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Characteristics of Type 2 Diabetes Patients and Their Association with the Metabolic Syndrome and Cardiovascular Risk Factors at Thika Level Five Hospital in Kenya

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Abstract: Type 2 diabetes is a public health problem and one of the most common life threatening conditions globally, due to its related complications that are usually very costly to treat, with increasing number of people being diagnosed with this condition each year. Presence of the metabolic syndrome (MetS) and cardiovascular risks in Type 2 Diabetes patients increases the risk to complications. The objective of this study was to determine characteristics of type 2 diabetes patients and their association with MetS and associated cardiovascular risk. The study employed a cross section design method. Subjects with Type 2 Diabetes were recruited for the study from Thika Level Five Hospital in Kenya. Socio-demographic, clinical and lifestyle data were obtained using questionnaires. The nutrition status was determined by anthropometry. Other laboratory parameters that were determined included total cholesterol (TC), high density cholesterol (HDL-c) and low density cholesterol (LDL-c), triglyceride (TG), fasting blood glucose (FBG), glycated haemoglobin (HbA1C), and blood pressure (BP). Overall 153 (40.5% men and 59.5% women) Type 2 diabetic patients aged 20-79 years were included in the study. The overall mean age of patients was 56.07 years. The prevalence of the metabolic syndrome was 86.3% as per WHO criteria. The MetS components were elevated waist circumference (WC, 90.8%), increased waist hip ratio (WHR, 86.9%), elevated blood pressure (65.7% & 72.5%) and elevated triglycerides (64.8%). The prevalence of occurrence of the components of the MetS was not significantly different among male and female patients except for WC, BMI and reduced serum HDL-C where women were at a significantly higher risk than men (P≤0.00.). The current study showed that income was associated with elevated diastolic blood pressure (BP), secondary education and years lived with diabetes were associated with elevated TG, while occupation showed some association with high WHR. Additionally Gender, marital status and type of residence were associated with elevated HDL while education, family history of diabetes and alcohol intake was associated with obesity. The prevalence of the MetS and associated cardiovascular risk among Type 2 Diabetes patients was high and similar among males and females. Enhanced surveillance on Mets and associated cardiovascular risk in Type 2 Diabetes in addition to application of preventive measures are critical in order to reduce the risk of macro vascular complications as well as increased cardiovascular risks in Type 2 Diabetes patients.

Keywords: Metabolic Syndrome, Type 2 Diabetes, Cardiovascular Risk and Patient Characteristic

1. Introduction

Type 2 Diabetes is a group of metabolic disorders of multiple etiologies characterized by chronic hyperglycemia [1]. It is further characterized by disturbances of carbohydrate, fat and protein metabolism as a result of insulin resistance and relative insulin deficiency; both of which may be present at the time that diabetes becomes clinically manifested [2–4]. It is a major risk for cardiovascular diseases (CVD) and metabolic syndrome (MetS) [5]. It is a public health problem and one of the most common life threatening conditions globally, due to its related complications that are usually very costly to treat, with more and more people living with the condition each year [2, 4, 6, 7]. It is the fourth leading cause of death in most developed countries [6–8]. It is also the main cause of morbidity with a fast growing incidence due to demographic transition and changes in the population's lifestyle [4, 6–8]. Typically, this type of diabetes is diagnosed in people aged 20 years or older [4, 7]. Increasingly, however, it is being diagnosed in younger peoples too [4, 7]. Poor glycemic control in addition to presence of MetS in Type 2 Diabetes patients worsens the condition further due to related complications and increases the risk for development of CVD [2, 9, 10].

The MetS comprises a complex of interrelated risk factors that include abdominal obesity, dyslipidemia (low level of high density lipoprotein cholesterol (HDL-C) and /or high triglycerides level (TG)/low density lipoproteins (LDL-c), hypertension and hyperglycemia as a result of insulin resistance [11–14]. It increase the risk of developing Type 2 Diabetes by fivefold and CVD by two folds [13, 15]. These risks; MetS, Type 2 Diabetes and CVD risk factors are therefore closely interrelated (14-17). Studies conducted on Type 2 Diabetes patients have shown high prevalence of MetS and associated risks [10, 14, 16–19] This pose a greater risk to microvascular and macrovascular complications in addition to development of CVD [6, 7]. Furthermore, patient characteristics (socio demographic, lifestyle and clinical characteristic) have also been shown to be a strong predictor of developing MetS, Type 2 Diabetes and occurrence and progression of CVD [14, 18, 20, 21]. In Kenya studies on MetS status and cardiovascular risk factors have been determined in the general population in some regions and have shown a high prevalence of >50% [16, 22]. However, there is very limited information on MetS prevalence and cardiovascular risk factors among Type 2 Diabetes patients. Therefore, the aim of this study was to determine the association of Type 2 diabetes patient characteristics with MetS and cardiovascular risk factors.

2. Methodology

2.1. Study Design

The study applied a cross section design to find out the characteristics of Type 2 Diabetes patients and their association with the MetS and associated CVD risk factors.

2.2. Study Setting

The study was conducted at Thika Level 5 Hospital (TL5H), Kiambu County, Kenya on Type 2 Diabetes patients attending the Diabetes Comprehensive Centre (DCC).

2.3. Population

2.3.1. Study Participants

The Study participants were men and women aged 20–79 years with Type 2 Diabetes attending care at the DCC in TL5H. They were recruited during their monthly clinic attendance while waiting to see a health professional. Recruitment was done over a period of two months from August 2016 to October 2016.

2.3.2. Inclusion Criteria

Patient suffering from Type 2 diabetes aged between 20-79 years with regular attendance at the DCC who signed an informed consent and were willing to participate in the study were included.

2.3.3. Exclusion Criteria

Type 2 Diabetes patients with complications which included renal failure, congestive heart failure (CCF), and stroke were excluded from the study. Pregnant women and HIV patients with Type 2 diabetes were also excluded.

2.4. Sample Size

A target sample size of 153 patients calculated using the formula by Armitage et al., [23] and Lwanga and Lemeshow [24] was used for the study.

2.5. Data Collection

2.5.1. Baseline Data (Social Demographic, Anthropometry, Clinical and Physical Activity)

The demographic data and medical history were obtained using structured questionnaires. Anthropometric measurements that included weight, height, waist circumference and hip circumference were also done. Height and weight was measured using standard protocol with the participant wearing light clothing and no shoes [25]. Weight was measured to the nearest 0.1kg using a pre-calibrated Seca scale (SECA, Hamburg, Germany model no. 786/2021994), while height was measured to the nearest 0.1cm using a stadiometer attached to the scale as per CDC protocol [25]. The participants were requested to stand straight, with their body weight evenly distributed, both feet flat on the platform with the heels together and toes apart, the back of the head, shoulder blades, buttocks and heels in contact with the stadiometer backboard plus their heads in the Frankfort horizontal plane. The stadiometer head piece was then lowered so that it rested firmly on top of the participant's head, with sufficient pressure to compress the hair. The participants were then requested to take a deep breath and the reading recorded while the patient released the breath. Two readings of each (weight and height) were taken and the average recorded. Body mass index (BMI) was then calculated as weight (kilograms)/height (meters)^2 and classified as per WHO classification [26]. The waist circumference was measured mid-way between the lower rib margin and the iliac crest with an anthropometric tape while hip circumference was measured as

the maximal circumference around the buttocks posteriorly and pubic symphysis anteriorly as per WHO protocol [27]. The waist circumference and hip circumference was measured twice to the nearest 0.5cm while the participants were standing relaxed with their feet apart and arms on the sides. If the variation between these two measurements was greater than 2cm, a third measurement was taken and the mean calculated using the two closest measurements. Blood pressure was measured by trained nurses on left arms with a Spengler digital sphygmomanometer (model: Autortensio® noSPG440), while the participants were in a seated position and the arm supported at heart level. There was at least a 10-minute rest period before the measurement. Two measurements were taken from all the participants at 2-min intervals, and the mean of the measurements used as the final measurement. Readings from the blood pressure machine were recorded to the nearest 2 mm Hg.

Information on physical activity pattern was collected using a modified WHO designed physical activity questionnaire. [28]. Accordingly, the physical activity level of the participants was categorized using metabolic equivalent (MET) as per the WHO classification [29]. This classification included light physical activities that included light house work job accumulating a MET minutes per week of <600MET minute/week; moderate physical activities that included the routine productive activities of an electrician, mechanics, jogging, walking accumulating MET minutes per week of 600-1499 and heavy/vigorous physical activities that included productive activities of non-mechanized agriculture, dance, sports, aerobics digging accumulating MET minute per week of ≥1500. Participants who participated in moderate activities and accumulated ≥3000 MET minutes were also considered in the vigorous physical activity category. The average energy expenditure and duration of total physical activity per week was calculated from the questionnaire and recorded in MET minute week

2.5.2. Laboratory Assay

Blood samples were collected from each participant while in a seated position after fasting for at least 8-12hrs. Within 1 hour of blood collection, the samples were centrifuged and separated. Lipid profile (total cholesterol, triglycerides, high density lipoprotein cholesterol [HDL-C] and blood glucose estimation were determined using enzymatic method. Level of serum TG was determined using Glycerol Phosphate Oxidase Peroxidase GPO/POD, endpoint method [30], total cholesterol (TC) using Cholesterol Oxidase Peroxidase (CHOD-POD), end point method [31, 32] and high density lipoprotein (HDL-c) using Phosphotungstic Acid, end Point method [33]). Serum low density cholesterol (LDL-C) was calculated using the Friedwald's formula (LDL-cholesterol (mmol/l) = Total cholesterol - (HDL+ triglycerides/2.181) [34]. All parameters were read on a spectrophotometer (Dilui 240T autoanalyzer) at 510nm Glycated hemoglobin (HbA1c) was determined by Biorad D-10 hemoglobin testing system an automated analyzer, intended for percent determination of HbA1c in human blood using high-performance liquid chromatography [35]. Fasting plasma glucose was determined by glucose oxidase method [36].

2.5.3. Metabolic Syndrome Diagnosis Criteria

Metabolic syndrome in the study was defined according to WHO criteria [35] This criteria requires the presence of diabetes mellitus, impaired glucose tolerance or insulin resistance, and any two of the following:(1) body mass index (BMI) ≥ 30 kg/m^2 and/or waist-to-hip ratio >0.90 (male), >0.85 (female); (2) blood pressure ≥140/ ≥90mmHg or on hypertension medication; and (3) triglyceride ≥ 1.7mmol/L and/or HDL-C < 0.91mmol/L (male), <1.01mmol/L (female).

2.5.4. Classification of Other CVD Risk Factors

Glycemic status control was categorized as good glycemic control if HbA1c is<7% and poor control HbA1c is >7% as per the American Diabetes Association (ADA) guidelines [1, 37]. Elevated waist circumference was considered as waist circumference of ≥94 cm in males and ≥80 cm in females) [13] and BMI was categorized as obese >30kg/m^2 and non-obese <30kg/m^2 [26] Elevated blood pressure was considered for participants with systolic/diastolic pressure of 130/80 mmHg or those already using hypertensive drugs [13, 38]. Classification of lipid profiles was done as described by the ADA [1, 37] and American Association of Clinical Endocrinologists and American College Of Endocrinology (AACE-ACE) [39, 40]. These include elevated triglyceride level ≥1.7 mmol/l and/or the use of triglyceride-lowering drugs), reduced HDL cholesterol (<1.0 mmo/l in males and <1.3 mmol/l in females, elevated LDL cholesterol (>2.6mmol/l) and elevated total cholesterol (>5.2mmol/l) [39, 40].

2.6. Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS, version 20). Data was presented using mean± S.D. for continuous variables and proportions for categorical variables. Categorical variables were compared using Chi-Square test. Independent t-test was used to compare statistical difference between means. Multivariate logistic regression analysis was performed to determine variables associated with Mets and associated risk. A P value <0.05 was considered statistically significant.

2.7. Ethical Approval

The study was approved by the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee (Permit No. KNH-ERC/A/232) and the National Commission for Science, Technology and Innovation (NACOSTI) Permit No. NACOSTI/P/16/83452/10118. Study participants gave a written informed consent.

3. Results

3.1. Demographic Characteristics

Socio demographic characteristics of the respondents are presented in Table 1. Overall, 153 Type 2 Diabetic patients participated in the study. Their mean age was 56.1 years. Over half of them (58.6%) were aged between 50-69 years. One

hundred and nineteen (119; 77.8%), with a mean age of 56.8 years had poor glycemic control (HbA1C>7%). The highest proportion (41.2%) of the study participants were farmers and about one third (31.3%) were engaged in business. In addition most of the participants had attained primary education (54.9%), owned a mobile phone (96.1%), owned a house (75.8%), were married (84.3%) and lived in rural areas (62.1%).

Table 1. *Socio-demographic characteristics of the participants.*

Parameters Category		Totals n (%)
Gender	Male	62 (40.5)
	Female	91 (59.5)
Age	20-49	12 (7.8)
	40-49	29 (19.1)
	50-59	46 (30.5)
	60-69	43 (28.1
	70-79	23 (15.1)
Marital status	Single	16 (10.5)
	Married	129 (84.3)
	Separated /divorced	5 (3.3)
	widowed	3 (2.0)
Highest Education Level	Primary	84 (54.9)
	Secondary	54 (35.3)
	Tertiary	14 (9.2)
	No formal education	1 (0.7)
Occupation	formal employment	6 (3.9)
	Casual employment	10 (6.5)
	Farming	63 (41.2)
	Business	49 (32.0)
	unemployed	25 (17.1)
Location of residence	Rural	95 (62.1)
	Urban	58 (37.9)
House ownership	Own house	116 (75.8)
	Rental house/others	37 (24.2)
No of people in HH	None	24 (15.7)
	1 -2 person	56 (36.6)
	3-4 person	48 (31.4)
	5 person or more	25 (16.3)
Income	<1000	72 (47.1)
	>1000-10000	55 (35.9)
	>10000	26 (17.0)
Assets	Radio	136 (88.9)
	Television	120 (78.4)
	Mobile phone	147 (96.1)
	Bicycle	37 (24.2)
	Vehicle	23 (15.0)

n represents the number of participants while (%) represents the percentage HH-house hold.

3.2. Clinical and Lifestyle Characteristic

As shown in Table 2, less than half (46.4%) of the study participants had a family history of diabetes. Of these participants who had a family history of diabetes, 35.3% had poor glycemic control. About half (47.1%) of the participants had a complication as a co-morbidity to Type 2 diabetes. These complications included retinopathy (23.5%), arthritis (11.8%), lower limb extremity problems (9.8%), nephropathy (1.3%) and neuropathy (2.6%). Majority (96.1%) of the respondents did not take alcohol. Over half of the participants (53.6%) were able to meet the recommended physical activity level as per the WHO guidelines (≥600 MET/week) with only 5.9% being vigorously active (>3000MET/week) (Table 2).

Table 2. *Clinical and lifestyle characteristics of the participants.*

Parameter		Total n (%)
FHD	Yes	71 (46.4)
	No	82 (53.6)
Complication	Retinopathy	36 (23.5)
	Nephropathy	2 (1.3)
	Neuropathy	4 (2.8)
	Foot disease	15 (9.8)
	Arthritis	18 (11.8)
Alcohol intake	Yes	6 (3.9)
	No	147 (96.1)
PAL	light	71 (46.4)
	moderate	73 (47.7)
	vigorous	9 (5.9)
YLWD	1-4 years	89 (58.2)
	5-9 years	30 (19.6)
	10-14 years	19 (12.4)
	15-19 years	10 (6.5)
	≥20 years	5 (3.3)

n represents the number of participants while (%) represents the percentage. FHD; family history of diabetes, YLWD; years lived with diabetes, PAL; physical activity level.

As shown in Table 3, majority (82.4%) of the respondents were on oral hypoglycemic agents as a monotherapy; 12.4% on insulin as a monotherapy and only 5.2% took a combination of insulin and oral hypoglycemic agents. Most (92.8%) of the study participants monitored their blood glucose level but did not do other routine examinations recommended for Type 2 diabetes patients, including foot examination (125; 81.7%), eye examination (115; 75.2%), lipid profile (116; 75.8%) and HbA1c (114; 74.5%). More than half (64.1%) of the participants were unable to work as well as before and only 15.0% had not had a change in lifestyle due to diabetes.

3.3. Screening, Treatment and Effect of Diabetes on the Patient Life

Table 3. *Screening, treatment and effect of diabetes on the patient life.*

Parameter		Total n (%)
Screening		
Blood glucose monitoring	Yes	142 (92.8)
	No	9 (5.9)
Hba1c	Yes	22 (14.4)
	No	131 (85.6)
Lipid profile	Yes	19 (12.4)
	No	134 (87.6)
Eye examination	Yes	23 (15.0)
	No	130 (85.0)
Foot examination	Yes	11 (7.2)
	No	142 (92.8)
Current treatment	Oral medication	126 (82.4)
	Oral medication and insulin injection	8 (5.2)
	Insulin injection	19 (12.4)
How the disease has affected life	Unable to work as well as before	98 (64.1)
	Unable to work completely	10 (6.5)
	Family life	20 (13.1)
	Socially	2 (1.3)
	No change noted	23 (15.0)

n represents the number of participants while (%) represents the percentage. Metabolic syndrome (MetS) and associated Mets risk factors.

Prevalence of MetS, MetS and cardiovascular risk factors

as well as antropometry and biochemical parameters are as shown in Table 4, Table 5 and Table 6. As shown in Table 4, the prevalence of Mets was 86.3% with no significant difference among male and female patient.

Table 4. *Prevalence of MetS based on WHO criteria.*

Metabolic syndrome status	Gender			χ2 (P values)
	Male n (%)	Female n (%)	Total n (%)	
Yes	54 (35.3)	78 (51.0)	132 (86.3)	2.658 (0.103)
No	8 (5.2)	13 (8.5)	21 (13.7)	

n represents the number of participants while (%) represents the percentage.
Chi-square (χ2) test; statistical significance at p value<0.05.

As shown in Table 5 majority of the participants; 90.8% and 86.9% had high WC and WHR. The prevalence of hypertension was seen in 65.7% of the participants and raised TG in 64.7%. About a third of the participants (28.8%) had reduced serum HDL cholesterol levels with the prevalence being statistically significant higher (p=0.000) among women than men. Statistically significant differences (p= 0.0 and p<0.01) were also observed among gender in prevalence's of those participants who were obese and those who had increased WC.

As shown in Table 6, there was no significant difference in the mean body mass index (BMI) of the participants However, there was a statistically significant difference in the WHR (P=0.001 and WC (P=0.032) among males and females participants with males having a higher mean for both measurements. There was also significant difference (p= 0.045) between the mean TG among gender with females having a higher level (2.39mmol/l) as compared to males (2.03 mmol/l). There was no significant difference in all the other parameters assayed (Table 6).

Table 5. *Prevalence of the various components of metabolic syndrome components and other cardiovascular disease risk factors among the study population stratified by Gender.*

Parameter	Total n (%)	Male n (%)	Female n (%)	χ2 (P values)
BMI >30Kg/M^2	33 (21.6)	8 (5.2)	25 (16.3)	4.627 (0.037)*
High WHR	133 (86.9)	57 (37.3)	76 (49.)	2.300 (0.129)
elevated TG	99 (64.7	39 (25.5)	60 (39.2)	0.148 (0.700)
Reduced serum HDL –c[a]	44 (28.8)	4 (2.6)	40 (26.1)	25.317 (0.000)*
Dyslipidemia	106 (69.3)	41 (26.8)	65 (42.5)	0.487 (0.485)
Elevated BP [a]	100 (65.7)	41 (26.8)	59 (38.6)	0.027 (0.869)
Cardiovascular risk factors				
High	139 (90.8)	50 (32.7)	89 (58.2)	13.058 (0.000)*
Reduced serum HDL-c[b]	44 (29.7)	6 (3.9)	38 (24.8)	18.524 (0.000) *
Elevated BP [b]	111 (72.5)	47 (30.7)	64 (41.8)	0.555 (0.0456) *
Elevated LDL-c	68 (44.4)	27 (17.6)	41 (26.8)	0.034 (0.854)
Elevated TC	64 (41.8)	24 (15.7)	40 (26.1)	0.000 (0.983)

n represents the number of participants while (%) represents the percentage chi-square (χ2) test; *statistical significance at p value<0.05 BMI obese >30 kg/m^2, Elevated Waist hip ratio (WHR)>0.9 for men and >1.0 for women, Elevated blood pressure [a] >140/90mmHg or treatment of previously diagnosed hypertension (WHO criteria); Elevated blood pressure [b] >130/80mmHg or treatment of previously diagnosed hypertension (ACC criteria), Reduced serum HDL cholesterol (a) <0.9 mmol/L for men or<1.0 mmol/L for women or specific treatment for this abnormality (WHO criteria); Reduced serum HDL cholesterol [b] <1.0 mmol/L for men or<1.3 mmol/L for women or specific treatment for this abnormality (ADA criteria), Elevated triglycerides (TAG) >1.7 mmol/L or specific treatment for this abnormality (both criteria), Waist circumference (WC) ≥94 cm for men or ≥80 cm for women, Elevated TC>5.2mmol/l, Elevated LDL-cholesterol>2.6mmol/l.

Table 6. *Anthropometric, clinical and biochemical parameters of patients with Type 2 Diabetes stratified by gender and MetS.*

Parameter	Total	Gender		P values	Presence of MetS		p value (<0.05)
		Male	Female		Yes	No	
BMI (Kg/M^2)	27.03±4.70	26.88±4.11	27.13±5.08	0.750	27.21±4.77	25.66±3.98	0.188
WC (cm)	100.84±9.58	102.85±9.03	99.47±9.76	0.032*	101.70±9.23	94.44±10.02	0.002*
HC (cm)	105.0±9.68	103.63±8.89	105.93±10.12	0.149	105.95±9.33	97.89±9.60	0.001*
WHR	0.96±0.09	1.00±0.078	0.94±0.098	0.001*	0.96±0.097	0.97±0.069	0.735
TC (mmol/L)	4.97±1.1.22	4.80±1.22	5.09±1.231	0.171	5.00±1.26	4.81±0.94	0.540
TG (mmol/L)	2.24±1.09	2.02±0.92	2.38±1.17	0.045*	2.35±1.09	1.41±1.0.62	0.001*
HDL (mmol/L)	1.39±0.37	1.38±0.35	1.38±0.38	0.920	1.36±0.35	1.59±0.41	0.011*
LDL (mmol/L)	2.57±1.07.	2.52±1.12	2.61±1.04	0.574	2.57±1.08	2.57±0.99	0.917
HbA1c (%)	8.48±1.86	8.65±1.99	8.37±1.76	0.375	8.48±1.89	8.52±1.64	0.994
FBG (mmol/L)	11.01±3.39	11.28±3.67	10.83±3.19	0.422	10.91±3.09	11.75±5.17	0.328
DP (mmHg)	88.90±9.55	88.69±8.56	89.03±10.21	0.830	89.66±9.78	83.17±4.77	0.006*
SP (mmHg)	143.78±20.09	142.77±20.35	144.47±1999	0.609	145.80±20.16	128.67±11.47	0.001*

*statistical significance at p<0.05; (a) independent t test
Data are presented as mean ± standard deviation of the mean. BMI: body mass index, HC: hip circumference, WHR: waist-to-hip ratio, SP: systolic blood pressure, DP: diastolic blood pressure, LDL low density lipoprotein, TC: total cholesterol and HbA1c –glycated hymoglobin

3.4. Association of Patient Characteristics with MetS and Associated Risks

The association of patient characteristics with metabolic syndrome indicators and associated risk is as shown in Table 7. As shown in Table 7 occupation status was associated with increased WHR with reduced risk seen in patient with formal employment, farming and business (OR= 0.017, p =0.012; OR, 0.037, P=0.028 & OR =0.07, P<0.01) respectively. Additionally participant who had a family history of diabetes (OR=6.391, P<0.01) and those drinking alcohol (OR=32.64, P=0.011) were significantly associated with obesity (Table 7). Compared to patient earning an income of Ksh. 500-999 per month, participants earning an income of Ksh. 5000-9,999 and >10,000 were significantly associated with elevated DBP (OR= 5.648, P=0.046 & OR=5.326, P=0.042) with reduced risk as income increases (Table 7). Moreover partcipants earning an income of >10000 were associated with reduced risk of MetS (OR=0.037, P=0.018) (Table 7). In addition as shown in Table 7, patient who had secondary education were significantly associated with elevated TG (OR=3.807, P=0.008) and elevated BP (OR=0.323, P=0.031) compared to those who had only attained primary education. Patient who had lived with diabetes for ≥15 years were also significantly associated with elevated TG (OR=29.308, P=0.014) (Table 7). Gender, Marital status and type residence showed some association with elevated HDL. Compared to male, female were significantly associated with reduced HDL (OR=0.047, P=0.000) (Table 7). Also as shown in Table 7 patient who were living in the urban area were significantly associated with reduced compared to the single and those living in the rural areas HDL (OR=0.065, P <0.01 OR = 0.207, p=0.037) respectively. Additionally as shown in Table 7 patient who lived in the urban areas were associated with elevated BP (OR=0.276, p=0.033). Other characteristic of the participants showed some association with Mets Component and cardiovascular risk that were not statistically significant.

Table 7. *Associations of patient Characteristics and Metabolic syndrome components.*

Parameter		High WHR				
		n (%)	OR	95% CI		P value
Gender	Male	57 (42.9)	Ref			
	Female	76 (57.1)	2.534	0.494	13.002	0.265
Age	20-39	11 (8.3)	Ref			
	40-49	22 (16.5)	2.833	0.071	113.376	0.580
	50-59	40 (30.1)	2.055	0.057	74.329	0.694
	60-69	39 (29.3)	1.554	0.036	67.061	0.819
	70-79	21 (15.8)	1.505	0.023	98.465	0.848
Marital status	Single	12 (9.0)	Ref			
	Married	114 (85.7)	1.380	0.119	15.967	0.796
	others	7 (5.3)	2.512	0.050	125.342	0.644
Education	Primary	72 (54.1)	Ref			
	Secondary	49 (36.8)	0.230	0.041	1.289	0.095
	Tertiary	12 (9)	0.396	0.035	4.522	0.456
Occupation	unemployed	25 (18.8)	Ref			
	Formal employment	2 (1.5)	0.043	0.001	1.633	0.090
	Casual employment	8 (6.0)	0.017	0.001	0.403	0.012*
	Farming	57 (42.9)	0.037	0.002	0.704	0.028*
	Business	41 (30.8)	0.007	0.000	0.283	0.009*
Type of residence	Rural	85 (63.9)	Ref			
	Urban	48 (36.1)	3.382	0.559	20.455	0.185
house ownership	Own house	100 (75.2)	Ref			
	Rental house &others	33 (24.9)	0.196	0.029	1.312	0.093
No. of HH members	None	19 (14.3)	Ref			
	1-2 person	50 (37.6)	0.476	0.056	4.048	0.497
	3-4 person	43 (32.3)	0.533	0.079	3.578	0.517
	5 person or more	21 (15.8)	0.766	0.107	5.504	0.791
Income (Ksh)	500-1000	65 (48.9)	Ref			
	>1000-4999	27 (20.3)	1.796	0.350	9.214	0.483
	>5000-9999	19 (14.3)	1.292	0.120	13.903	0.832
	≥10000	22 (16.5)	0.781	0.077	7.966	0.835
FHD	No	63 (47.4)	Ref			
	Yes	70 (52.6)	2.572	0.596	11.093	0.205
Complication	Yes	64 (48.1)	Ref			
	No	69 (51.9)	2.350	0.552	10.012	0.248
YLWD	1 - 4.99 years	69 (51.9)	Ref			
	>5-9.99 years	24 (18.0)	3.230	0.562	18.570	0.189
	>10-14.99 years	24 (19.0)	4.463	0.651	30.604	0.128
	>15-19.99 years	16 (12.0)	3.322	0.182	60.572	0.418
	≥20 years		0.000	0.000	.	0.999
Alcohol intake	No	127 (95.5)	Ref			
	Yes	6 (4.6)	0.000	0.000		0.999

Parameter		High WHR				
		n (%)	OR	95% CI		P value
PAL	Light	57 (42.9)	Ref			
	moderate	67 (50.4)	0.479	0.121	1.888	0.293
	vigorous	9 (6.8)	0.000	0.000	.	0.999

Parameter		Obese				
		n (%)	OR	95% CI		P value
Gender	Male	8 (24.4)	Ref			
	Female	25 (75.8)	0.280	0.070	1.121	0.072
Age	20-39	2 (6.1)	Ref			
	40-49	6 (18.2)	2.053	0.166	25.317	0.575
	50-59	11 (33.3)	1.158	0.107	12.519	0.904
	60-69	9 (27.3)	0.820	0.066	10.219	0.877
	70-79	5 (15.2)	0.549	0.036	8.371	0.666
Marital status	Single	4 (12.1)	Ref			
	Married	28 (84.8)	1.379	0.186	10.239	0.754
	others	1 (3.0)	24.123	0.644	904.03	0.085
Education	Primary	15 (45.5)	Ref			
	Secondary	15 (45.5)	0.144	0.035	0.587	0.007**
	Tertiary	3 (9.1)	0.136	0.013	1.449	0.098
Occupation	unemployed	1 (3.0)	Ref			
	Formal employment	15 (45.5)	0.000	0.000	.	0.998
	Casual employment		0.569	0.020	16.228	0.741
	Farming	13 (39.4)	0.283	0.012	6.631	0.432
	Business	4 (12.1)	1.444	0.046	45.349	0.834
Type of residence	Rural	21 (63.6)	Ref			
	Urban	12 (36.4)	1.099	0.215	5.611	0.909
house ownership	Own house	26 (78.8)				
	Rental house &others	7 (21.2)	.488	0.090	2.637	0.404
No. of HH members	None	7 (21.2)	Ref			
	1-2 person	8 (24.2)	3.740	0.587	23.835	0.163
	3-4 person	13 (39.4)	.690	0.139	3.438	0.651
	5 person or more	5 (15.2)	1.605	0.240	10.756	0.626
Income (Ksh)	500-1000	14 (42.4)	Ref			
	>1000-4999	13 (39.4)	.281	0.074	1.066	0.062
	>5000-9999	4 (12.1)	1.491	0.164	13.595	0.723
	≥10000	2 (6.1)	6.806	0.501	92.527	0.150
FHD	No	21 (63.6)	Ref			
	Yes	12 (36.4)	6.391	1.889	21.623	0.003*
Complication	Yes	13 (39.4)				
	No	20 (60.6)	.551	0.175	1.738	0.309
YLWD	1 - 4.99 years	20 (60.6)	Ref			
	>5-9.99 years	6 (18.2)	1.597	0.368	6.937	0.532
	>10-14.99 years	5 (15.2)	1.125	0.140	9.020	0.912
	>15-19.99 years	2 (6.1)	14.514	0.884	238.228	0.061
	≥20 years		0.000	.000	.	0.999
Alcohol intake	No	2 (6.1)	Ref			
	Yes	31 (36.4)	32.640	2.239	475.767	0.011*
PAL	Light	20 (66.6)	Ref			
	moderate	12 (36.4)	3.334	.956	11.624	0.059
	vigorous	1 (3.0)	12.502	.814	192.020	0.070

Parameter		Elevated BP				
		n (%)	OR	95% CI		P value
Gender	Male	30 (40)	Ref			
	Female	45 (60)	0.815	0.313	2.122	0.675
Age	20-39	7 (9.3)				0.392
	40-49	12 (16.0)	3.170	0.435	23.086	0.255
	50-59	22 (29.3)	1.844	0.266	12.775	0.535
	60-69	26 (34.9)	1.693	0.224	12.814	0.610
	70-79	8 (10.7)	3.467	0.395	30.405	0.262
Marital status	Single	8 (10.7)	Ref			
	Married	63 (84.0)	1.513	0.311	7.373	0.608
	others	4 (5.3)	2.991	0.267	33.545	0.374
Education	Primary	38 (50.7)				0.232
	Secondary	31 (41.3)	0.323	0.116	0.902	0.031*

Parameter		Elevated BP				
		n (%)	OR	95% CI		P value
	Tertiary	6 (8.0)	0.513	0.085	3.103	0.467
	unemployed	2 (2.6)	Ref			
	Formal employment	5 (6.4)	0.067	0.002	1.947	0.116
Occupation	Casual employment	29 (37.2)	0.739	0.102	5.336	0.765
	Farming	25 (32.1)	0.515	0.138	1.918	0.323
	Business	17 (21.8)	0.444	0.113	1.741	0.244
Type of residence	Rural	52 (69.3)	Ref			
	Urban	23 (30.7)	0.276	0.085	0.898	0.033*
house ownership	Own house	61 (81.3)	Ref			
	Rental house &others	14 (18.7)	0.719	0.214	2.416	0.594
	None	11 (14.7)	Ref			
No. of HH members	1-2 person	29 (38.7)	1.953	0.426	8.957	0.389
	3-4 person	25 (33.3)	1.721	0.460	6.441	0.420
	5 person or more	10 (13.3)	1.186	0.319	4.415	0.799
	500-1000	36 (48.0	Ref			
Income (Ksh)	>1000-4999	12 (16.0)	2.077	0.395	10.916	0.388
	>5000-9999	9 (12.0)	5.648	1.030	30.979	0.046*
	≥10000	18 (24.0)	5.326	1.065	26.628	0.042*
FHD	No	36 (48.0)	Ref			
	Yes	39 (52.0)	1.483	0.609	3.610	0.386
Complication	Yes	36 (48.0)				
	No	39 (52.0)	0.560	0.238	1.315	0.183
	1 - 4.99 years	33 (44.0)	Ref			
	>5-9.99 years	16 (21.3)	2.085	0.163	26.690	0.572
YLWD	>10-14.99 years	14 (18.7)	2.484	0.171	36.111	0.505
	>15-19.99 years	12 (16.0)	0.428	0.020	9.143	0.587
	≥20 years		2.184	0.119	40.040	0.599
Alcohol intake	No	4 (5.3)	Ref			
	Yes	71 (94.7)	1.012	0.137	7.493	0.991
	Light	33 (44.0)	Ref			
PAL	moderate	37 (49.3)	.957	0.840	0.349	2.021
	vigorous	5 (6.7)	1.027	0.631	0.081	4.907

Ref –reference point.
n represents the number of participants while (%) represents the percentage.
OR – Odds ratio; 95% CI- 95% confidence interval; ** statistical significance at p value<0.05, ref -reference point.
BMI obese >30 kg/m^2, Elevated Waist hip ratio (WHR)>0.9 for men and >1.0 for women, High blood pressure >140/90mmHg or treatment previously diagnosed hypertension.
HH-house hold; FHD; family history of diabetes, YLWD; years lived with diabetes, PAL; physical activity level.

Table 7. *Continued.*

Parameters		Elevated HDL				
		n (%)	OR	95% CI		P valve
Gender	Male	4 (9.1)	Ref			
	Female	40 (90.9)	0.047	0.011	.210	0.000**
Age	20-39	5 (11.4)				0.656
	40-49	11 (25)	1.457	0.170	12.513	0.732
	50-59	14 (31.8)	2.542	0.291	22.168	0.398
	60-69	9 (20.5)	4.270	0.443	41.143	0.209
	70-79	5 (11.4)	3.494	0.247	49.417	0.355
Marital status	Single	5 (11.4)	Ref			
	Married	38 (86.4)	0.065	0.010	.422	0.004**
	Separated /divorced/widowed	1 (23)	0.373	0.017	8.155	0.531
Education	Primary	25 (56.8)	Ref			
	Secondary	16 (36.4)	0.933	0.293	2.976	0.907
	Tertiary	3 (6.8)	1.755	0.171	18.012	0.636
Occupation	unemployed	4 (9.1)				0.379
	Formal employment	3 (6.8)	0.903	0.074	11.018	0.936
	Casual employment	18 (40.9)	3.062	0.303	30.911	0.343
	Farming	10 (22.7)	1.731	0.320	9.374	0.524
	Business	9 (20.5)	4.945	0.825	29.627	0.080
Type of residence	Rural	25 (56.8)	Ref			
	Urban	19 (43.2)	0.207	0.047	.907	0.037*
House ownership	Own house	33 (75.0)				
	Rental house and others	11 (25.0)	1.465	0.365	5.872	0.590
	None	7 (15.9)	Ref			0.160

Parameters		Elevated HDL				
		n (%)	OR	95% CI		P valve
	1-2 person	20 (45.5)	1.078	0.249	4.657	0.920
Dependents	3-4 person	10 (22.7)	4.046	0.789	20.754	0.094
	5 person or more	7 (15.9)	3.127	0.441	22.148	0.254
Income (Ksh)	500-999	20 (45.5)	Ref			
	>1000-4999	11 (25)	0.401	0.110	1.466	0.167
	>5000-9999	5 (11.4)	0.643	0109	3.799	0.626
	>10000	8 (18.2)	0.189	0.028	1.297	0.090
FHD	Yes	19 (43.2)	Ref			
	No	25 (56.8)	0.789	0.290	2.144	0.642
Complication	Yes	20 (45.5)	Ref			
	No	24 (54.5)	1.621	0.559	4.702	0.374
	1 - 4.99 years	24 (54.5)	Ref			
	>5-9.99 years	9 (20.5)	0.215	0.014	3.387	0.274
YLWD	>10-14.99 years	6 (13.0)	2.747	0.120	63.125	0.528
	15-19.99 years	5 (11.4)	0.138	0.007	2.919	0.203
	≥20 years		0.269	0.010	6.931	0.428
Alcohol intake	Yes	3 (6.8)	Ref			
	No	41 (93.2)	1.283	0.107	15.404	0.844
PAL	light	17 (38.6)	Ref			
	moderate	23 (52.3)	0.578	0.199	1.675	0.312
	vigorous	4 (9.1)	0.147	0.016	1.323	0.087

Parameters		Elevated TG				
		n (%)	OR	95% CI		P value
Gender	Male	39 (39.4)	Ref			
	Female	60 (60.5)	0.603	0.229	1.589	0.306
Age	20-39	7 (7.1)				0.925
	40-49	20 (20.7)	0.714	0.112	4.558	0.722
	50-59	28 (28.3)	0.896	0.154	5.219	0.903
	60-69	29 (29.3)	0.653	0.098	4.349	0.659
	70-79	15 (15.2)	0.469	0.059	3.717	0.473
Marital status	Single	10 (10.1)	Ref			
	Married	83 (83.8)	1.073	0.201	5.716	0.934
	Separated /divorced/widowed	6 (6.1)	0.289	0.020*	4.148	0.361
Education	Primary	59 (59.6)	Ref			
	Secondary	31 (3.3)	3.807	1.425	10.172	0.008
	Tertiary	9 (9.1)	4.594	0.770	27.389	0.094
Occupation	unemployed	5 (5.1)	Ref			
	Formal employment	7 (7.1)	1.952	0.059	64.490	0.708
	Casual employment	39 (39.4	12.018	0.564	256.085	0.111
	Farming	31 (31.3)	4.479	0.250	80.166	0.308
	Business	17 (17.2)	3.936	0.190	81.449	0.375
Type of residence	Rural	61 (61.6)	Ref			
	Urban	38 (38.4)	0.324	0.095	1.105	0.072
House ownership	Own house	81 (81.8)				
	Rental house and others	18 (18.2)	13.207	3.268	53.368	0.000**
	None	15 (15.2)	Ref			
	1-2 person	36 (36.4)	0.440	0.115	1.688	0.231
Dependents	3-4 person	33 (33.3)	0.403	0.094	1.731	0.222
	5 person or more	15 (15.2)	1.146	0.256	5.136	0.858
Income (Ksh)	500-999	44 (44.4)	Ref			
	>1000-4999	22 (22.2)	0.772	0.249	2.399	0.655
	>5000-9999	17 (17.7)	0.312	0.067	1.450	0.137
	>10000	16 (16.2)	0.359	0.074	1.736	0.202
FHD	Yes	44 (44.4)	Ref			
	No	55 (55.6)	0.601	0.247	1.462	0.262
Complication	Yes	46 (46.5)	Ref			
	No	53 (53.5)	0.753	0.298	1.901	0.548
	1.- 4.99 years	46946.5)	Ref			
	>5-9.99 years	24 (24.2)	0.401	0.123	1.311	0.130
YLWD	>10-14.99 years	20 (20.2)	0.400	0.094	1.705	0.215
	15-19.99 years	9 (9.1)	0.514	0.087	3.037	0.463
	≥20 years	1 (1.0)	29.308	1.956	439.182	0.014
Alcohol intake	Yes	98 (99.0)	Ref			
	No	50 (50.5)	0.025	0.002	.345	0.006**
PAL	light	46 (46.5)	Ref			

Parameters		Elevated TG				
		n (%)	OR	95% CI		P value
	moderate	3 (3.0)	1.483	0.600	3.663	0.393
	vigorous		2.514	0.409	15.469	0.320

Parameters		MetS				
		n (%)	OR	95% CI		P value
Gender	Male	54 (40.9)	Ref			
	Female	78 (59.1)	0.716	0.190	2.692	0.621
Age	20-39	11 (8.3)	Ref			
	40-49	23 (17.4)	1.095	0.053	22.733	0.953
	50-59	40 (30.3)	0.730	0.038	13.969	0.835
	60-69	38 (28.8)	0.555	0.025	12.469	0.710
	70-79	20 (15.2)	0.823	0.030	22.587	0.908
Marital status	Single	13 (9.8)	Ref			
	Married	113 (85.6)	0.990	0.142	6.908	0.992
	Separated /divorced/widowed	6 (3.9)	1.713	0.094	31.158	0.716
Education	Primary	73 (55.3)	Ref			
	Secondary	48 (36.4)	0.696	0.173	2.809	0.611
	Tertiary	11 (8.3)	4.175	0.514	33.886	0.181
Occupation	unemployed	21 (15.9)	Ref			
	Formal employment	4 (3.0)	0.318	0.015	6.885	0.465
	Casual employment	7 (5.3)	0.080	0.004	1.512	0.092
	Farming	57 (43.2)	0.102	0.007	1.542	0.100
	Business	43 (32.6)	0.090	0.005	1.762	0.113
Type of residence	Rural	86 (65.2)	Ref			
	Urban	46 (34.8)	1.829	0.368	9.095	0.460
House ownership	Own house	102 (87.3)	Ref			
	Rental house and others	30 (22.7)	1.428	0.287	7.100	0.663
	None	18 (13.6)				
	1-2 person	49 (37.2)	0.418	0.072	2.421	0.330
Dependents	3-4 person	44 (33.3)	0.140	0.019	1.050	0.056
	5 person or more	21 (15.9)	0.383	0.060	2.457	0.311
Income (Ksh)	500-999	60 (45.5)	Ref			
	>1000-4999	29 (45.5)	0.430	0.077	2.399	0.336
	>5000-9999	18 (13.6)	0.357	0.047	2.714	0.319
	>10000	25 (18.9)	0.037	0.002	.572	0.018
FHD	Yes	61 (46.2)	Ref			
	No	71 (53.8)	2.038	0.306	13.587	0.462
Complication	Yes	60 (47.0)				
	No	72 (53.0)	0.754	0.212	2.675	0.662
	1 - 4.99 years	78 (59.1)	Ref			
	>5-9.99 years	25 (18.9)	1.368	0.293	6.398	0.690
YLWD	>10-14.99 years	16 (12.1)	0.965	0.141	6.615	0.971
	15-19.99 years	9 (9.0)	0.952	0.075	12.056	0.970
	≥20 years	4 (4.0)	7.234	0.320	163.386	0.213
Alcohol intake	Yes	4 (3.0)	Ref			
	No	12 (97.0)	9.871	0.904	107.718	0.060
PAL	light	58 (43.9)	Ref			
	moderate	66 (50.0)	0.408	0.102	1.624	0.203
	vigorous	2 (6.1)	0.226	0.007	7.002	0.396

Ref: refrence point; n represents the number of participants while (%) represents the percentage.
OR – Odds ratio; 95% CI- 95% confidence interval; * statistical significance at p value<0.05, ** statistical significance at p value<0.01 ref -reference point.
Reduced HDL cholesterol <1.0 mmol/L for men or <1.3 mmol/L for women or specific treatment for this abnormality (Elevated triglycerides (TAG) >1.7 mmol/L or specific treatment for this abnormality.
FHD; family history of diabetes, YLWD; years lived with diabetes, PAL; physical activity level MetS defined as per WHO criteria.

4. Discussion

Type 2 Diabetes, metabolic syndrome (MetS) and cardiovascular disorder (CVD) are prevalent chronic conditions of global importance that can be controlled with proper management. [4, 6, 8] This could result to potential benefit geared toward the patient, the health care system as well economic development [4, 15, 41]. The metabolic syndrome (MetS), a cluster of risk factors which include raised blood pressure, dyslipidemia (raised triglycerides and lowered high-density lipoprotein cholesterol), raised fasting glucose, and central obesity (increased waist circumference) has been shown to increase the risk to type 2 Diabetes by 5 fold and cardiovascular disease by 2 folds [13, 15]. Our current study explored the association between patient

characteristic and MetS and associated cardiovascular risk. Exploring these association might aid in development of preventive measure therefore improving the quality of life of the diabetes patients.

Overall 153 (59.5 female and 40.5 male) Type 2 Diabetic patient were incorporated into the study. Majority were aged between 50-59 years with an average age of 56.08 years and 56.51 years for those with MetS and poor glycemic control respectively. Indeed, age has been shown to be a risk factor in Type 2 diabetes, MetS and associated cardiovascular risk [19] Studies conducted on Type 2 Diabetes patients have reported a high prevalence of Type 2 diabetes and MetS in older people (>50 years) and this is in congruent with our current study [12, 17, 18, 42].

Prevalence study on MetS, MetS risk and associated CVD risk factors in Type 2 diabetes patients have revealed different rates in different places, depending on definition criteria used [11, 14, 43]. Our study reported a high prevalence (>80%) of MetS using the WHO criteria which was comparable among gender. These results are agreement to previous studies which reported high prevalence's (>70%) of MetS in Type 2 Diabetes patients supported by [21, 44] Presence of MetS in Type 2 Diabetes patient increases the risk of microvascular macrovascular complications in addition to cardiovascular disorders [35, 36]. The high prevalence of Mets in the current study might have been due increased risk factors in the study participant. In fact, most (88.9%) of the Type 2 diabetes patients who participated in this study had three or more MetS component risk factors and this, might explain the high prevalence of Mets. Similar findings were reported by Raman *et al* [45] and Ogbera 2010 [18] and are in support of the current study. Increased WC was the most prevalent component, followed by high WHR, elevated serum TG and elevated blood pressure; with most of the participants recording higher figures than the cut-off point (Table 5). Higher overall mean above the agreed cut off points for BMI, WC, TG, SBP, FBG, and HbA1c were noted in the current study. The male participants had statistically significantly higher mean WC, WHR and female higher statistically significantly TG. The current study is in agreement with other studies that have shown an association of dyslipidemia with obesity characterized by BMI>30kg/m^2, elevated WC, high WHR, poor glycemic control and elevated BP. [46–49]. This association is a key risk factor to MetS, CVD as well as progression of Type 2 diabetes complication Over half of the patient had elevated TC and LDL-c key indicator of cardiovascular risk factor related to progression of MetS, Type 2 Diabetes and CVD [4, 6, 8]. Moreover combination of these risk factors complicates the management thus escalating the problem further [4, 6, 50–52].

Majority (77.8%) of the participants had poor glycemic control, with an average mean HbA1c of 8.49%. Similar findings were reported by Raman et al., and Moreira et al [45, 46]. Poor glycemic control (HbA1c>7%) poses a major risk to Type 2 diabetes patients and those with MetS. Moreover, combinations of risk factors such as increased WC, elevated TC, increased BP and reduced HDL, elevated TC, and elevated LDL-c may lead to poor glycemic control, development of cardiovascular, micro vascular and macro vascular complications in Type 2 diabetes [1, 32]. A strong association of poor glycemic control, hypertension, dyslipidemia and central obesity with MetS as well as Type 2 diabetes has been reported [46–49]. Elevated WC as well as high WHR or BMI and dyslipidemia have been associated with abdominal obesity, which is a major cause of insulin resistance; one of the important risk factors of MetS and type diabetes [6, 7]. The condition worsens in the presence of elevated blood pressure, one of the major complications in Type 2 Diabetes and key risk to CVD [6, 7, 50, 51].

Patient characteristics have been associated with increased risk to MetS, associated risk and CVD risk factors. Studying their association with Mets and associated risk is paramount as strategic way for preventive measures Studies have reported varying prevalence of MetS among gender, as well as other patient characteristics. A study by Kengen et al., [17] reported a significant high prevalence of MetS in women compared to men. A study by Kaduka et al, [22] in a general population showed significant association of MetS with age, level of education, monthly income and social economic status with advanced age, wealth quantile and higher education being strongly associated with MetS. A study by Tadewos et al., [53] on Type 2 Diabetes also revealed significant association of gender, occupation, duration of diabetes and nutrition status with MetS.

Moreover our current study showed different association of patient characteristics with MetS risk factors and selected CVD risk factors. (Table 7) using multiple logistic regression. Studies have shown that occupation status of patient have been associated with improved social economic status that usually leads to adaptation of behavior traits that increase the metabolic risk in patient with Type 2 diabetes [55]. Our study was unique as it showed some association of economic status with increased MetS risk with patient having a higher income being associated with elevated blood pressure (BP). Patient occupation status also showed some significant association with high WHR. A study by Ogunsina *et al* [56] is in support of the current study as it showed that high social economic status for both men and women was associated with increased odds of overweight/ obesity. Patient with secondary education from the current study were associated with increased odds of obesity and elevated TG. However our current study reported reduced risk of overall MetS as income level increased (Table 7) supporting the evidence that high income levels is associated with reduced risk [54].

Additionally patient with a family history of diabetes and were taking alcohol were also associated with obesity. Patient who had lived with diabetes ≥15 years were also associated with elevated TG. Family history of diabetes (FHD), alcohol intake and increased years with diabetes predisposes Type 2 Diabetes patient to metabolic risk like obesity and dyslipidemia as well as associated complication [57] and this is in support of our current study. Moreover

gender, marital status and type of residence were associated with reduced HDL with female patient, married patient and patient living in urban areas being significantly associated with increased odds of reduced HDL. This might have been due to adapted behaviour by the patients

Our study had some limitations. The above study was conducted in a Hospital setup on Type 2 Diabetes patients visiting the clinic. Thus the result might not represent a true sample of population, given that some diabetes patients may not be attending the clinic. To find out the true prevalence, a community-based study needs to be conducted and comparison with hospital based studies done. However, several studies conducted on Type 2 Diabetes on prevalence of MetS in different countries have been done on hospital set up, hence making our result comparable.

5. Conclusion

A high prevalence of MetS in our current study was noted on Type 2 Diabetes patients using the WHO and harmonized criteria. The most prevalent components of the MetS were elevated WC, increased WHR, and elevated TG and elevated BP. The current study showed that participants with some form of occupation had attained secondary education and earned a higher income was associated with increased MetS risk factors. Income was associated with elevated diastolic blood pressure (DBP), secondary education and years lived with diabetes were associated with elevated TG, while occupation showed some association with high WHR. Additionally Gender, marital status and type of residence were associated with reduced HDL while education, family history of diabetes and alcohol intake was associated with obesity. This calls for an urgent action aimed at preventing the progression of the patients to diabetes complications and cardiovascular problems. Increased surveillance on MetS in Type 2 Diabetes patients need to be hastened and preventive measures (like lifestyle and diet intake modification, doing regular moderate to vigorous intensity physical exercises) put in place to prevent the condition from worsening.

Abbreviations

MetS-metabolic syndrome; HbA1c: glycated hymoglobin; WHO: World Health Organization; WC: waist circumference; HDL-c: High Density Lipoprotein cholesterol; TG: Triglyceride; Total Cholesterol; LDL-C: Low Density Lipoprotein; BMI: Body Mass Index; WHR: Waist Hip Ratio; CVD: Cardiovascular Disease; TL5H: Thika Level 5 Hospital; DCC: Diabetes Care Centre; NEG: Nutrition Education Group; NEP: Nutrition Education Peer to peer support Group; MET: Metabolic Equivalent; GPO/POD: Glycerol Phosphate Oxidase Peroxidase; CHOD/POD: Cholesterol Oxidase Peroxidase, KNH-UoN/ERC: Kenyatta National Hospital-University of Nairobi Ethical Research Committee; NACOSTI: National Commission for Science Technology and Innovation; ADDRF: Africa Doctoral Dissertation Research Fellowship; APHRC: Africa Population and Health Research Center; IDRC: International Development Research Centre; SD: Standard Deviation; SPSS: Statistical Package for Social Sciences.

Competing Interests

The authors declare that they have no competing interests.

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Availability of Data and Materials

All the data collection tool and data are in the custody of Thuita Ann and are available on request.

Ethics Approval and Consent to Participate

Ethical approval was obtained from Kenyatta National Hospital and University of Nairobi Ethical Committee (Permit No. KNH-ERC/A/232) and while administrative approval was obtained from the National Commission for Science, Technology and Innovation (NACOSTI) Permit No. NACOSTI/P/16/83452/10118, the Ministry of Interior and Co-ordination of National Government, County Commissioner Kiambu Permit No. ED.12/1/VOL. IV/92, Ministry of Education Kiambu Permit No. KBU/CDE/HR/4/VOL. II (138) county health officials and health facility administrators. Study participants gave a written informed consent before commencement of data collection.

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