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SOCIODEMOGRAPHIC FACTORS ASSOCIATED WITH BODY COMPOSITION AND METABOLIC SYNDROME AMONG TYPE 2 DIABETES PATIENTS AT A LEVEL 5 HOSPITAL IN KENYA

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ABSTRACT

Metabolic syndrome (MetS) is one of the leading global public health and clinical challenges, with increasing prevalence figures between 10% to 84%. This study explored the association between socio-demographic characteristics both metabolic syndrome and body composition. Sociodemographic characteristics were summarized using descriptive statistics and presented as frequencies and percentages. The prevalence of cardiometabolic risk factors and body composition indicators was calculated and compared between males and females using the Chi-square or Fisher's exact test, as appropriate, with p-values reported. Multivariable logistic regression analysis was subsequently performed to estimate adjusted associations between socio-demographic factors and cardiometabolic and body composition outcomes, with results presented as odds ratios and 95% confidence intervals. Blood pressure and anthropometric measurements such as waist circumference (WC) and body mass index (BMI) were measured. Data collection methods included a structured questionnaire for sociodemographic data, a bioelectrical impedance machine & anthropometric measurements for body composition and anthropometric data, a digital sphygmomanometer for blood pressure and blood samples for cardiometabolic risk factors using standard laboratory protocols. Highly prevalent body composition and cardiometabolic risk factors were high waist circumference, (65%), waist hip ratios (86.2%), systolic blood pressure (68%) and elevated total body fat percentage (81%) especially in women. The results showed that study participants comprised of 67.2% females and 32.8% males with a mean ± SD of 56.5 years ±10.5, within the range of 20 to 79 years. The presence of MetS was defined using the International Diabetes Federation (IDF) harmonized criteria where 3/5 findings would qualify a person as having MetS. 39 out of 67 participants presented with metabolic syndrome (58.2%). Overall, none of the sociodemographic factors were associated with MetS, however, females had higher odds of developing MetS compared to men, (OR=2.03 p value= 0.243). Similarly, participants aged 60-79years, also had higher odds of developing MetS compared to younger ages (OR=1.15 p value= 0.888), though the associations were not statistically significant. The prevalence of body composition and cardio-metabolic risk factors for metabolic syndrome stratified by gender, showed females had elevated levels of waist to height ratio (p=0.027), WC (p=0.001), total body fat % (p=0.001) and low total body water % (p=0.004), while males reported higher risk of decreased bone mass (p=0.001). In conclusion body composition and cardiometabolic risk factors are higher in women compared to men and older ages compared to younger ages.

Key words: Metabolic syndrome, Sociodemographic characteristics; Body composition, Cardiometabolic risk factors

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INTRODUCTION

The identification of socio-demographic and socioeconomic factors that contribute to the risk of developing metabolic syndrome and cardiovascular disease is crucial for designing preventive strategies. Factors such as gender, age, socioeconomic status, and education level among others have been explored to show associations with metabolic syndrome [1]. In Kenya however, these studies in relation to body composition and cardiometabolic risk factors in type 2 diabetes patients have not been extensively studied. Metabolic syndrome (MetS) is a cluster of interrelated factors that significantly increase the risk of type 2 diabetes and cardiovascular diseases. The cluster of risk factors include elevated blood pressure, artherogenic dyslipidemia, low density lipoproteins (LDL), loweered levels of high density lipoprotein cholesterol (HDL-c)), raised fasting glucose, and central obesity [2, 3]. The prevalence of MetS has been increasing worldwide for several decades especially in developing countries with a range of 10-84% across different countries [4].The etiology of MetS, although not entirely understood, is considered to occur in a complex interaction between genetic, metabolic and environmental factors [5]. There is an increasing concern regarding metabolic syndrome (MetS) due to multiple factors such as epidemiologic transition, lifestyle changes, and the burden of nutritional disorders [6]. The risk factors therefore include a combination of sociodemographic, socioeconomic, genetic, occupational, lifestyle and health-related factors, including smoking, alcohol intake, poor exercise regimes, and diet [7]. Understanding what factors are predictive of MetS and how these risk factors are distributed and interrelated with socio-demographics within different populations is important for identifying and targeting populations at risk, thus helping in the development and implementation of public health interventions. The aim of this study was to investigate how socio-demographic factors (age, sex, marital status, education, residence and socioeconomic status) are associated with body composition parameters (waist circumference, waist height & hip ratios, total body fat and visceral fat) and with the presence of MetS.

MATERIALS AND METHODS

Study design

The study utilized a cross sectional design to collect baseline characteristics of participants selected for a randomized control trial, which was used to determine the association between socio-demographic characteristics of type two diabetes mellitus (T2DM) patients with the presence of metabolic syndrome and body composition.

Study setting

The study was conducted at the Non –Communicable disease (NCD) of Gatundu Level 5 Hospital located in Ngenda location, Gatundu South Constituency Kiambu County, Kenya.

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Study participants

The Study participants were Type 2 diabetes (T2DM) patients aged 20–79 years with T2DM who consented and were attending care at the NCD in Gatundu level 5 Hospital.

Inclusion and exclusion criteria

Participants who had type 1 diabetes, major complications, pregnant women and hospitalized patients were excluded from this study. T2DM patients with no major complications who consented were included.

Sample size

The procedure used to calculate the sample size was adapted from Chan's formula [8], yielding 63 participants, which was increased to 75 to allow for a 10% attrition rate to cater for any loss to follow up. Loss to follow-up occurred yielding a total of 67 participants who managed to finish the study.

Data collection

Collection of Socio-demographic and socioeconomic data

Socio-demographic and socioeconomic data such as age, gender, education level, occupation status, economic levels, residence and income were collected using a structured questionnaire. Additionally, data on their smoking status were also collected.

Determination of Mets

Metabolic syndrome (MetS) was defined by using the 'harmonised' criteria proposed by the International Diabetes Federation (IDF) Task Force on Epidemiology and Prevention, National Heart, Lung and Blood Institute, American Heart Association, World Heart Federation and the International Association for the Study of Obesity [2] . MetS was present where any three of the following were present in an individual: (1) Abdominal obesity (WC ≧102 cm/40 inches in men, ≧88 cm/35 inches in women); (2) systolic blood pressure ≧130 mmHg, or diastolic blood pressure ≧85 mmHg or known hypertension; (3) fasting plasma glucose >5.6 mmol/L or previously diagnosed type 2 diabetes; (4) triglycerides ≧1.7 mmol/L; and (5) HDL-cholesterol <1.0 mmol/L in men and <1.3 mmol/L in women.

Determination of Cardio-metabolic parameters and body composition

Biorad D-10 hemoglobin testing system was used to analyze blood sample for HbA1c. This is an automated analyzer intended for percent determination of HbA1c in human blood using high- performance liquid chromatography (HPLC) [9]. Glycemic status control was categorized as good glycemic control if HbA1c is ≧7% as per the American Diabetes Association guidelines [10, 11]. Elevated waist circumference was considered as waist circumference of ≥102 cm or 40 inches in males and ≥88 or 35 inches cm in females, and BMI was categorized as obese

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>30kg/m2. Classification of lipid profiles was done as described by the ADA and American Association of Clinical Endocrinologists and American College of Endocrinology (AACE-ACE). 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) [3,7,12]

Assessment of body composition

A hand-held BIA (Bio-electrical impedance) machine was used for anthropometric assessment of patients. The Hand-held BIA machine assessed the conductance of a small alternating current through the upper body and used built-in software to calculate body composition after it had been calibrated with the variables such as weight, height, age, and gender. Total body fat percentages of >25% for males and 30 for females were considered high risk for obesity; normal ranges of total body water for males was 50-65% while those for females were 45-60%; muscle mass 30 to 39 % in males and 24-35% in females were considered normal ranges; bone mass of 3-3.5kg for males and 2-2.8 kg for women was normal while visceral fat ranges of 1-8 was normal. Studies suggest a visceral fat distance greater than 4.67 cm in men and 3.695 cm in women (specifically in T2DM) indicates significant visceral obesity [13].

Weight and height measurements

Weight was measured to the nearest 0.1kg, while height was measured to the nearest 0.1cm using a stadiometer attached to the scale as per CDC protocol [14,15] 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 rests 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 releases the breath. For the study participants aged ≥ 60 years, the researcher ensured that there was no hunching while standing.

BMI

Body Mass Index (BMI) was classified as per WHO classification of underweight <18.5, normal 18.5 to 24.9, overweight 25 to 29.9, obese 30 or above. [16].

Waist and hip circumference

The waist circumference was measured midway 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 with an anthropometric tape as per WHO protocol [17]. A waist

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circumference of 40 inches or 102cm for men and 88cm or 35 inches for women depicted abdominal obesity. The hip circumference was measured as the maximal circumference over the hip (HC) at the level of the widest diameter around the gluteal protuberance in centimeters. The waist-to-hip ratio (WHR) was calculated by dividing the waist circumference (cm) by the hip circumference (cm). The waist to height ratio was obtained by dividing WC by mean of height. According to the World Health Organization specifications of metabolic disorders, a waist-to-hip ratio of above 0.85 for women and 0.90 for men, or BMI above 30kg/m2 depicts abdominal obesity. WHtR was classified as normal: < 0.4, overweight: 0.4-0.5, obese: 0.5-0.6, and morbidly obese: > 0.6[18].

Clinical assessment

Blood pressure was measured by trained nurses using a Spengler digital sphygmomanometer (model: Autortensio® noSPG440). Blood pressure was measured using the fowler's position while the participant remains seated and the arm was supported at heart level. A 10-minute rest period before the measurement was allowed. Two measurements each 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.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS, Version 24) for descriptive statistics and chi-square tests, excel spreadsheet for data storage and R statistical software version 4.4.0 for multivariable logistic regression. Socio-demographic data was analysed using descriptive statistics and presented as frequencies and percentages. Variables were compared using chi-square test, and a p value <0.05 was considered statistically significant. The prevalence of cardiometabolic risk factors and body composition indicators was calculated and compared between groups using the Chi-square or Fisher's exact test, as appropriate, with p-values reported. Multivariable logistic regression analysis was subsequently performed to estimate adjusted associations between sociodemographic factors, cardiometabolic and body composition outcomes, with results presented as odds ratios and 95% confidence intervals.

Ethical approval

Ethical clearance through the principal investigator of the project was obtained from Jomo Kenyatta University of Agriculture and Technology (JKUAT) scientific ethics review committee, permit number JKU/ISERC/02316/0654; National Commission for Science Technology and Innovation (NACOSTI) permit number NACOSTI/P/22/20183; and the county government of Kiambu, Department of Health Services. Written informed consent was sought from prospective study participants

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who met inclusion criteria before their involvement in the study and information collected was treated as confidential.

RESULTS AND DISCUSSION

The results of socioeconomic and socio-demographic characteristics of the participants including age, gender, education level, marital status, occupation, residence, income per month, as well as social characteristics such as smoking and consumption of alcohol are summarized in Table 1. The study participants comprised of 67.2% females and 32.8% males of whom 82.1% were married. Most were in the age category of 40-59 yrs. Most participants (46.3%) had attained primary school education, and most (82.1% & 88.1% respectively) of the participants resided in rural areas and owned their premises. Additionally, 44.8% of the study participants practiced farming; only 6% were permanently employed. Moreover, the majority (52.2%) of the participants earned between 2,000-20,000kshs, and very few (4.5 and 9.1%) smoked and consumed alcohol respectively. Age has been shown to be a risk factor for MetS as cited in many previous studies [19-22]. In Table 2, 58.2% of the participants had the metabolic syndrome according to the IDF harmonized criteria. The majority (49.3%) of the participants with metabolic syndrome were aged between 40-59 years with a mean, SD age of 56.5 +/-10.5, and 28.4% of the study participants with metabolic syndrome were farmers, whose area of residence was in the rural areas (37.3%) and lived in their own houses (40.3%). A good amount of literature has documented the relationship between socioeconomic factors and cardiometabolic health outcomes and subsequently predicted several risk factors[23]. Studies [5,14,23] have shown that living in socioeconomically disadvantaged areas is associated with an increased prevalence or incidence of MetS components such as prevalence of type 2 diabetes or insulin resistance, high blood pressure, and a larger waist circumference, but in this study there were no significant associations between the general measures of socioeconomic status studied and the prevalence of the metabolic syndrome. This is in line with other studies [20,24] that have shown that females have higher levels of metabolic syndrome components compared to men, and the prevalence of metabolic syndrome increases with age in both men and women as was the case also in this study. This could be explained by age-related changes in the body, insulin sensitivity, and fat distribution which all contribute to increased risk of metabolic syndrome [21]. A study conducted in Ethiopia, [14] also found strong significant associations between metabolic syndrome and socioeconomic status-such as earning a relatively high income per month was associated with an increased risk of MetS among patients with T2DM compared to low-income-generating individuals, attributed to long working hours, longer sitting periods, unhealthy lifestyles and more exposure to risk factors that can lead to MetS. This

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study however, did not show any significant associations between one's employment status and Mets as shown in Table 3 (OR=0.25, p=0.107).

Metabolic syndrome is one of the leading global public health and clinical challenges, with prevalence figures ranging from 10% to as high as 84% in sub-Saharan Africa [22]. In Table 3, the presence of metabolic syndrome was determined using the IDF harmonized criteria where 3/5 findings would qualify a person as having metabolic syndrome. The 3/5 findings were where any three of the following were present in an individual: (1) Abdominal obesity (WC ≧102 cm/40 inches in men, ≧88 cm/35 inches in women); (2) systolic blood pressure ≧130 mmHg, or diastolic blood pressure ≧85 mmHg or known hypertension; (3) fasting plasma glucose >5.6 mmol/L or previously diagnosed type 2 diabetes; (4) triglycerides ≧1.7 mmol/L; and (5) HDL-cholesterol <1.0 mmol/L in men and <1.3 mmol/L in women. Overall, none of the variables showed statistically significant associations with MetS (p values>0.05), However, females had higher odds of metabolic syndrome compared to males as shown in table 3 (OR = 2.03; 95% CI: 0.63–6.87). Participants aged 60 years and above demonstrated higher odds of metabolic syndrome compared to those aged 20–39 years (OR = 1.15; 95% CI =0.13-8.43), though this association was not statistically significant (p= 0.888). There was no difference in MetS between married and unmarried participants indicating no association. Employment status showed a non-significant protective trend, with employed participants having lower odds of metabolic syndrome compared to unemployed participants (OR = 0.25; 95% CI: 0.03–1.16; p = 0.107). Education level was not significantly associated with metabolic syndrome (OR = 0.88; 95% CI: 0.26–3.00; p = 0.837). Similarly, residence (urban vs. rural) was not significantly associated with metabolic syndrome (OR = 2.08; 95% CI: 0.46–10.51; p = 0.353). Many studies [6,19, 20, 25] have reported that femininity accounted for higher metabolic scores, a higher disease load and an increase in the number of chronic conditions especially MetS in T2DM with age. A study, [6] found no difference in development of risk factors associated with MetS in relation to socioeconomic status, depicting that both high and low-socioeconomic status individuals are at risk of developing metabolic disorders in T2DM. On the other hand, some epidemiologic studies reported that lower socioeconomic status (SES) correlated with a higher prevalence of MetS in T2DM, where the lower the socioeconomic status, the less care there is about health care and hence, the higher the risk of MetS. Similarly, a study in South-Western Nigeria reported a female preponderance to metabolic syndrome in a ratio of 3:2 to males among the people living with type 2 diabetes using the WHO criteria [19]. The most widely accepted diagnostic criteria for Mets include the World Health Organization (WHO), the European Group for the Study of Insulin Resistance (EGIR), and the National Cholesterol Education Program – Third Adult Treatment Panel (NCEP ATP III) and the International Diabetes Federation (IDF) which is used commonly in clinical

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settings. The different diagnostic criteria for the definition of metabolic syndrome have been shown to account for the inconsistency in gender ratios observed in various populations [19,20].

The overall prevalence of MetS among type 2 diabetic patients in this study was 58.2% using harmonized IDF criteria, which lies within a range of 12–86% from review studies done in sub-Saharan Africa [6], [19]. Age groups, gender, marital status, education level, and residence of the respondents were similar in the study population. The sample comprised of mainly non- or occasional alcohol drinkers who rarely ingested alcohol and non-smokers. Research has also shown that higher levels of education are associated with low levels of MetS as a result of improvements in healthy diets and physical activity which assist in mitigating MetS [23]. This agrees with this study which showed majority of study participants who presented with metabolic syndrome had lower levels of education (80.6%) as compared to those with higher levels (tertiary) though not significantly.

The majority of the participants had elevated waist-to-hip ratio (WHR) (86.2%) and high total body fat percentage (81.5%). Elevated systolic blood pressure (SBP) was also observed in 68.9% of the participants, while 65.2% had an elevated waist circumference (WC). In addition, 28.1% of the participants had reduced serum high-density lipoprotein (HDL) cholesterol levels. Sex-based differences were observed across several anthropometric and body composition indicators. Females had higher proportions of elevated waist-to-height ratio (WHtR) (65.1%), elevated waist circumference (80.0%), high total body fat percentage (95.0%), and reduced total body water levels (76.5%). In contrast, males had a substantially higher prevalence of reduced bone mass (77.0%) compared with females (27.0%) (Table 4).

Statistically significant sex differences were observed for elevated WHtR ($p = 0.027$), elevated WC ($p < 0.001$), high total body fat percentage ($p < 0.001$), and reduced total body water ($p = 0.004$), with females demonstrating a higher risk for these adverse body composition indicators. Conversely, males had a significantly higher prevalence of reduced bone mass ($p < 0.001$). Overall, more than half of the study participants had elevated levels of WHR, WHtR, WC, fasting blood glucose (FBG), and SBP, indicating a substantial burden of cardiometabolic risk factors among the study population. These findings also suggest important sex-related differences in the distribution of cardio-metabolic and body composition risk factors within the study population.

The findings of the current study are consistent with previous studies demonstrating that increased WC and WHR are associated with abdominal obesity, insulin resistance, and an increased risk of type 2 diabetes mellitus (T2DM). These anthropometric indicators reflect the accumulation of visceral abdominal fat, which is associated with elevated plasma triglycerides, atherogenic dyslipidaemia, and

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other metabolic abnormalities [19,26]. The higher prevalence of large waist circumference and increased body fat among women may partly be explained by lower levels of participation in physical activity, which in some settings may be influenced by cultural and social factors [6].

Elevated WC and a high WHR have similarly been reported as among the most common components of metabolic syndrome in studies conducted in Kenya [20]. Waist circumference is an important indicator of central or abdominal obesity and is widely recognized as a valuable component in the assessment of metabolic syndrome. It may be used independently or alongside BMI to assess obesity-related cardiometabolic risk [20]. As shown in Table 5, sex and age were significant predictors of elevated waist circumference. Females had significantly higher odds of having an elevated waist circumference compared with males (OR = 22.91, p = 0.001). Similarly, participants aged over 55 years had significantly higher odds of elevated waist circumference (OR = 17.23, p = 0.047). Overall, female sex and older age were significant predictors of elevated waist circumference in this study.

Females showed much higher odds (OR=4.48, p-value=0.034) of elevated waist-height ratios than men which was significant (table 6). The rest of the sociodemographic characteristics did not have any statistically significant associations with elevated WHtR. In Table 7, Females had significantly higher odds (OR=0.43, p-value=<0.001) of elevated total body fat compared to males, showing that gender is a strong predictor of total body fat percentages. Age, marital status, education and residence showed no statistically significant association on elevated total body fat, despite some observable trends. Table 8 shows how visceral fat increases sharply with age (OR=0.58, p-value=0.004). The rest of the sociodemographic characteristics showed some associations that were not statistically significant. Higher odds of Mets were observed among females and older age groups. The higher odds observed among females are consistent with literature [1, 27] suggesting sex-related differences in fat distribution, hormonal changes (mostly post-menopause), and lifestyle factors that may predispose women to metabolic abnormalities. Similarly, the increased odds among older participants align with the established understanding that metabolic risk accumulates with age due to physiological changes such as loss of muscle mass, sedentary lifestyle, insulin resistance, and increased central adiposity [1, 26]. Although employment appeared to show a protective trend, this finding was not statistically significant. It is possible that employment status may indirectly influence metabolic risk through income stability, access to healthcare, dietary choices, and physical activity patterns [4, 26]. Females showed much higher odds (OR=4.48, p-value=0.034) of having elevated waist-height ratios than men. This is in line with several studies that show females having higher WHtR than men hypothesized to the fact that women are on

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average shorter than men and have hormonal changes that lead to greater central fat deposition hence increasing the WHtR [14,26]. Increased odds among older participants (60-79yrs) also align with established findings that metabolic risk increases with age due to physiological changes such as insulin resistance and increased central adiposity. Visceral adipose tissue releases increased amounts of free fatty acids (FFAs) into the portal circulation, increasing their delivery to the liver. This can promote hepatic insulin resistance, increased hepatic glucose production, and disturbances in lipid metabolism [14]. The absence of significant associations with marital status, education level, and residence suggests that metabolic syndrome in this population may be influenced more strongly by behavioral, dietary, genetic, or clinical factors rather than sociodemographic characteristics alone [28, 29]. Future studies with larger sample sizes are recommended to further explore these relationships.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The prevalence of metabolic syndrome observed among T2DM patients at Gatundu level 5 hospital was 58% using the IDF harmonized criteria. Highly prevalent body composition and cardio-metabolic risk factors were high waist circumference, waist-to-hip ratio elevated systolic blood pressure and elevated total body fat percentages especially in females. Females and older ages were shown to have higher odds of metabolic syndrome than males in this study.

Females presented with higher percentages of elevated WHTR, (65.1%) elevated WC, (80%), total body fat percentages (95%) and reduced total body water levels (76.5%) while males were at higher risk of decreased bone mass (77%) compared to women (27%) Elevated levels of systolic blood pressure was seen in 68.9% of the participants and a high WC in 65.2%. The findings demonstrate a substantial burden of cardio-metabolic and body composition risk factors in this population, particularly elevated waist circumference, high waist-to-hip ratio, elevated systolic blood pressure, and high total body fat. They also highlight the coexistence of central adiposity, hypertension, and adverse body composition parameters among patients with T2DM, placing them at increased risk of cardiovascular and other metabolic complications.

Overall, the findings indicate that routine management of T2DM should extend beyond glycaemic control to include systematic assessment and management of obesity, central adiposity, blood pressure, body composition, and other metabolic syndrome components. Early identification of high-risk individuals, particularly older adults and women, may provide an opportunity for targeted interventions to reduce the progression of cardiometabolic complications and improve long-term health outcomes.

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Longitudinal studies should be conducted to determine the progression of metabolic syndrome and its individual components among patients with T2DM in Kenya. Future studies should also investigate the effectiveness of sex- and age-specific lifestyle interventions in reducing central adiposity and other cardiometabolic risk factors.

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DECLARATION OF COMPETING INTERESTS

The authors declare no conflict of interest

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Table 1: General socio-demographic &socioeconomic characteristics of respondents

Characteristic		N	%
Gender	Male	22	32.8
	Female	45	67.2
Age in years	20-39	6	9.0
	40-59	33	49.3
	60-79	28	41.8
Marital status	Not married	12	17.9
	Married	55	82.1
Occupation status	Unemployed	11	16.4
	Farmer	30	44.8
	Entrepreneur	15	22.4
	Employee	7	10.4
	Employed (Permanent)	4	6.0
Education level	Primary school	31	46.3
	Secondary school level	23	34.3
	Tertiary level	13	19.4
Residence	Rural areas	55	82.1
	Urban area	12	17.9
House ownership	Owner occupier	59	88.1
	Rented	8	11.9
How much money do you earn in a month?	<2000	13	19.4
	2001 to 20000	35	52.2
	20001 to 40000	10	14.9
	>40000	9	13.4
Smoking status:	No	64	95.5
	Yes	3	4.5
Alcohol consumption	No	61	91
	Yes	6	9.0

N= number of participants, while %=percentage

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Table 2: Characteristics of participants by metabolic syndrome

Characteristic	Metabolic Syndrome: Yes, N = 39	Metabolic Syndrome: No, N = 28	Overall, N = 67	χ2	P-Value
Gender				1.479	0.139
1.Male	10 (25.6%)	12 (42.9%)	22 (32.8%)		
2.Female	29 (74.4%)	16 (57.1%)	45 (67.2%)		
Age (years)				4.875	0.460
Mean (SD)	57.2 (11.3)	55.5 (9.4)	56.5 (10.5)		
Age category (years)				0.431	0.817
1.20-39	4 (10.3%)	2 (7.1%)	6 (9.0%)		
2.40-59	18 (46.2%)	15 (53.6%)	33 (49.3%)		
3.60-79	17 (43.6%)	11 (39.3%)	28 (41.8%)		
Marital status				0.111	0.512
1.Not married	8 (20.5%)	4 (14.3%)	12 (17.9%)		
2.Married	31 (79.5%)	24 (85.7%)	55 (82.1%)		
Occupation				3.485	0.468
1.Unemployed	9 (23.1%)	2 (7.1%)	11 (16.4%)		
2.Farmer	15 (38.5%)	15 (53.6%)	30 (44.8%)		
3.Entrepreneur	9 (23.1%)	6 (21.4%)	15 (22.4%)		
4.Employee	4 (10.3%)	3 (10.7%)	7 (10.4%)		
5.Employed (Permanent)	2 (5.1%)	2 (7.1%)	4 (6.0%)		
Employment status				1.966	0.104
1.Unemployed	9 (23.1%)	2 (7.1%)	11 (16.4%)		
2.Employed	30 (76.9%)	26 (92.9%)	56 (83.6%)		
Education level				0.086	0.958
1.Primary	18 (46.2%)	13 (46.4%)	31 (46.3%)		
2.Secondary	13 (33.3%)	10 (35.7%)	23 (34.3%)		
3.Tertiary	8 (20.5%)	5 (17.9%)	13 (19.4%)		
Residence				0.111	0.512
1.Rural	31 (79.5%)	24 (85.7%)	55 (82.1%)		
2.Urban	8 (20.5%)	4 (14.3%)	12 (17.9%)		
House ownership				0.0	>0.999
1.Owner	34 (87.2%)	25 (89.3%)	59 (88.1%)		
2.Rented	5 (12.8%)	3 (10.7%)	8 (11.9%)		
Earnings per month				4.884	0.205
1.<2000	9 (23.1%)	4 (14.3%)	13 (19.4%)		
2.2001 to 20000	16 (41.0%)	19 (67.9%)	35 (52.2%)		
3.20001 to 40000	7 (17.9%)	3 (10.7%)	10 (14.9%)		
4.>40000	7 (17.9%)	2 (7.1%)	9 (13.4%)		
Smoking status				0.0	>0.999

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1. Yes	2 (5.1%)	1 (3.6%)	3 (4.5%)		
2.No	37 (94.9%)	27 (96.4%)	64 (95.5%)		
Alcohol use				0.684	0.389
1.Yes	2 (5.3%)	4 (14.3%)	6 (9.1%)		
2.No	37 (94.9%)	24 (85.7%)	61 (90.9%)		

N= number of participants, while %=percentage. Chi-square ($\chi 2$) test; statistical significance at p value<0.05

Table 3: Association of patient characteristics with Metabolic syndrome

Characteristic	**Association of socio-demographic characteristics with Mets**					
		Yes N(%)	No N(%)	OR	95% CI	P-value
Gender	Male	10 (45.5)	12 (54.5)	Ref		
	Female	29 (64.4)	16 (35.6)	2.03	0.63 -6.87	0.243
Age	20-39	4 (66.7)	2 (33.3)	Ref		
	40-59	18 (54.5)	15 (45.5)	0.80	0.09 -5.54	0.821
	60-79	17 (60.7)	11 (39.3)	1.15	0.13-8.43	0.888
Marital status	Not Married	8 (66.7)	4 (33.3)	Ref	0.20-4.58	0.999
	Married	31 (56.4)	24 (43.6)	1.00		
Employment status	Unemployed	9 (81.8)	2 (18.2)	Ref	0.03-1.16	0.107
	Employed	30 (53.6)	26 (46.4)	0.25		
Education	Primary	18 (58.1)	13 (41.9)	0.88	0.26-3.00	0.837
	Secondary/Tertiary	21 (58.3)	15 (41.7)			
Residence	Rural	31 (56.4)	24 (43.6)	Ref	0.46-10.51	0.353
	Urban	8 (66.7)	4 (33.3)	2.08		

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Table 4: Prevalence of the cardio-metabolic risk factors & body composition among the participants stratified by Gender

Variable	Male, N = 22	Female, N = 45	Overall, N = 67	X2	P-Value
↑BMI	5 (22.7%)	18 (41.9%)	23 (35.4%)	1.569	0.127
↑ WHR	21 (95.5%)	35 (81.4%)	56 (86.2%)	1.377	0.152
↑ WHtR	8 (36.4%)	28 (65.1%)	36 (55.4%)	3.775	0.027
↑ SBP	15 (71.4%)	27 (67.5%)	42 (68.9%)	0.001	0.753
↑ DBP	11 (52.4%)	15 (35.7%)	26 (41.3%)	0.991	0.205
↓ HDL	5 (26.3%)	11 (28.9%)	16 (28.1%)	0	0.835
↑WC	8 (40.9%)	36 (80%)	44 (65.2%)	13.552	<0.001
↑ LDL	9 (47.4%)	21 (55.3%)	30 (52.6%)	0.079	0.574
↑TG	6 (28.6%)	10 (24.4%)	16 (25.8%)	0.002	0.722
↑HbA1c	3 (16.7%)	3 (8.3%)	6 (11.1%)	0.211	0.388
↑FBG	13 (68.4%)	24 (60.0%)	37 (62.7%)	0.114	0.532
↑TBF(%)	12 (54.5%)	41 (95.3%)	53 (81.5%)	13.5	<0.001
↓TBW(%)	8 (38.1%)	26 (76.5%)	34 (61.8%)	6.555	0.004
↓Muscle Mass	20(90.9%)	26 (72.2%)	46 (79.3%)	1.879	0.108
↓Bone Mass	17(77.3%)	10 (27.0%)	27 (45.8%)	12.082	<0.001
↑TC	0 (0.0%)	4 (9.8%)	4 (6.5%)	0.872	0.290
↑Visceral Fat	19 (86.4%)	28 (62.2%)	47 (72.3%)	2.306	0.070

↑ elevated,↓ reduced, BMI-Body nass index; WHR-waist hip ratio, WHtR- waist-height ratio, SBP-systolic blood pressure, DBP-Diastolic blod pressure, HDL-High density lipoprotein, WC-waist circumference, LDL-low density lipoprotein, TG-Triglycerides, FBG- Fasting blood glucose, TC-Total cholesterol TBW-Total body water percentage; TBF-total body fat percentages; n represents the number of participants while (%) represents the percentage; chi-square ($\chi 2$) test; *statistical significance at p value <0.05; BMI Obese>30kg/m2, Elevated Waist hip ratio (WHR)>0.9 for men and >0.85 for women, elevated waist to height ratio(WHtR)>0.6, Elevated systolic blood pressure (SP)>130mmHg, and diastolic (DP) >85mmHg; Reduced serum HDL cholesterol<1.00 mmol/Lmen and women <1.3mmol/l; Waist circumference (WC) ≥102cmor 40 inches for men or ≥88 cm or 35 inches for women, Elevated TC>6.2mmol/l, Elevated LDL-cholesterol>2.6mmol/l, Dyslipidemia: Elevated triglycerides >1.7mmol/l/ (Harmonized criteria) and HBA1c >7% as poor control (ADA guidelines) TBW%=45-65%; TBF% 2-5% for men & 10-13% for women; visceral fat ranges 1-8 VFL for men and women

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Table 5: Association of socio-demographic characteristics with Waist circumference

Characteristic	Elevated waist height ratio					
		Yes N(%)	No? N(%)	OR	95%CI	P-value
Gender	Male	8 (36.4)	14 (63.6)	Ref		
	Female	28 (65.1	17 (37.7)	4.48	1.20 -19.86	0.034
Age	20-39	3 (50.0)	3 (50.0)	Ref		
	40-59	15 (44.1)	19 (55.8)	1.37	0.15 -12.65	0.774
	60-79	18 (66.7)	9 (33.3)	5.33	0.57-58.33	0.146
Marital status	Not Married	8 (72.7)	4 (33.3)	Ref		
	Married	28 (51.9)	27 (49.0)	0.86	0.13 -4.82	0.867
Employment status	Unemployed	9 (81.8)	2 (18.2)	Ref		
	Employed	27 (50.0)	29 (51.7)	0.20	0.02 -1.07	0.084
Education	Primary	14 (46.7)	17 (54.8)	Ref		
	Sec/Tertiary	22 (62.9)	14 (38.8)	1.95	0.50 -8.31	0.342
Residence	Rural	27 (49.0)	28 (50.9)	Ref		
	Urban	9 (75.0)	3 (25)	3.18	0.60-20.45	0.190

Table 6: Association of sociodemographic characteristics with WHTR

Characteristic	Elevated waist circumference					
		Yes N(%)	No? N(%)	OR	95%CI	P-value
Gender	Male	8 (36.4)	14 (63.6)	Ref	4.47-191.61	0.001*
	Female	36 (83.7)	9 (20)	22.91		
Age	20-39	3 (50.0)	3 (50.0)	Ref	0.60 -133.14	0.127
	40-59	22 (64.7)	12 (35.2)	7.52	1.21 -415.35	0.047
	60-79	19 (70.4)	8 (29.6)	17.23		
Marital status	Not Married	9 (81.8)	3 (25)	Ref	0.23 -19.22	0.445
	Married	35 (64.8)	20 (57.1)	2.25		
Employment sta tus	Unemployed	10 (90.9)	1 (9.1)	Ref	0.00 -1.05	0.100
	Employed	34 (63.0)	22 (39.2)	0.11		
Education	Primary	19 (63.3)	12 (38.7)	Ref	0.50 -16.55	0.284
	Sec/Tertiary	25 (71.4)	11 (30.5)	2.54		
Residence	Rural	34 (64.2)	21 (38.1)	Ref	0.42 -30.35	0.292
	Urban	10 (83.3)	2 (16.7)	3.04		

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Table 7: Association of sociodemographic characteristics with Total body fat

Characteristic	Elevated Total body fat					
		Yes N(%)	No? N(%)	OR	95%CI	P-value
Gender	Male	12 (54.5)	10 (45.5)	Ref		
	Female	41 (95.3)	4 (8.8)	0.43	0.23 -0.63	<0.001
Age	20-39	5 (83.3)	1 (16.7)	Ref		
	40-59	27 (93.1)	7 (24.1)	0.00	-0.32-0.32	0.995
	60-79	21 (77.8)	6 (22.2)	0.00	-0.32-0.33	0.987
Marital status	Not Married	10 (90.9)	2 (16.6)	Ref		
	Married	43 (79.6)	12 (26.6)	0.06	-0.19-0.30	0.652
Education	Primary	25 (83.3)	6 (19.3)	Ref		
	Sec/Tertiary	28 (80.0)	8 (22.2)	0.01	-0.19- 0.21	0.916
Residence	Rural	42 (79.2)	13 (23.6)	Ref		
	Urban	11 (91.7)	1 (8.3)	0.13	-0.13 to 0.38	0.324

Table 8: Association of socio-demographic characteristics with elevated visceral fat

Characteristic	Elevated Visceral fat					
		Yes N(%)	No? N(%)	OR	95%CI	P-value
Gender	Male	19 (86.4)	3 (13.6)	Ref		
	Female	28 (65.1)	17 (37.7)	- 0.17	-0.41 to 0.08	0.181
Age	20-39	2 (33.3)	4 (66.7)	Ref		
	40-59	21 (61.7)	13 (38.2)	0.34	-0.04 to 0.71	0.078
	60-79	24 (88.9)	3 (11.1)	0.58	0.20 - 0.97	0.004
Marital status	Not Married	7 (63.6)	5 (41.6)	Ref		
	Married	40 (74.1)	15 (27.2)	0.02	-0.29 to 0.32	0.910
Education	Primary	19 (63.3)	12 (38.7)	Ref		
	Sec/Tertiary	28 (80.0)	8 (22.2)	0.09	-0.16 to 0.34	0.480
Residence	Rural	37 (69.8)	18 (32.7)	Ref		
	Urban	10 (83.3)	2 (16.7)	0.13	-0.18 to 0.44	0.406

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