.3)	0.000	17 (41.5)	106 (45.5)	50 (41.0)	0.689
Obesity, n (%)	62 (31.8)	67 (33.3)	0.744	14 (34.2)	82 (35.2)	33 (27.1)	0.291
Truncal obesity, n (%)	67 (34.4)	178 (88.6)	0.000	21 (51.2)	146 (62.7)	78 (63.9)	0.324

Metabolic Syndrome, n (%)	26 (13.3)	82 (40.8)	< 0.001	7 (17.1)	63 (27.0)	38 (31.2)	0.214
Proteinuria, n (%)	52 (26.7)	52 (25.9)	0.857	4 (9.8)	59 (25.3)	41 (33.6)	0.010
Reduced eGFR, n (%)	63 (32.3)	68 (33.3)	0.747	8 (19.5)	69 (29.6)	54 (44.2)	0.003

HDL = High Density Lipoprotein; eGFR = Estimated Glomerular Filtration Rate. ***Reduced eGFR was defined as <60 mL/min/1.73 m² using the CKD-EPI equation. Truncal obesity was defined as waist circumference ≥94 cm in men and ≥80 cm in women.***

Table 4. Distribution of Composite Cardiovascular Risk Factors by Sex and Age Group in Patients With Type 2 Diabetes Mellitus (N=396)

Number of risk factors	Male (n = 195)	Female (n = 201)	p - value	< 40 yrs (n = 41)	40 – 59 yrs (n =233)	≥ 60 yrs (n =122)	p - value
0 – 1	**5 (2.6)**	**9 (4.5)**	< 0.001	**2 (4.9)**	**9 (3.9)**	**3 (2.5)**	**0.510**
2 – 3	**112 (57.4)**	**62 (30.9)**		**22 (53.7)**	**96 (41.2)**	**56 (45.9)**	
≥ 4	**78 (40.00**	**130 (64.7)**		**17 (41.5)**	**128 (54.9)**	**63 (51.6)**	

Table 5. Multivariable Logistic Regression Analysis of Factors Associated withHigh Cardiovascular Risk Factor Clustering (≥4 Risk Factors) among Patients with Type 2 Diabetes (N = 396)

Predictor	Adjusted OR (95% CI)	p-value
Sex (male vs female	1.34 (0.80 – 2.26)	0.265
Age group (years)		
40 – 59 vs < 40	1.65 (0.79 – 3.45)	0.184
≥ 60 vs < 40	1.08 (0.48 – 2.41)	0.856
Duration of diabetes (years)		
5 – 10 vs < 5	1.15 (0.72 – 1.84)	0.562
> 10 vs <5	0.66 (0.34 – 1.28)	0.216
Poor glycaemic control (mean FBS,mmol/L)		
>7.2 vs 4.4 – 7.2	0.96 (0.62 – 1.49)	0.860

Truncal obesity Present vs absent	5.15 (2.95 – 8.99)	<0.001
Model: LR χ^2 = 52.17, p < 0.001; pseudo R^2 = 0.096. High clustering = ≥4 risk factors. Reference categories: female, age <40 years, diabetes duration <5 years. Poor glycaemic control = fasting glucose outside 4.4–7.2 mmol/L; truncal obesity = waist ≥94 cm (men) or ≥80 cm (women).		

Table 6. Multivariable Logistic Regression Analysis of Factors Associated withRenal Abnormality (Reduced Creatinine Clearance) among Patients with Type 2 Diabetes (N = 396)

Predictor	**Adjusted OR (95% CI)**	**p-value**
Sex Male vs Female	1.08 (0.60 – 1.94)	0.800
Age group (years) 40–59 vs <40 ≥60 vs <40	0.62 (0.26 – 1.43) 0.41 (0.17 – 0.99)	0.260 0.048
Duration of diabetes (years) 5–10 vs <5 >10 vs <5	0.69 (0.42 – 1.13) 0.23 (0.12 – 0.44)	0.137 <0.001
Hypertension Present vs absent	1.20 (0.74 – 1.94)	0.461
Truncal obesity Present vs absent	0.92 (0.53 – 1.60)	0.770
Poor glycaemic control (mean FBS) Abnormal vs normal	0.90 (0.57 – 1.42)	0.645
Dyslipidaemia Present vs absent	1.08 (0.59 – 1.99)	0.808
Model: LR χ^2 = 33.52, p < 0.001; Pseudo R^2 = 0.067. Renal abnormality = reduced creatinine clearance. Reference categories: female, age <40 years, diabetes duration <5 years, no hypertension, no truncal obesity, normal fasting glucose, no dyslipidaemia. aORs from multivariable logistic regression.		

Table 7. Multivariable Logistic Regression Analysis of Factors Associated with Dyslipidaemia among Patients with Type 2 Diabetes (N = 396)

Predictor	Adjusted OR (95% CI)	p-value
Sex Male vs Female	33.34 (11.67 – 95.24)	<0.001
Age group (years)		
40–59 vs <40	0.81 (0.32 – 2.04)	0.648
≥60 vs <40	1.03 (0.37 – 2.86)	0.949
Duration of diabetes (years)		
5–10 vs <5	0.96 (0.52 – 1.78)	0.898
>10 vs <5	1.17 (0.48 – 2.83)	0.732
Hypertension		0.164
Present vs absent	1.57 (0.83 – 2.96)	
General obesity		0.030
Present vs absent	2.02 (1.07 – 3.81)	
Poor glycaemic control (mean FBS)		0.087
Abnormal vs normal	1.66 (0.93 – 2.95)	
Model: LR $\chi^2 = 100.87$, $p < 0.001$; Pseudo $R^2 = 0.255$. Dyslipidaemia = standard lipid abnormalities. Reference categories: female, no hypertension, age <40 years, diabetes duration <5 years, non-obese BMI, normal fasting glucose. aORs from multivariable logistic regression.		

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