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Control to Target of Cardiometabolic Risk Factors among Type 2 Diabetic Out-Patients: An Experience from A Tertiary Health Facility in South-Eastern Nigeria

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ABSTRACT

Background: *Clusters of cardiometabolic risk factors (CMRFs) are very common in type 2 diabetes mellitus (T2DM) subjects, placing them at increased risk of cardiac events.*

Objective: *To evaluate the status of control of the CMRFs and its associations among T2DM subjects at NAUTH, Nigeria.*

Materials and Methods: *This was a cross-sectional descriptive study that evaluated 228 T2DM out-patients seen at NAUTH. Relevant data were extracted with a researcher-designed study proforma and anthropometric measurements done. Biochemical tests: glycated haemoglobin (HbA1c), fasting blood glucose (FBG) and fasting lipid profile (FLP) were done. Data was analysed using SPSS version 28. Categorical and continuous variables were summarized using frequencies and percentages and mean and standard deviation respectively and results presented in tables. Associations of the CMRFs were tested using Chi-square test. The level of significance was set at $p < 0.05$.*

Results: *There were 114 male and female subjects with mean age and mean duration of DM of 59.35±14.82 years and 9.97 ± 7.94 years respectively. There was suboptimal control for HbA1c, FPG, abdominal and global obesity but not for systolic and diastolic blood pressures (SBP & DBP), total cholesterol (TC) and triglycerides*

(TG). Besides TG, optimal control of HbA1c was significantly associated with educational level; FBG with antihypertensive medication use; abdominal obesity with sex and use of lipid lowering medications; SBP with age, marital status and antihypertensive medications use; DBP with DM treatment and antihypertensive medications use; TC with educational level; HDL-C with sex and educational level; LDL-C with sex and type of DM treatment and finally; dyslipidaemia with sex, educational level and the use of lipid lowering medications.

Conclusion: *There was suboptimal control of most of the CMRFs evaluated among the subjects. With the exception of TG, there was significant association between optimal control of the CMRFs and some of the socio-clinical determinants evaluated.*

Keywords
Cardiometabolic risk factors, Control, Target, Type 2 diabetes.

Introduction
Diabetes mellitus (DM) is defined as a group of metabolic disorders of multiple aetiology characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both [1].

Diabetes mellitus is assuming a pandemic level globally. International Diabetes Federation (IDF) estimated that 425 million people had DM globally and this figure was projected to rise to 629 million by the year 2045 [2]. Diabetes mellitus is classified into type 1 diabetes mellitus (T1DM), type 2 diabetes mellitus (T2DM), gestational diabetes mellitus (GDM) and the others. Type 2 DM constitutes about 90% of all the cases of diabetes and is viewed as a complex metabolic disorder characterized by various proportions of insulin resistance, decreased insulin production resulting from increased pancreatic beta cells apoptosis and resultantly increased hepatic glucose output [3]. There is a complex amalgamation of genetic, metabolic and environmental risk factors that contribute to the prevalence of type 2 diabetes mellitus [3]. The current soaring prevalence of DM, more especially T2DM has made it a serious public health concern globally. Nigeria as a country is not left out of this growing global burden. A systematic review and meta-analysis done in 2018 placed the overall pooled prevalence of DM in Nigeria at 5.77% [4]. Adeloye et al. in 2017 found that the age-adjusted prevalence of T2DM in Nigerian adults has increased from 2.0% in 1990 to 5.7% in 2015 [5].

People living with T2DM are more likely to have several cardiometabolic risk factors (CMRFs) that result in cardiovascular diseases (CVDs). These risk factors include but are not limited to poor glycaemic control, obesity especially central obesity, dyslipidaemia and hypertension. A cluster of these CMRFs in an individual, known as metabolic syndrome could double both as a cause or a consequence of type 2 diabetes [6]. Impaired glycaemic control is key in the development of the CMRFs-induced CVDs. It leads to up-regulations of de novo lipogenesis, promotes hepatic triglyceride (TG) synthesis and worsening dyslipidaemia that is accompanied by low levels of high-density lipoprotein cholesterol (HDL-C) and high quantities of small dense, low-density lipoprotein cholesterol (LDL-C) leading to atherosclerosis, endothelial dysfunction, oxidative stress and chronic inflammation [3]. The CMRFs evaluated by this study included glycaemic control (both immediate and long-term glycaemic control), obesity (both central/abdominal and global), dyslipidaemia and hypertension. These risk factors are modifiable and are the basis for therapeutic total life style modification in the management of T2DM that includes medical nutrition therapy, weight reduction for the obese patients and moderate regular aerobic exercise. Adequate and holistic management of T2DM is aimed at not only achieving good glycaemic control but also controlling the other CMRFs of T2DM to their recommended target.

Okafor et al. found a suboptimal glycaemic control, blood pressure control and dyslipidaemia of 65.7%, 51.9% and 97.1% respectively among their T2DM subjects. They also found that 60.1% of their subjects were overweight/obese and on comparing the mean indices of the risk factors with the recommended therapeutic goals that the status of control was optimal for HDL-C, waist circumference (WC) and triglycerides. All other risk factors were suboptimally-controlled [7]. Franch-Nadal et al. found that the duration of DM was associated with a poorer glycaemic control but had a limited role in blood pressure or lipid profile control [8]. Orozco-Beltan et al. found that the proportion of T2DM patients with adequate control for HbA1c, dyslipidaemia and hypertension was 31.0% according to the contemporary clinical practice guide line criteria. According to them therapeutic inertia was greater for dyslipidaemia and hypertension than for type 2 diabetes mellitus [9]. Finally, Zuo et al. in China found that the proportion of their T2DM patients achieving therapeutic target for FPG, BP and LDL-C were 52.6%, 58.2% and 33.0% respectively and that only 11.1% achieved all three goals. Among their patients that did HbA1c, 27.8% achieved HbA1c target. Blood glucose and BP were more likely to be controlled than LDL-C [10].

It is a common knowledge that physicians often focus mainly on therapies aimed at lowering the blood glucose of their diabetic patients, especially their T2DM patients without evaluating for the presence of and ensuring the adequate control of the other associated CMRFs that equally contribute to CVDs, a major cause of morbidity and Mortality in this group of patients. Studies that evaluated holistically the status of control of the CMRFs and the socio-clinical determinants associated with such control among subjects with T2DM are scarce. This study aimed at evaluating the degree of control to recommended target of the CMRFs of T2DM and their associations with certain socio-clinical determinants among T2DM subjects at Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi in South-eastern Nigeria.

Materials and Methods

This was a cross-sectional descriptive hospital-based study among T2DM subjects who were evaluated for the status of control of their CMRFs at the diabetes out-patient clinic of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi in South-eastern Nigeria. This study was carried out between January and December, 2022. A total of 234 subjects with T2DM were recruited for the study. A total of 228 subjects had complete data and were analyzed while 6 subjects had incomplete data that were discarded. The study participants were gender matched. A convenient sampling method was adopted in recruiting the consenting subjects for the study as they were seen consecutively at the diabetes clinic during consultation. Participation in the study was entirely voluntary; subjects were also free to withdraw from the study at any stage and the data generated were handled with confidentiality.

Inclusion Criteria

T2DM subjects aged 30 years and above who gave their written informed consent to participate in the study were recruited while subjects were excluded from the study if they had T1DM or were pregnant or very ill.

The study participants had two contacts with the researcher during the course of the study. At first a focused medical history was taken and a tailored medical examination that included blood pressure (BP) measurement and anthropometric measurements were done according to the WHO STEPS instruments. These and other relevant clinical data were extracted using a researcher-designed and administered study protocol. The next contact with the subjects was at the subsequent clinic appointment between 8:00 to 9:00 am for blood sample collection, after the subjects had observed a 10 – 12 hours fast as they were instructed. 5 ml of blood was collected via venipuncture of the cubital vein from each subject for biochemical tests, while observing strict aseptic procedures; 1 ml for FPG, 3 ml for FLP and another 1 ml for HbA1c. The samples for HbA1c were collected in EDTA bottles and measured with automated CLOVER A1c Analyzer (Infopia, Korea) and CLOVER A1c Self-Test Cartridge using the boronate affinity method [11]. The blood samples for FPG were collected in fluoride oxalate bottles and measured by the Trinder glucose oxidase method [12]. The blood samples for FLP were collected in plain bottles. High density lipoprotein cholesterol (HDL-C) level was measured by precipitation technique [13]. Total cholesterol (TC) level was determined using a kit employing the enzymatic and the 4-hyroxybenzoate/4-aminophenazone system (Biosystem) [14]. Triglyveride (TG) level was determined using a kit employing enzymatic hydrolysis of triglyceride with lipases (Randox) and LDL-C was measured using a kit employing a precipitation technique [15,16]. Weight and height were measured using Stadiometer (RGZ-120), waist and hip circumference measured with a measuring tape and blood pressure using Accoson mercury sphygmomanometer all in line with the WHO STEPS instruments. Optimal control for the CMRFs for the subjects was defined by the following therapeutic goals: FBG of 5.0 – 7.2 mmol/L, SBP of ≤ 130 mmHg and DBP of ≤ 80 mmHg, HbA1c of ≤ 7.0%, BMI of < 25.0 kg/m^2 and < 30.0 kg/m^2 for overweight and obesity respectively, WC of ≤ 102 cm for males and ≤ 88 cm for females, HDL-C of ≥ 1.04 mmol/L for males and ≥ 1.3 mmol/L for females respectively, LDL-C of < 2.6 mmol/L, TG of < 1.7 mmol/L and TC of < 5.2 mmol/L [16,17].

Statistical Analysis

The data collected were entered into Microsoft Excel spread sheet and analysed using the IBM SPSS version 28. The data analysis was done using both descriptive and inferential statistics. The categorical variables were analysed and summarized using frequencies and percentages while continuous variables were analysed using mean and standard deviation and results presented in tables. Inferential statistics were used to provide deeper understanding of the descriptive statistics. The association between the status of CMRFs and the socio-clinical determinants were tested using Wald's Chi-square test. All inferences and conclusions were made at 95% confidence interval and the significance level was set at $p < 0.05$.

Definition of Terms and Criteria

1. Hypertension was defined as systolic BP ≥ 140mmHg and or diastolic BP ≥ 90 mmHg, measured on at least 2 separate occasions or if a patient is already on anti-hypertensive medications [18].
2. Diabetes mellitus was defined by fasting plasma glucose of ≥ 7.0 mmol/l (126 mg/dl) measured on at least 2 separate occasions or the patient is already on glucose lowering agents [1].
3. Type 1 DM was defined as subjects with DM who are dependent on insulin for survival and are at risk for ketoacidosis [1].
4. Type 2 DM was defined as patients with DM on diet therapy either alone or in combination with oral glucose lowering agent (s) for glycaemic control [1].
5. Dyslipidaemia was taken as HDL-C < 1.04 mmol/L (males) or < 1.3 mmol/L or TG ≥ 1.7 mmol/L or LDL-C ≥ 2.6 mmol/L or total cholesterol (TC) ≥ 5.2 mmol/L or if the patient is on lipid lowering agents [6].
6. Young age was taken as 18-44 years, middle age as 45-64 years and old age as 65 years and above [19].

Result

A total of 228 T2DM subjects had complete data and were analysed. They comprised 114 male and female subjects respectively.

Descriptive Statistics of the Studied Subjects

The mean duration of DM among the subjects was 9.79 ± 7.94 years, mean WC for males was 98.68 ± 12.41 cm, mean WC for female was 99.61 ± 12.13 cm and the overall mean WC was 99.15 ± 12.25 cm. Next, the mean BMI for the subjects was 28.11 ± 5.55 kg/m^2, mean HbA1c was 8.35 ± 2.20 %, mean FBG was 8.55 ± 3.67 mmol/L, mean SBP was 129.23 ± 21.71 mmHg and mean DBP was 78.43 ± 13.97 mmHg. Mean TC was 4.54 ± 1.22 mmol/L, mean TG was 1.34 ± 0.82 mmol/L, mean HDL-C was 1.09 ± 0.35 mmol/L and mean LDL-C was 2.84 ± 1.08 mmol/L (details in Table 1).

Table 1: Descriptive statistics of the studied subjects.

Parameters	Minimum	Maximum	Mean	SD
DM duration (years)	0.25	40.00	9.79	7.94
WC (cm)	70.00	131.00	99.15	12.25
WC - male (cm)	72.50	131.00	98.68	12.41
WC – female (cm)	70.00	127.00	99.61	12.13
HC (cm)	63.00	143.00	104.37	12.06
W/H Ratio	0.39	1.34	0.94	0.09
BMI (mm/kg^2)	18.28	45.18	28.11	5.55
HbA1c (%)	3.37	15.60	8.35	2.20
FBG (mmol/L)	4.00	28.40	8.55	3.67
SBP (mmHg)	70.00	230.00	129.23	21.71
DBP (mmHg)	50.00	170.00	78.43	13.97
TC (mmol/L)	1.09	8.8	4.54	1.22
TG (mmol/L)	0.19	6.10	1.34	0.82
HDL-C (mmol/L)	0.24	3.09	1.09	0.35
LDL-C (mmol/L)	0.10	7.01	2.84	1.08

DM: Diabetes Mellitus; WC: Waist Circumference; HC: Hip Circumference; W/H: Waist to Hip ratio; BMI: Body Mass Index; HbA1c: Glycated Haemoglobin; FBG: Fasting Blood Glucose; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC: Total Cholesterol; TG: Triglyceride; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol.

Socio-Demographic Characteristics of the Studied Subjects

Half of the respondents 114 (50.0%) were male and female subjects respectively. More than half of the subjects, 115 (50.4%) were between 45 and 64 years of age (middle age); 84 (36.8%) were aged 65 years and above, while 29 subjects (12.7%) were between the ages of 30 and 44 years. The mean age of the respondents was 59.35±14.82 years. Majority of the respondents: 192 (84.2%) were married, while less than one fifth: 25 (11.0%) were widowed and a few of the respondents: 11 (4.8%) were single. Regarding the educational attainment of the respondents; 95 (41.7%) had tertiary education, 50 (21.9%) had secondary education, 78 (34.2%) had primary education, while a few 5 (2.2%) had no formal education (details as in table 2).

Table 2: Socio-demographic characteristics of the studied subjects.

Variable	Frequency	Percent
Age (years)		
Young age	29	12.7
Middle age	115	50.4
Elderly	84	36.8
Mean age ± SD	**59.35±14.82**	
Sex		
Male	114	50.0
Female	114	50.0
Marital Status		
Single	11	4.8
Married	192	84.2
Widowed	25	11.0
Education		
No formal	5	2.2
Primary	78	34.2
Secondary	50	21.9
Tertiary	95	41.7

Clinical Characteristics of the Studied Subjects

A total of 65.4% of the subjects had DM for five years and above (long duration), 72.4% were on oral antidiabetic drugs (OADs), 6.6% were on insulin, 1.3% on diet alone for blood glucose control while 19.7% were on both OADs and insulin for blood glucose control. Also 57% were known hypertensive patients and 55.7% were on antihypertensive medication (s) and over half of them (53.4%) were taking angiotensin converting enzyme inhibitors (ACEI). 91.2% of the subjects had dyslipidaemia and 64.5% were on lipid lowering drugs while only 18.9% of the subjects engaged in regular exercise (details shown in Table 3).

Table 3: Clinical Characteristics of the Studied Subjects.

Variable	Frequency	Percent
DM Duration		
Long	149	65.4
Short	79	34.6
DM Treatment		
OADs	165	72.4
OADs and Insulin	45	19.7
Insulin alone	15	6.6
Diet alone	3	1.3
Known Hypertensive		
Yes	130	57
No	98	43
On antihypertensive medications		
Yes	127	55.7
No	101	44.3
Antihypertensive medications the subjects were taking		
ACEIs	70	53.4
ARBs	56	42.7
Others	5	3.8
Dyslipidemia		
Present	208	91.2
Absent	20	8.8
On Lipid lowering medications		
Yes	147	64.5
No	81	35.5
Exercise		
Yes	43	18.9
No	185	81.1

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Status of the Control of the Cardiometabolic Risk Factors among the Subjects

Among the subjects, 26.3% and 42.1% had their glycated haemoglobin (HbA1c) and fasting plasma glucose (FBG) controlled optimally respectively. Almost two-third (71.5%) of the subjects had abdominal (central) obesity of which 56.1% and 86.6% of them were males and females respectively. Similarly, 35.5% of the subjects had global obesity, 32.9% were overweight while 31.6% had normal body mass index. Also 63.2% and 71.9% of the subjects had optimal SBP and DBP control respectively while 70.6%, 78.1%, 43.0% and 41.2% of the subjects had their

TC, TG, HDL-C, and LDL-C controlled optimally. Overall, 91.2% of the subjects had dyslipidaemia (details on Table 4).

Table 4: Status of the Control of the Cardiometabolic Risk Factors among the Subjects.

Variable	Frequency	Percent
HbA1c control		
Optimal	60	26.3
Suboptimal	168	73.7
FBG control		
Optimal	96	42.1
Suboptimal	132	57.9
Abdominal Obesity (over all)		
Present	163	71.5
Absent	65	28.5
Abdominal Obesity (Male)		
Present	64	56.1
Absent	50	43.9
Abdominal Obesity (Female)		
Absent	99	86.6
Absent	15	13.2
BMI		
Normal	72	31.6
Overweight	75	32.9
Global obesity	81	35.5
SBP control		
Optimal	144	63.2
Suboptimal	84	36.8
DBP control		
Optimal	164	71.9
Suboptimal	64	28.1
TC control		
Optimal	161	70.6
Suboptimal	67	29.4
TG control		
Optimal	178	78.1
Suboptimal	50	21.9
HDL-C control		
Optimal	98	43
Suboptimal	130	57
LDL-C control		
Optimal	94	41.2
Suboptimal	134	58.8
Dyslipidemia		
Present	208	91.2
Absent	20	8.8

HbA1c: Glycated Haemoglobin; FBG: Fasting Blood Glucose; BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC: Total Cholesterol; TG: Triglyceride; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol.

Association between the status of control of HbA1c and selected socio-clinical determinants among the subjects

The result showed that increasing educational level had a statistically significant association with optimal HbA1c control ($p<0.05$). The subjects with tertiary education had good long-term glycaemic (HbA1c) control compared to those with lower educational levels (details in Table 5).

Table 5: Association between the Status of Control of HbA1c and Socio-clinical Determinants among the Subjects.

Variable	HbA1c Control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	9 (31)	20 (69)	0.545	0.762
Middle age	30 (26.1)	85 (73.9)		
Elderly	21 (25.0)	63 (75.0)		
Sex				
Male	32 (28.1)	82 (71.9)	0.362	0.547
Female	28 (24.6)	86 (75.4)		
Marital status				
Single	5 (45.5)	6 (54.5)	2.828	0.243
Married	47 (24.5)	145 (75.5)		
Widowed	8 (32)	17 (68)		
Education				
No formal	1 (20)	4 (80)	8.066	0.044*
Primary	17 (21.8)	61 (78.2)		
Secondary	8 (16.0)	42 (84)		
Tertiary	34 (35.8)	61 (64.2)		
DM duration				
Long	35 (23.5)	114 (76.5)	1.771	0.183
Short	25 (31.6)	54 (68.4)		
DM treatment				
OADs	48 (29.1)	117 (70.9)	3.419	0.331
OADs and Insulin	10 (22.2)	35 (77.8)		
Insulin only	2 (13.3)	13 (86.7)		
Diet alone	0 (0)	3 (100)		
Exercise				
Yes	10 (23.3)	33 (76.7)	0.256	0.613
No	50 (27)	135 (73)		
On antihypertensive medications				
Yes	38 (29.9)	89 (70.1)	1.922	0.166
No	22 (21.8)	79 (78.2)		
Antihypertensive medications				
ACEIs	18 (25.7)	52 (74.3)	2.887	0.236
ARBs	18 (32.1)	38 (67.9)		
Others	3 (60)	2 (40)		
On lipid lowering medications				
Yes	39 (26.5)	108 (73.5)	0.01	0.921
No	21 (25.9)	60 (74.1)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Association between the status of control of FBG and selected socio-clinical determinants among the subjects

Chi-square test was done to determine the association between the control of FBG and some selected socio-clinical determinants among the studied population. The result showed that the use of antihypertensive medications and the type of antihypertensive medications used had a statistically significant association with

optimal FBS control (p<0.05). The subjects on anti-hypertensive medications and those specifically taking ACEIs had optimal FBG control (details in Table 6).

Table 6: Association between the Control of FBG and Selected Socio-clinical Factors among the Subjects.

Variable	FBG Control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	14 (48.3)	15 (51.7)	2.971	0.226
Middle age	42 (36.5)	73 (63.5)		
Elderly	40 (47.6)	44 (52.4)		
Sex				
Male	50 (43.9)	64 (56.1)	0.288	0.592
Female	46 (40.4)	68 (59.6)		
Marital status				
Single	7 (63.6)	4 (36.4)	3.597	0.166
Married	76 (39.6)	116 (60.4)		
Widowed	13 (52)	12 (48)		
Education				
No formal	3 (60)	2 (40)	2.352	0.503
Primary	28 (35.9)	50 (64.1)		
Secondary	22 (44)	28 (56)		
Tertiary	43 (45.3)	52 (54.7)		
DM duration				
Long	58 (38.9)	91 (61.1)	1.783	0.182
Short	38 (48.1)	41 (51.9)		
DM treatment				
OADs	76 (46.1)	89 (53.9)	6.593	0.086
OADs and Insulin	13 (28.9)	32 (71.1)		
Insulin only	7 (46.7)	8 (53.3)		
Diet alone	0 (0)	3 (100)		
Exercise				
Yes	19 (44.2)	24 (55.8)	0.094	0.759
No	77 (41.6)	108 (58.4)		
On antihypertensive medications				
Yes	61 (48.0)	66 (52.0)	4.13	0.042*
No	35 (34.7)	66 (65.3)		
Antihypertensive medications				
ACEIs	37 (52.9)	33 (47.1)	8.55	0.014*
ARBs	21 (37.5)	35 (62.5)		
Others	5 (100)	0 (0)		
On lipid lowering medications				
Yes	60 (40.8)	87 (59.2)	0.282	0.595
No	36 (44.4)	45 (55.6)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Association between the Status of Control of Abdominal Obesity and selected Socio-clinical Determinants among the Subjects

The result showed that sex and use of lipid lowering medications had a statistically significant association with optimal control of abdominal obesity (p<0.05). Male subjects had less abdominal adiposity. Equally the subjects taking lipid lowering medications had less abdominal obesity (details in Table 7).

Table 7: Association between the Control of Abdominal Obesity and some selected Socio-clinical Determinants among the Subjects.

Variable	Abdominal Obesity		χ^2	p-value
	Present n (%)	Absent n (%)		
Age (years)				
Young age	26 (89.7)	3 (10.3)	5.448	0.066
Middle age	80 (69.6)	35 (30.4)		
Elderly	57 (67.9)	27 (32.1)		
Sex				
Male	64 (56.1)	50 (43.9)	26.361	0.000*
Female	99 (86.8)	15 (13.2)		
Marital status				
Single	7 (63.6)	4 (36.4)	1.213	0.545
Married	140 (72.9)	52 (27.1)		
Widowed	16 (64)	9 (36)		
Education				
No formal	3 (60)	2 (40)	3.717	0.294
Primary	51 (65.4)	27 (34.6)		
Secondary	35 (70)	15 (30)		
Tertiary	74 (77.9)	21 (22.1)		
DM duration				
Long	105 (70.5)	44 (29.5)	0.22	0.639
Short	58 (73.4)	21 (26.6)		
DM treatment				
OADs	118 (71.5)	47 (28.5)	0.281	0.964
OADs and Insulin	33 (73.3)	12 (26.7)		
Insulin alone	10 (66.7)	5 (33.3)		
Diet alone	2 (66.7)	1 (33.3)		
Exercise				
Yes	35 (81.4)	8 (18.6)	2.551	0.11
No	128 (69.2)	57 (30.8)		
On antihypertensive medications				
Yes	90 (70.9)	37 (29.1)	0.055	0.815
No	73 (72.3)	28 (27.7)		
Antihypertensive medications				
ACEIs	49 (70)	21 (30)	2.126	0.345
ARBs	39 (69.6)	17 (30.4)		
Others	5 (100)	0 (0)		
On lipid lowering medications				
Yes	115 (78.2)	32 (21.8)	9.223	0.002*
No	48 (59.3)	33 (40.7)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Association between the Status of Control of Blood Pressure and Selected Socio-clinical Determinants among the Subjects

Age, marital status and as well as antihypertensive medications use among the subjects had a statistically significant association with optimal SBP control (p<0.05). Subjects who were of young age, single and those on anti-hypertensive medications had optimal control of SBP. Also, the type of DM Treatment, the use of antihypertensive medications and the type of antihypertensive medications used by the subjects had a statistically significant

association with optimal DBP control (p<0.05). Subjects who were on both OADs and insulin for their DM treatment, those on antihypertensive medications as well as those that were specifically taking ACEIs had optimal control of DBP (details in Tables 8 & 9).

Table 8: Association between the status of control of Systolic blood pressure and selected socio-clinical determinants among the subjects.

Variable	SBP Control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	25 (86.2)	4 (13.8)	7.720	0.021*
Middle age	70 (60.9)	45 (39.1)		
Elderly	49 (58.3)	35 (41.7)		
Sex				
Male	79 (69.3)	35 (30.7)	3.694	0.055
Female	65 (57)	49 (43)		
Marital status				
Single	10 (90.9)	1 (9.1)	6.121	0.043*
Married	122 (63.5)	70 (36.5)		
Widowed	12 (48)	13 (52)		
Education				
No formal	3 (60)	2 (40)	1.604	0.659
Primary	45 (57.7)	33 (42.3)		
Secondary	33 (66)	17 (34)		
Tertiary	63 (66.3)	32 (33.7)		
DM duration				
Long	89 (59.7)	60 (40.3)	2.17	0.141
Short	55 (69.6)	24 (30.4)		
DM treatment				
OADs	105 (63.6)	60 (36.4)	0.686	0.876
OADs and Insulin	29 (64.4)	16 (35.6)		
Insulin alone	8 (53.3)	7 (46.7)		
Diet alone	2 (66.7)	1 (33.3)		
Exercise				
Yes	27 (62.8)	16 (37.2)	0.003	0.956
No	117 (63.2)	68 (36.8)		
On antihypertensive medications				
Yes	63 (49.6)	64 (50.4)	22.627	0.000*
No	81 (80.2)	20 (19.8)		
Antihypertensive medications				
ACEIs	37 (52.9)	33 (47.1)	1.383	0.501
ARBs	24 (42.9)	32 (57.1)		
Others	2 (40)	3 (60)		
On lipid lowering medications				
Yes	91 (61.9)	56 (38.1)	0.279	0.597
No	53 (65.4)	28 (34.6)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Association between the status of control of Fasting lipid profile and selected socio-clinical determinants among the subjects

The result showed that educational level had a statistically significant association with optimal control of TC among the subjects (p < 0.05). Subjects that had secondary education had good control of TC compared with those that had other levels of education.

Table 9: Association between the status of Control of Diastolic Blood Pressure and selected Socio-clinical Determinants among the Subjects.

Variable	DBP Control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	22 (75.9)	7 (24.1)	1.21	0.546
Middle age	79 (68.7)	36 (31.3)		
Elderly	63 (75)	21 (25)		
Sex				
Male	86 (75.4)	28 (24.6)	1.39	0.238
Female	78 (68.4)	36 (31.6)		
Marital status				
Single	9 (81.8)	2 (18.2)	5.842	0.054
Married	142 (74)	50 (26)		
Widowed	13 (52)	12 (48)		
Education				
No formal	3 (60)	2 (40)	0.856	0.836
Primary	56 (71.8)	22 (28.2)		
Secondary	38 (76)	12 (24)		
Tertiary	67 (70.5)	28 (29.5)		
DM duration				
Long	107 (71.8)	42 (28.2)	0.003	0.957
Short	57 (72.2)	22 (27.8)		
DM treatment				
OADs	120 (72.7)	45 (27.3)	9.119	0.028*
OADs and Insulin	36 (80.0)	9 (20)		
Insulin alone	6 (40.0)	9 (60)		
Diet alone	2 (66.7)	1 (33.3)		
Exercise				
Yes	31 (72.1)	12 (27.9)	0.001	0.979
No	133 (71.9)	52 (28.1)		
On antihypertensive medications				
Yes	79 (62.2)	48 (37.8)	13.429	0.000*
No	85 (84.2)	16 (15.8)		
Antihypertensive medications				
ACEIs	50 (71.4)	20 (28.6)	7.054	0.029*
ARBs	27 (48.2)	29 (51.8)		
Others	3 (60)	2 (40)		
On lipid lowering medications				
Yes	100 (68)	47 (32)	3.121	0.077
No	64 (79)	17 (21)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

There was no statistically significant association between optimal control of TG and any of the socio-clinical determinants tested (p > 0.05). On the other hand, sex and educational level of the subjects had a statistically significant association with optimal control of HDL-C (p<0.05). Male subjects and those that had secondary education had optimal control of HDL-C compared to their female

counterparts and the subjects with other levels of education. Lastly, sex and type of DM treatment the subjects were getting had a statistically significant association with optimal control of LDL-C ($p<0.05$). Males subject as well as the subjects on insulin treatment had optimal control of LDL-C (details in Tables 10-13).

Association between the Presence of Dyslipidaemia and selected Socio-clinical determinants among the Subjects

Sex and the educational level of the studied subjects had a statistically significant association with dyslipidaemia ($p<0.05$). Males subjects, as well as the subjects with primary education had significantly less incidence of dyslipidaemia (details in Table 14).

Table 10: Association between the status of control of Total cholesterol and selected socio-clinical determinants among the subjects.

Variable	TC control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	23 (79.3)	6 (20.7)	1.366	0.505
Middle age	81 (70.4)	34 (29.6)		
Elderly	57 (67.9)	27 (32.1)		
Sex				
Male	85 (74.6)	29 (25.4)	1.712	0.191
Female	76 (66.7)	38 (33.3)		
Marital status				
Single	9 (81.8)	2 (18.2)	5.134	0.077
Married	139 (72.4)	53 (27.6)		
Widowed	13 (52)	12 (48)		
Education				
No formal	2 (40)	3 (60)	8.506	0.037*
Primary	56 (71.8)	22 (28.2)		
Secondary	42 (84.0)	8 (16.0)		
Tertiary	61 (64.2)	34 (35.8)		
DM duration				
Long	103 (69.1)	46 (30.9)	0.458	0.499
Short	58 (73.4)	21 (26.6)		
DM treatment				
OADs	111 (67.3)	54 (32.7)	3.458	0.326
OADs and Insulin	36 (80)	9 (20)		
Insulin alone	12 (80)	3 (20)		
Diet alone	2 (66.7)	1 (33.3)		
Exercise				
Yes	33 (76.7)	10 (23.3)	0.96	0.327
No	128 (69.2)	57 (30.8)		
On antihypertensive medications				
Yes	94 (74)	33 (26)	1.599	0.206
No	67 (66.3)	34 (33.7)		
Antihypertensive medications				
ACEIs	51 (72.9)	19 (27.1)	0.17	0.918
ARBs	42 (75)	14 (25)		
Others	4 (80)	1 (20)		
On lipid lowering medications				
Yes	99 (67.3)	48 (32.7)	2.128	0.145
No	62 (76.5)	19 (23.5)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Table 11: Association between the Status of Control of Triglyceride and selected Socio-clinical Determinants among the Subjects.

Variable	TG control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	24 (82.8)	5 (17.2)	0.905	0.636
Middle age	87 (75.7)	28 (24.3)		
Elderly	67 (79.8)	17 (20.2)		
Sex				
Male	87 (76.3)	27 (23.7)	0.41	0.522
Female	91 (79.8)	23 (20.2)		
Marital status				
Single	9 (81.8)	2 (18.2)	3.274	0.195
Married	153 (79.7)	39 (20.3)		
Widowed	16 (64)	9 (36)		
Education				
No formal	4 (80)	1 (20)	5.458	0.141
Primary	54 (69.2)	24 (30.8)		
Secondary	41 (82)	9 (18)		
Tertiary	79 (83.2)	16 (16.8)		
DM duration				
Long	122 (81.9)	27 (18.1)	3.644	0.056
Short	56 (70.9)	23 (29.1)		
DM treatment				
OADs	125 (75.8)	40 (24.2)	2.718	0.437
OADs and Insulin	39 (86.7)	6 (13.3)		
Insulin alone	12 (80)	3 (20)		
Diet alone	2 (66.7)	1 (33.3)		
Exercise				
Yes	35 (81.4)	8 (18.6)	0.342	0.559
No	143 (77.3)	42 (22.7)		
On antihypertensive medications				
Yes	97 (76.4)	30 (23.6)	0.48	0.489
No	81 (80.2)	20 (19.8)		
Antihypertensive medications				
ACEI	58 (82.9)	12 (17.1)	4.475	0.107
ARB	38 (67.9)	18 (32.1)		
Others	3 (60)	2 (40)		
On lipid lowering medications				
Yes	118 (80.3)	29 (19.7)	1.172	0.279
No	60 (74.1)	21 (25.9)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Table 12: Association between the Status of Control of High-density Lipoprotein and selected Socio-clinical Determinants among the Subjects.

Variable	HDL-C control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	14 (48.3)	15 (51.7)	2.115	0.347
Middle age	44 (38.3)	71 (61.7)		
Elderly	40 (47.6)	44 (52.4)		
Sex				
Male	65 (57.0)	49 (43.0)	18.326	0.000*
Female	33 (28.9)	81 (71.1)		
Marital status				
Single	6 (54.5)	5 (45.5)	0.697	0.706
Married	82 (42.7)	110 (57.3)		
Widowed	10 (40)	15 (60)		
Education				
No formal	2 (40)	3 (60)	14.617	0.002*
Primary	41 (52.6)	37 (47.4)		
Secondary	28 (56.0)	22 (44'0)		
Tertiary	27 (28.4)	68 (71.6)		
DM duration				
Long	66 (44.3)	83 (55.7)	0.302	0.582
Short	32 (40.5)	47 (59.5)		
DM treatment				
OADs	72 (43.6)	93 (56.4)	2.384	0.497
OAD and Insulin	19 (42.2)	26 (57.8)		
Insulin alone	7 (46.7)	8 (53.3)		
Diet alone	0 (0)	3 (100)		
Exercise				
Yes	13 (30.2)	30 (69.8)	3.515	0.061
No	85 (45.9)	100 (54.1)		
On antihypertensive medications				
Yes	58 (45.7)	69 (54.3)	0.844	0.358
No	40 (39.6)	61 (60.4)		
Antihypertensive medications				
ACEIs	33 (47.1)	37 (52.9)	1.395	0.498
ARBs	25 (44.6)	31 (55.4)		
Others	1 (20)	4 (80)		
On lipid lowering medications				
Yes	58 (39.5)	89 (60.5)	2.1	0.147
No	40 (49.4)	41 (50.6)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Table 13: Association between the Status of Control of Low-density Lipoprotein and selected Socio-clinical determinants among the Subjects.

Variable	LDL-C control		χ^2	p-value
	Optimal n (%)	Suboptimal n (%)		
Age (years)				
Young age	11 (37.9)	18 (62.1)	3.174	0.205
Middle age	42 (36.5)	73 (63.5)		
Elderly	41 (48.8)	43 (51.2)		
Sex				
Male	55 (48.2)	59 (51.8)	4.634	0.031*
Female	39 (34.2)	75 (65.8)		
Marital status				
Single	6 (54.5)	5 (45.5)	2.683	0.261
Married	81 (42.2)	111 (57.8)		
Widowed	7 (28)	18 (72)		
Education				
No formal	2 (40)	3 (60)	0.438	0.932
Primary	30 (38.5)	48 (61.5)		
Secondary	22 (44)	28 (56)		
Tertiary	40 (42.1)	55 (57.9)		
DM duration				
Long	62 (41.6)	87 (58.4)	0.026	0.872
Short	32 (40.5)	47 (59.5)		
DM treatment				
OADs	60 (36.4)	105 (63.6)	9.159	0.027*
OADs and Insulin	22 (48.9)	23 (51.1)		
Insulin alone	11 (73.3)	4 (26.7)		
Diet alone	1 (33.3)	2 (66.7)		
Exercise				
Yes	15 (34.9)	28 (65.1)	0.88	0.348
No	79 (42.7)	106 (57.3)		
On antihypertensive medications				
Yes	57 (44.9)	70 (55.1)	1.58	0.209
No	37 (36.6)	64 (63.4)		
Antihypertensive medications				
ACEIs	28 (40)	42 (60)	1.799	0.407
ARBs	29 (51.8)	27 (48.2)		
Others	2 (40)	3 (60)		
On lipid lowering medications				
Yes	55 (37.4)	92 (62.6)	2.483	0.115
No	39 (48.1)	42 (51.9)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Table 14: Association between the Presence of Dyslipidaemia and selected Socio-clinical determinants among the Subjects.

Variable	Dyslipidemia		χ^2	p-value
	Present n (%)	Absent n (%)		
Age (years)				
Young age	28 (96.6)	1 (3.4)	1.177	0.555
Middle age	104 (90.4)	11 (9.6)		
Elderly	76 (90.5)	8 (9.5)		
Sex				
Male	99 (86.8)	15 (13.2)	5.481	0.019*
Female	109 (95.6)	5 (4.4)		
Marital status				
Single	10 (90.9)	1 (9.1)	1.854	0.396
Married	177 (92.2)	15 (7.8)		
Widowed	21 (84)	4 (16)		
Education				
No formal	5 (100)	0 (0.0)	9.506	0.023*
Primary	65 (83.3)	13 (16.7)		
Secondary	47 (94.0)	3 (6.0)		
Tertiary	91 (95.8)	4 (4.2)		
DM duration				
Long	137 (91.9)	12 (8.1)	0.277	0.599
Short	71 (89.9)	8 (10.1)		
DM treatment				
OADS	150 (90.9)	15 (9.1)	0.393	0.942
OADs and Insulin	41 (91.1)	4 (8.9)		
Insulin alone	14 (93.3)	1 (6.7)		
Diet alone	3 (100)	0 (0)		
Exercise				
Yes	39 (90.7)	4 (9.3)	0.019	0.891
No	169 (91.4)	16 (8.6)		
On antihypertensive medications				
Yes	120 (94.5)	7 (5.5)	3.808	0.051
No	88 (87.1)	13 (12.9)		
Antihypertensive medications				
ACEIs	65 (92.9)	5 (7.1)	1.078	0.583
ARBs	54 (96.4)	2 (3.6)		
Others	5 (100)	0 (0)		
On lipid lowering medications				
Yes	147 (100)	0 (0)	39.786	0.000*
No	61 (75.3)	20 (24.7)		

DM: Diabetes Mellitus; OADs: Oral Antidiabetic Drugs; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin 11 Receptor Blockers.

Discussion

This study evaluated the status of control of the CMRFs among the subjects with T2DM and this is in keeping with previous research works [7,10]. Digban et al. found that the people living with T2DM had significantly higher SBP, FBG, TC, LDL, TG and TG : HDL-C ratio compared to their non-diabetic counterparts [20]. The index study evaluated 228 T2DM subjects with a mean age of 59.75±14.82 years and this is comparable to the 233 T2DM subjects with a mean age of 55.7±11.7 years studied by Okafor et al. equally in South-Eastern Nigeria. Contrastingly, the subjects that participated in this study were gender matched comprising 114 males and females respectively and this study also reported a higher mean duration of DM of 9.79±7.94 years compared to the 98 males and 125 female subjects with a mean duration of DM of 6.7±6.3 years studied by Okafor et al. [7].

Status of Control of Cardio-Metabolic Risk Factors among the Studied Subjects

This study found that less than a third (26.3%) of the subjects had optimal long term glycaemic (HbA1c) control while less than half (42.1%) had optimal short term glycaemic (FBG) control. Also, over two-third (71.5%) of the subjects collectively had abdominal obesity (suboptimal control of WC), of these 56.1% and 86.6% of the male and female subjects had abdominal obesity respectively, while 28.5% of the subjects had optimal control of their WC (absence of abdominal obesity). Additionally, less than a third (31.6%) of the subjects had optimally controlled (normal) BMI, 68.4% had suboptimal control of their BMI, 32.9% were over-weight and 35.5% had overt global obesity.

Also 63.25 and 71.9% of the subjects had optimal control of their systolic and diastolic blood pressures respectively. Almost all the subjects (91.2%) had dyslipidaemia with over half (64.5%) of them taking lipid lowering medications. 70.6% and 78.1% of the subjects had optimal control of their TC and TG respectively, while 43.0% and 41.2% of the subjects had optimal control of their HDL-C and LDL-C respectively. Comparable to this study, Okafor et al. found a suboptimal control of FBS, LDL-C and BMI among their T2DM subjects and then suboptimal control of WC (abdominal obesity) and HDL-C among their female subjects. In contrast to this study, they found suboptimal control of both the SBP, DBP and TC among their subjects, as well as a normal WC (absence of abdominal obesity) and optimal control of HDL-C among their male subjects [7]. Both studies were carried out in South-eastern Nigeria and had a comparable study population and sample size but unlike the index study, Okafor et al did not evaluate the HbA1c levels of their subjects: a marker for long term glycaemic control. The reasons for some of the disparities in the findings could be attributable to the differences in the cut off values of some of the recommended goals by some of the expert groups adopted by the two sets of researchers for the definition of the target control for the different CMRFs. Also, some of the innovations regarding the management of TD2M and its comorbid cardiovascular risk factors that had taken place over the last decade could also account for the differences. Okafor et al. published their study over a decade ago. Also, Digban et al., in North-central Nigeria found that 70% of their T2DM subjects had abdominal obesity and this is comparable to the 71.5% found by this study [20]. Equally, 40% of their patients had optimal control of their SBP which is still similar to the 36.8% recorded by the index study [20]. A little over half of their subjects (57.5%) had dyslipidaemia, a finding much less than the 91.2% found by the index study [20]. It should be noted that although both were Nigerian studies, there were some differences in the methodology applied by the two studies; Digban et al. studied a much smaller number of diabetics (80 T2DM patients) and there were equally some differences in the diagnostic cut off

values adopted by the two studies for the definition of the status of control of some of the cardio-metabolic risk factors.

Franch-Nadal et al. found that the women with cardiovascular diseases (CVDs) had worse overall control of cardiovascular risk factors than men except for smoking. Equally, the women without prior CVDs were only better than men at controlling smoking and BP with no significant difference in glycaemic control [21]. Orozco-Beltran et al. found that the proportion of patients with adequate control for both the HbA1c, dyslipidaemia and hypertension was 31.0% according to the contemporary clinical practice guideline criteria [9]. According to them therapeutic inertia was greater for dyslipidaemia and hypertension than for type 2 diabetes mellitus [9].

Zuo et al. in China found that the population of patients achieving their therapeutic targets for FBG, BP and LDL-C were 52.6%, 58.2% and 33.0% respectively and that only 11.1% achieved all three goals [10]. Among the patients that had a record of HbA1c, 27.8% achieved HbA1c goal and this is comparable to the 26.3% that achieved HbA1c target in the index study [10]. Their subjects achieved better control of FPG (52.6%) but a poorer control of DBP (58.2%) compared with the index study. Additionally, both works recorded comparable suboptimal control for LDL-C among their subjects with less than half: 33.0% and 41.2% achieving optimal LDL-C control respectively as recorded by Zuo et al. and the index study [10]. Additionally, Yan et al. found that only 4.6% of their elderly T2DM subjects aged 60 – 90years met the target control for HbA1c, BP, serum lipid level, serum uric acid level and BMI combined together [22]. Comparable to this study, less than a third (23.0%) of their patients achieved target HbA1c level. They equally found that the patients with poor control of BP, serum lipid, serum uric acid level and BMI had 4.05 times the odd to meet glycaemic target than those with none of the metabolic abnormalities [22]. Lastly, Weeranrathna et al. found that 59.3%, 75.0%, 46.7%, 84.3%, 46.0%, 33.0% and 10.9% of their T2DM patients had optimal control of SBP, DBP, LDL-C, TG, HDL-C, HbA1c and albumin-to-creatinine ratio respectively [23].

Association Between the Status of Control of the Cardio-metabolic Risk Factors and Socio-Clinical Determinants

This study found a statistically significant association between achieving optimal HbA1c control and the educational level of the study-subjects. The subjects that had tertiary education had good HbA1c control. Better education creates better awareness among people generally and there was a significant association between the level of education and good knowledge and management of diabetes among T2DM subjects [24,25]. Diabetic subjects who achieved higher levels of education seemed to have better knowledge, attitude and practices regarding diabetes management that included medical nutrition therapy, exercise and more regular blood glucose monitoring. Also found by this study was the fact that achieving optimal FBG control was significantly associated with the use of antihypertensive medications as well as the type of antihypertensive medications the subjects were using. Subjects who were on antihypertensives and who were specifically on ACEIs had optimal control of the fasting blood glucose. Alhassan et al. found that taking two or more anti-hypertensive medications by T2DM patients with co-morbid hypertension was positively associated with controlled blood glucose levels [26]. Similarly, Li et al. found that antihypertensive treatment, especially Amlodipine improved glycaemic control (reduced HbA1c levels) significantly in diabetic subjects with co-morbid hypertension on Amlodipine compared to those on standard diabetic therapy alone [27]. This study also found a significant association between the presence of abdominal obesity, sex of the subjects and the use of lipid lowering medications among the subjects. Male subjects and the subjects that were taking lipid lowering agents, which were mainly statins had significantly lower prevalence of abdominal obesity. Understandably, lipid lowering medications decrease peripheral adipose tissues levels, including abdominal fats, thereby reducing abdominal obesity. Equally found was a significant association between optimal SBP control and age, marital status and the use of antihypertensive medications. Subjects that were young, single and on anti-hypertensive medications had optimal control of SBP.

Also, optimal control of DBP showed significant association with the type of DM treatment the subjects were receiving, the use of antihypertensive medications and the type of antihypertensive medications the subjects were taking. Subjects on both insulin and OADs for their DM treatment, those taking antihypertensive medications and those specifically taking ACEIs had optimal control of their DBP. Most antidiabetic drugs including insulins had been found to have neutral effects on blood pressure. However, sodium glucose co-transporter 2 inhibitors (SGLT2- inhibitors), glucagon-like peptide 1 receptor agonists (GLP-1 agonist) and thiazolidinediones (TZDs) demonstrated a significant BP reduction in outcome randomized controlled trials (RCTs) [28]. Notably also is the fact that over half, 55.7% and 53.4% of the subjects evaluated by the index study were taking antihypertensive medications and were specifically taking ACEIs respectively.

This study equally recorded a significant association between dyslipidaemia and sex and educational levels of the study-subjects with males and those with primary education having less dyslipidaemia which translated to a better control of the serum fasting lipid profile. In Africa, men often times are the ones that engage in rigorous and strenuous out door jobs akin to exercising, while women engage in the more sedentary chores of housekeeping and grooming the children at home. Similarly, lower educational levels like primary education are commonly associated with low socio-economic status, rural dwelling and peasant living, subsistence farming and laborious out door jobs and diet comprising locally sourced food consisting mainly of natural farm produce including fibre rich vegetables as opposed to the western sedentary life style and the highly refined continental diet of the educated elites and the rich. Furthermore, this study found a significant association between optimal TC control and the educational level of the study-participants, with subjects that had secondary education having good control of their TC. Additionally, sex and educational level showed statistically significant association with optimal control of HDL-C: male subjects and the subjects with secondary education

had good control of their HDL cholesterol.

Finally, this study found that sex and the type of DM treatment the subjects were getting had a statistically significant association with optimal control of LDL-C: male subjects as well as the subjects on insulin had optimal control of their LDL-C. On the other hand, TG showed no significant association with any of the tested socio-clinical determinants. Yamaguchi et al. found that insulin therapy reduces cholesterol synthesis and absorption markers in patients with T2DM early during treatment [29]. Galland et al. had equally found that insulin therapy significantly reduced oxidized LDL/LDL-C ratio in T2DM patients [30].

Strength of the Study

A search of literature showed that there was a dearth of published literature that evaluated the status on control to recommended goals of the CMRFs in subjects with type 2 diabetes mellitus globally and in sub-Saharan Africa particularly. The published data on this topic in South-Eastern Nigeria is more than a decade old and did not evaluate the glycated haemoglobin, a marker of long-term glycaemic control. This shortfall depicts clinicians' inertia in evaluating for and treating to the desired target these co-morbid CMRFs that are the harbinger of cardiovascular diseases among T2DM patients.

Limitations

This study is hospital-based and the participants were out-patients seen at the specialist diabetes clinic and the results may differ with what obtains in our rural communities and in the primary health care settings. Also, the cross-sectional nature of this study could not allow the researchers make inference about cause and effect of the CMRFs in the population studied.

Conclusion

There was suboptimal control of most of the cardiometabolic risk tactors evaluated among the subjects which potentially predisposed them to CVDs. With the exception of TG, there were varying but significant associations between the optimal control of all the other CMRFs and some of the socio-clinical determinants tested that included age sex, educational level, marital status, use of antihypertensive medications, lipid lowering medication and the treatment for diabetes mellitus.

Recommendations

A similar community-based study may be needed to evaluate the status of control of the CMRFs of type 2 diabetes mellitus and the socio-clinical determinants associated with their optimal control among the subjects with T2DM in our rural settings. Clinicians should conduct periodic assessment of the status of control and ensure prompt treatment of these cardiometabolic risk factors. Finally, more studies are needed on this very important topic to create more awareness on the need to eradicate therapeutic inertia and ensure a more holistic approach in the management of type 2 diabetes mellitus and its cardiovascular risk factors.

References

1. World Health Organization. Definition diagnosis and classification of diabetes mellitus and its complications. WHO/NCD/NCS. Geneva. 1999; 1-58.
2. International Diabetes Federation. Diabetes Atlas 9th ed. 2019. https://diabetesatlass.org/en
3. Chakraborty S, Verma A, Garg R, et al. Cardiovascular risk factors associated with type 2 Diabetes Mellitus A Mechanistic Insight. Clin Med Insights Endocrinol Diabetes. 2023; 16.
4. Uloko AE, Musa BM, Ramalan MA, et al. Prevalence and Risk Factors for Diabetes Mellitus in Nigeria. A systematic Review and Meta-Analysis. Diabetes Ther. 2018; 9: 1307-1316.
5. Adeloye D, Ige JO, Aderemi AV, et al. Estimating the prevalence hospitalization and mortality from type 2 diabetes mellitus in Nigeria. A systematic review and meta-analysis. BMJ Open. 2017; 7: e015424.
6. National Cholesterol Education Program. Third Report of the Expert Panel on Detection Evaluation and Treatment of High Blood Cholesterol in Adults ATP 111 Final Report. Circulation. 2022; 106: 3141-3421.
7. Okafor CI, Ofoegbu EN. Control to goal of cardiometabolic risk factors among Nigerians living with type 2 diabetes mellitus. Niger J Clin Pract. 2012; 15: 15-18.
8. Franch-Nadal J, Roura-Olmedia P, Benito-Badorrey B, et al. Metabolic control and cardiovascular risk factors in type 2 diabetes mellitus patients according to diabetes duration. Family Practice. 2015; 32: 27-34.
9. Orozco-Beltran D, Cinza-Sanjurjo S, Escribano-Serrano J, et al. Adherence control of cardiometabolic factors and therapeutic inertia in patients with type 2 diabetes in the primary care setting. Endocrinol Diabetes Metab. 2022; 5: e00320.
10. Zuo HJ, Wang WH, Deng LQ, et al. Control of cardiovascular disease risk factors among patients with type 11 diabetes in a primary-care setting in Beijing. J Am Soc Hypertens. 2018; 12: 128-134.
11. Fluckiger R, Woodtli T, Berger W. Quantitation of glycosylated haemoglobin by boronate affinity chromatography. Diabetes. 1984; 33: 73-76.
12. Mark V. An improved glucose oxidase method for determining blood csf urine glucose levels. Clin Chim Acta. 1996; 251: 19-24.
13. Hirano T, Nohtomi K, Koba S, et al. A simple and precise method for measuring HDL-cholesterol subfractions by a single precipitation followed by homogenous HDL-cholesterol assay. J lipid Res. 2008; 49: 1130-1136.
14. Allain CC, Poon LS, Chan CSG, et al. Enzymatic determination of total serum cholesterol. Clin Chem. 1974; 20: 470-475.
15. Bucolo G, David H. Quantitative determination of serum triglycerides by the use of enzymes. Clin Chem. 1973; 19: 476-482.

16. Assmann G, Jabs HU, Kohnert U, et al. LDL-cholesterol determination in blood serum following precipitation of LDL with polyvinylsulphate. Clin Chim Acta. 1984; 140: 77-83.
17. American Diabetes Association. Standards of Medical Care in Diabetes-2022 Abridged for Primary Care Providers. Clin Diabetes. 2022; 40: 10-38.
18. Chobanian AV, Bakris GL, Black HR, et al. Seventh Report of the Joint National Committee on Prevention Detection Evaluation and Treatment of High Blood Pressure. Hypertension. 2003; 42: 1206-1252.
19. US Census Bureau 2012 Population Estimates and 2012 National Projections. https://www.Census.gov
20. Digban K, Osakwe O, Adejumo E, et al. Assessment of Cardiometabolic Risk factors Among Type 2 Diabetes Mellitus Patients in Minna North-Central Nigeria. Sokoto Journal of Medical Laboratory Science. 2022; 6: 82-93.
21. Franch-Nadal J, Mata-Cases M, Vinagre I, et al. Differences in the Cardiometabolic control in Type 2 Diabetes according to gender and the presence of Cardiovascular Disease Results from the e Control Study. Int j Endocrinol. 2014; 2014: 131709.
22. Yan ST, Jia JH, Lv XF, et al. Glycemic control and comprehensive metabolic risk factors control in older adults with type 2 diabetes. Experimental Gerontology. 2019; 127: 110713.
23. Weerarathna TP, Lekamwasam S, Kodikara I, et al. Control of cardiometabolic risk factors and their association with carotid intima media thickness among patients with type 2 diabetes mellitus-single center experience in a developing country. Turk J Med Sci. 2024; 54: 545-554.
24. Alenbalu M, Egenasi CK, Steinberg WJ, et al. Corrigendum Diabetes Knowledge Attitudes and Practices in Adults with type 2 diabetes at primary health care clinic in Kimberley South Africa. Afr Fam Pract 2004. 2024; 66: 5922.
25. Alaofe H, Hounkpatin WA, Djrolo F, et al. Knowledge attitude practice and associated factors among patients with type 2 diabetes in Cotonou Southern Benin. BMC Public Health. 2021; 21: 339.
26. Alhassan Y, Kwakye AO, Dwomoh AK, et al. Determinants of blood pressure and blood glucose control I patients with co-morbid hypertension and type 2 diabetes mellitus in Ghana A hospital based cross sectional study. PLOS Glob Public Health. 2022; 2: e0001342.
27. Li JC, Cheng PC, Huang CN, et al. Antihypertensive treatment improves glycemic control I patients with newly diagnosed type 2 diabetes mellitus A Prospective Cohort Study. Front Endocrinol Louisanne. 2022; 13: 935561.
28. Ilias I, Thomopoulos C, Michalopouou H, et al. Antidiabetic drugs and blood pressure changes. Pharmacological Research. 2020; 161: 105108.
29. Yamaguci Y, Tanimura-Inagaka K, Fukuda I, et al. Early effect of insulin therapy on cholesterol synthesis and absorption markers in patients with type 2 diabetes. Clinical Nutrition Open Science. 2023; 48: 64-74.
30. Galland F, Duvillard L, Petit JM, et al. Effect of insulin treatment on plasma oxidized LDL/LDL-cholesterol ratio in type 2 diabetic patients. Diabetes Metab. 2006; 32: 625-631.