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Prevalence of Metabolic Syndrome and its Components in Kanifing Municipality, The Gambia

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ABSTRACT

Background: Metabolic syndrome (MetS) is a complex syndrome with clustering of interrelated risk factors for cardiovascular disease and diabetes. Its rising worldwide prevalence has been largely related to the increasing obesity. In The Gambia, the last and only time a MetS related study was conducted, and then reported, was 21 years. Therefore, there is need for evaluating the prevalence of MetS and its components in the country. **Objective:** This study was aimed to evaluate the prevalence of MetS and its individual components in Kanifing Municipality (KM). **Methods:** It was a cross-sectional study conducted at Kanifing General Hospital, Kanifing Municipality. Data obtained from each participants included anthropometric indices, blood pressure, fasting plasma glucose, triglyceride and high-density lipoprotein levels, and clinical information. **Results:** One hundred and thirty-six participants were included in the analysis. The overall MetS prevalence was 54.4% with significant female predominance (female, 58%; male, 29.4%; *P*=0.025). The most predominant component among the study population was central obesity (raised WC) (72.8%). Hypertriglyceridemia was found to be the strongest predictor of MetS among our participants (OR: 118.13; 95% CI: 33.79-412.77; *P* < 0.001). **Conclusion:** Our study discloses a very high prevalence of MetS among the participants, and a significant female predominance, with central obesity the commonest Mets component. The results suggest that hypertriglyceridemia is the strongest predictor of metabolic syndrome in our study participants.
Keywords: Metabolic syndrome, Prevalence, obesity, The Gambia.

1. BACKGROUND

Metabolic syndrome (MetS) is a complex syndrome with clustering of interrelated risk factors for cardiovascular disease (CVD) and diabetes. These factors include dysglycemia (raised fasting glucose), raised blood pressure, dyslipidemia (raised triglycerides and lowered high-density lipoprotein cholesterol), and obesity (particularly central adiposity) (1, 2).

Individuals with MetS are three times more likely to have a stroke or heart attack and two times more likely to die from these compared with individuals without the condition (3). Furthermore, it confers a fivefold greater risk of developing diabetes mellitus compared to adults without the syndrome (3).

Prevalence of obesity and the metabolic syndrome have shown a rapid rise in developing countries in the past few decades leading to increased risk of CVD and consequent morbidity and mortality (4).

In Africa, the rise in the prevalence is thought to be due to departure from traditional African to western lifestyles (5). In The Gambia, the prevalence of MetS was reported to be 42% (IDF) (6).

This was the last and the only time, 21 years ago, a study was conducted on MetS in The Gambia.

And with the prevalence of obesity having more than doubled in the country in that time period (7, 8), there is need for evaluating the prevalence of MetS and MetS components in the country.

2. OBJECTIVE

This study was aimed to investigate the prevalence of MetS and its individual components in Kanifing Municipality (KM) in The Gambia using the International Diabetes Federation (IDF) Worldwide Definition of the Metabolic Syndrome (1).

3. MATERIAL AND METHODS

Participants

It was a cross-sectional study conducted at Kanifing General Hospital (KGH) in The Gambia between November 2019 to February 2020. KGH is located in Kanifing Municipality (KM) and serves the most populous municipality in The Gambia. Two hundred and thirty individuals who visited the medical outpatient department (MOPD) and were of at least 18 years and resident in KM were recruited purposively as participants. Participants diagnosed with HIV, hepatocellular carcinoma and chronic renal disease; and those who did not give blood sample were excluded.

Interviews and Anthropometric Measurements

All participants were interviewed by two trained nurses using questionnaire in relation to their medical history and lifestyle characteristics. Each participant had their blood pressure, height, weight and waist circumference measured. Systolic and diastolic blood pressures were measured in a sitting position after at least 15 minutes rest using Omron blood pressure monitor (Omron-HEM-7124). Three blood pressure readings were done with a five-minute interval between readings. The average of the last two readings were recorded as blood pressure for a participant. Body weight of each participant was measured using Seca 9797 scale. Height of each participant was measured using Seca 213 Portable Stadiometer. Waist circumference for each participant was measured using non-elastic tape measure at a level midway between the lower rib margin and iliac crest with the tape all around the body in horizontal position as recommended by IDF (1). Body mass index was calculated as the ratio of weight in kilograms (kg) to the square of height in meters (m^2). Obesity was defined as a body mass index >30 kg/m^2.

Sample Collection and Assays

Five milliliter (5 mL) of peripheral venous blood was collected from each participant in an ethylene diamine-tetra acetic acid (EDTA) tube after 12 hours fasting. The sample was centrifuged at 3000rpm for 5 mins at room temperature to obtain the serum and plasma used for the assays for measuring fasting plasma glucose (FPG), triglyceride (TG) and high-density lipoprotein (HDL) using Reflotron Plus (Roche Diagnostics GmbH) chemistry analyzer.

Ethics

This study was approved by The Gambia Government/Medical Research Council Joints Ethics Committee (R019011v1.1).

Statistical Analyses

Group differences between male and female, and those with and without metabolic syndrome were assessed using Chi- square/Fisher's Exact test for categorical variables which were expressed as mean values ± standard deviation (SD); and Independent samples T test for continuous variables, expressed as frequencies. Logistic regression was used to evaluate the association between MetS and associated risk factors.

Statistical significance was defined as p-value < 0.05. All analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. (IBM Corp., Armonk, NY, USA).

4. RESULTS

The clinical and anthropometric characteristics of the 136 participants finally recruited for this study are presented on Table 1 by sex. Their mean age was 46.78±14.77 years with male being older (54.06±19.69 years compared to 45.7±513.73 years for female). Majority 87.5%(n=119) of the participants were female. There was significant difference between the two groups in terms of waist circumference (WC), BMI and TG (p=0.012, p=0.003 and p=0.008 respectively) with higher values in female. Although, systolic blood pressure (SBP), diastolic blood pressure (DBP), and FPG were higher; and HDL lower in female, they were not statistically significant (Table 1).

The overall metabolic syndrome was 54.4%. The prevalent was higher in females compared to male (female, 58%; male, 29.4%; p=0.025). When assessed using the harmonized definition of MetS in which abdominal obesity is not a prerequisite, the overall prevalence rose to 64.0%; and that of female rose to 67.2% (Table 2).

The most prevalent component of the MetS was increased WC which was present in 72.8% (n=99) of the participants, while the least prevalent was elevated blood pressure (both SBP and DBP present in 49.3% (n=69) of participants. The commonest component of the MetS in male participants was raised FPG (76.3%), while in females it was increased WC (78.2%) (Table 3). There was a statistically significant difference in the prevalence

Variable	Total (n=136)	Male (n=17)	Female (n=119)	P Value*
Age (years)[a]	46.78±14.77	54.06±19.69	45.7±513.73	0.029
SBP (mmHg)[a]	134.84±28.35	129.88±18.67	135.55±29.46	0.443
DBP (mmHg)[a]	88/16±14.10	84.47±10.56	88.69±14.49	0.250
DM (n (%))[b]				0.589
Yes	56(41.2)	6(35.3)	50(42.0)	
No	80(58.8)	11(64.7)	69(58.0)	
HTN (n (%))[b]				0.399
Yes	67(49.3)	10(58.8)	57(47.9)	
No	69(50.7)	7(41.2)	62(52.1)	
WC (cm)	89.69±13.61	81.97±11.73	90.80±13.55	0.012
Weight (kg)[a]	71.42±17.58	63.78±11.22	72.51±18.08	0.055
Height (cm)[a]	163.81±6.84	168.65±7.91	163.11±6.41	0.002
BMI (kg/m^2)[a]	26.54±6.39	22.22±3.54	27.16±6.48	0.003
FBS (mmol/L)[a]	8.12±4.01	6.97±3.16	8.28±4.10	0.209
TG (mmol/L)[a]	1.58±0.37	1.36±0.40	1.61±0.35	0.008
HDL (mmol/L)[a]	1.20±0.26	1.25±0.19	1.20±0.27	0.400

Table 1. Clinical and anthropometric characteristics of participants by sex. BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic bp; FPG, fasting plasma glucose; F, female; HDL, high density lipoprotein; M, male; TG, triglyceride; WC, waist circumference; Participants groups were compared by aT Test and bChi-square/Fisher's Exact test; *P<0.05 is considered to be significant

Variable	Total (n=136)	Male (n=17)	Female (n=119)	P Value*
Metabolic syndrome per IDF (n (%))				0.027
Yes	74(54.4)	5(29.4)	69(58.0)	
No	62(45.6)	12(70.6)	50(42.0)	
Metabolic syndrome per HD				0.036
Yes	87(64.0)	7(41.2)	80(67.2)	
No	49(36.0)	10(58.8)	36(32.8)	

Table 2. Prevalence of the metabolic syndrome in men and women according to IDF and HD criteria. IDF, International Diabetes Federation; HD, harmonized definition. Participants groups were compared by Chi-square/Fisher's Exact test; *P<0.05 is considered to be significant

of BMI, raised WC and low HDL levels (p=0.025, p <0.001, p <0.001 respectively) between male and female participants (Table 3). 61.3% of females in terms of BMI were either overweight or obese, compared to 29.4% of male (Table 3). The prevalence of general obesity (BMI≥30) was 24.3% with mean BMI of 26.54±6.39 (27.16±6.48, female; 22.22±3.54, male; p=0.003) (Table 1).

Participants with MetS (50.89 ± 12.54 years) were older(p<0.001) than those without the syndrome (41.87 ± 15.81years); with the prevalence increasing with age up to 55 years, and then declined. There is significant difference in the mean values of SBP, DBP, WC, BMI, FPG, TG and HDL between those with and without MetS, all at p < 0.001 (Table 4). 41.2% (n=56) of the participants presented with history of diabetes and receiving treatment for it (Table 1). Of this, 75% (n=42) were found to have MetS. Of the 49.3% of participants who presented with hypertension, 73.1%(n=49) had MetS (Table 4a).

The prevalence of components of MetS comparing those with and without the syndrome is significantly different in all; with age group at p=0.001 and the rest (SBP, DPB, present of HTN and DM, FPG, TG, HDL, BMI) at p < 0.001. Of the components of MetS, those with raised TG level (≥1.7mmol/L) had the highest prevalence at 89.7% (70 out of 78 participants with elevated TG) of the syndrome amongst them. This was followed by those with reduced HDL at 82.1% (Table 4b).

In terms of clustering of components, only 2.7% of those with MetS had only three. The rest had either four components (43.2%) or five components (54.1%) (Table 5). Table 5 also shows participants who have zero and up to four components with the exception of raised WC per IDF criteria. 21% (n=9, 3 components; n=4, 4 components) of these would have been categorized of the syndrome using the harmonized definition.

Using logistic regression analysis, high TG (≥1.7mmol/L) was found to be the strongest predictor of MetS among the participants (OR: 118.13; 95% CI: 33.79-412.77; p <0.001) (Table 6).

5. DISCUSSION

In the present study, we evaluated the prevalence of MetS and its individual components, using the International Diabetes Federation (IDF) Worldwide Definition of the Metabolic Syndrome (1). According to MetS status, participants with MetS were found to be older (50.89 ± 12.54 years, to 41.87 ± 15.81 year, without the syndrome p<0.001); with the prevalence increasing with age up to 55 years, and then declined. This finding is similar to those in several studies (9-12). The age dependency of the syndrome has been seen in most popula-

Variable	Categories	Total (n=136) n (%)	Male (n=17) n (%)	Female (n=119) n (%)	P Value*
BMI (kg/m2)	<18.5	10(7.4)	3(17.6)	7(5.9)	0.025
	18.5–24.5	48(35.3)	9(52.9)	39(32.8)	
	25.0–29.9	45(33.1)	5(29.4)	40(33.6)	
	≥30	33(24.3)	0(0.0)	33(27.7)	
WC (cm)	<94 (M) OR <80 (F)	37(27.2)	11(64.7)	26(21.8)	<0.001
	≥94 (M) OR ≥80 (F)	99(72.8)	6(35.3)	93(78.2)	
FPG (mmol/L)	<5.6	41(30.1)	9(23.5)	37(31.1)	0.528
	≥5.6	95(69.9)	13(76.5)	82(68.9)	
SBP (mmHg)	SBP < 130	67(49.3)	9(52.9)	58(48.7)	0.746
	SBP ≥130	69(50.7)	8(47.1)	61(51.3)	
DBP (mmHg)	< 85	67(49.3)	9(52.9)	58(48.7)	0.746
	≥ 85	69(50.7)	8(47.1)	61(51.3)	
TG (mmol/L)	<1.7	58(42.6)	10(58.8)	48(40.3)	0.149
	≥1.7	78(57.4)	7(41.2)	71(59.7)	
HDL (mmol/L)	≥1.03(M) OR ≥1.29 (F)	58(42.6)	15(88.2)	43(36.1)	<0.001
	<1.03(M) OR <1.29 (F)	78(57.4)	2(11.8)	76(63.9)	

Table 3. Prevalence of each component of the metabolic syndrome in the total population, men, as well as women. BMI, Body Mass Index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose; M, male; F, female; HDL, High density lipoprotein; TG, triglycerides; WC, waist circumference Participants groups were compared by Chi-square/Fisher's Exact test; *P<0.05 is considered to be significant

tions, indicating its role as risk factor (13).

The overall MetS prevalence in this study was 54.4%, with significant female predominance (female, 58%; male, 29.4%). This prevalence is higher than the one reported, 42% (female, 55.1%; male, 17.5%), by Nkum et al (6). Similar high prevalence, 60.6 %, was reported by Erasmus et al (14) in a study conducted in South Africa per IDF definition. In using the harmonized definition, the prevalence of MetS in our study rose to 64.0%, and that of the females to 67.2%. The very high prevalence in our participants, and the high increase in prevalence compared to that from the study conducted 21 years ago, though published in 2015 (6), could be attributed to the over years exponential increase in obesity prevalence in The Gambia (8, 15); given the rising prevalence of the syndrome in the world being largely attributed to increasing prevalence of obesity (3, 16).

Variables	Categories	Total number (n=136) n (%)	Metabolic Syndrome (n=74) n (%)	Nonmetabolic Syndrome (n=62) n (%)	P value*
Age (years)[a]		46.57±14.78	50.89 ± 12.54	41.87 ± 15.81	< 0.001
Age group[b]	18-25	11(8.1)	1(9.1)	10(90.9)	0.001
	26-35	24(17.6)	7(29.2)	14(70.0)	
	36-45	30(22.1)	17(56.7)	13(43.3)	
	46-55	26(19.1)	19(73.2)	7(26.9)	
	56-65	28(20.6)	19(67.1)	9(32.9)	
	65-75	17(12.5)	11(64.7)	6(35.3)	
DM (n (%))[b]	Yes	56(41.2)	42 (75.0)	14 (25.0)	< 0.001
	No	80(58.8)	32 (40.0)	48 (60.0)	
HTN (n (%))[b]	Yes	67(49.3)	49(73.1)	18 (26.9)	< 0.001
	No	69(50.7)	25(36.2)	44 (63.8)	
SBP (mmHg)[a]		134.70±28.28	145.47 ± 26.25	122.15 ± 25.55	< 0.001
SBP (mmHg)[b]	SBP < 130	67(49.3)	19(28.4)	48(71.6)	< 0.001
	SBP ≥130	69(50.7)	55(79.7)	14(20.3)	
DBP (mmHg)[a]		88.16±14.20	92.47 ± 11.84	83.02 ± 14.91	< 0.001
DBP (mmHg)[b]	< 85	67(49.3)	26(38.8)	41(61.2)	< 0.001
	≥ 85	69(50.7)	48(69.6)	21(30.4)	

Table 4a. Clinical and Metabolic syndrome component characteristics of participants according to metabolic syndrome status. BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic bp; FPG, fasting plasma glucose; F, female; HDL, high density lipoprotein; M, male; TG, triglyceride; WC, waist circumference; Participants groups were compared by aT Test and bChi-square/Fisher's Exact test; *P<0.05 is considered to be significant

Variables	Categories	Total number (n=136) n (%)	Metabolic Syndrome (n=74) n (%)	Nonmetabolic Syndrome (n=62) n (%)	P value*
WC (cm)[a]		89.49 ±13.61	97.99 ± 9.91	79.79 ± 10.46	< 0.001
WC (cm)[b]	<94 (M) OR <80 (F)	37(27.2)	0(0.0)	37(100.0)	< 0.001
	≥94 (M) OR ≥80 (F)	99(73.5)	74(74.7)	25(25.3)	
BMI (kg/m²)[a]		26.52±6.43	29.68 ± 6. 46	22.80 ± 3.78	< 0.001
BMI (kg/m²)[b]	<18.5	10(7.4)	0(0.0)	10(100.0)	< 0.001
	18.5−24.5	48(35.3)	17(35.4)	31(64.6)	
	25.0−29.9	45(33.1)	26(57.8)	19(42.2)	
	≥30	33(24.3)	31(93.9)	2(6.1)	
FPG mmol/L)[a]		8.08±4.0	9.37 ± 3.82	6.62 ± 3.73	< 0.001
FPG mmol/L)[b]	<5.6	41(30.1)	9(22.0)	32(78.0)	
	≥5.6	95(69.9)	65(68.4)	30(31.6)	< 0.001
TG (mmol/L)[a]		1.58±0.37	1.81 ± 0.16	1.315 ± 0.37	< 0.001
TG (mmol/L)[b]	<1.7	58(42.6)	4(6.9)	54(93.1)	< 0.001
	≥1.7	78(57.4)	70(89.7)	8 (10.3)	
HDL (mmol/L)[a]		1.20±0.26	1.07 ± 0.18	1.36 ± 0.26	< 0.001
HDL (mmol/L)[b]	≥1.03(M) OR ≥1.29 (F)	58(42.6)	10(17.2)	48(82.8)	< 0.001
	<1.03(M) OR <1.29 (F)	78(57.4)	64(82.1)	14(17.9)	

Table 4b. Clinical and Metabolic syndrome component characteristics of participants according to metabolic syndrome status. BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic bp; FPG, fasting plasma glucose; F, female; HDL, high density lipoprotein; M, male; TG, triglyceride; WC, waist circumference; Participants groups were compared by aT Test and bChi-square/Fisher's Exact test; *P<0.05 is considered to be significant

In 2020, Cham et al (8) reported that two-fifth of adults in The Gambia to be either overweight or obese, with a higher obesity prevalence in female (17% to 8.1% in men). In our study, 57.3% of participants were either overweight or obese (female, 61.3%; male, 29.4%). Cham et al (8) also reported more than 60% of the residents in the capital (Banjul) and Kanifing Municipality (our study area) to be either overweight or obese. Van der Sande et al (7) in 1997 reported 2.3% prevalence of obesity and 8.1% of overweight in The Gambia. This indicates tripling of prevalence of obesity in the country in little over 20 years. This would mean, until the increase in prevalence of obesity is stopped, MetS prevalence will continue to rise in The Gambia, obesity being identified as a cardinal feature; and the mechanistic link in the components of metabolic syndrome (3, 17-19). Of the 57.4% of our participants either overweight or obese, 71.8% were found to have metabolic syndrome. The rise in prevalence of

Variables	Categories	Total number (n=136) n (%)	Metabolic Syndrome (n=74) n (%)	Nonmetabolic Syndrome (n=62) n (%)	P value*
Mets Components	0	4(2.9)	0(0.0)	4(6.5)	< 0.001
	1	29(21.3)	0(0.0)	29(46.8)	
	2	16(11.8)	0(0.0)	16(25.8)	
	3	11(8.1)	2(2.7)	9(14.5)	
	4	36(26.5)	32(43.2)	4(6.5)	
	5	40(29.4)	40(54.1)	0(0.0)	

Table 5. Distribution of components according to the IDF criteria for participants with and without metabolic syndromeParticip. ants groups were compared by Chi-square/Fisher's Exact test; *P<0.05 is considered to be significant

Variable	Metabolic syndrome		
	OR	95% CI	P Value*
High TG	118.13	33.79-412.97	<0.001
Low HDL	21.94	8.98-53.63	<0.001
High SBP	9.93	4.50-21.90	<0.001
High FPG	7.71	3.27-18.15	<0.001
High DBP	3.60	1.78-7.33	<0.001

Table 6. Association between the variables related to metabolic syndrome in the total participants. HDL, high-density lipoprotein; TG, triglyceride; OR, odds ratio; CI, confidence interval; Analyses was done using logistic regression *P<0.05 is considered to be significant

obesity in The Gambia has been attributed to nutritional transition, increased consumption of processed foods, and urbanization which leads to sedentary occupations and plentiful high-fat diets causing rising obesity rates in the urban regions (8, 20).

The female predominance (female, 58%; male, 29.4%) in prevalence of MetS found in our study is similar to the findings by Nkum et al (6); and several other studies (9-12, 21). The high prevalence in the female could also be attributed to high level of obesity among them. 61.3% of our female participants were either overweight or obese compared to 29.4% for that of men. The Gambian society is generally tolerant of obesity especially in female folks (22); and even encourages it, as 'big body' is seen as sign of wealth, success and prestige, and beauty in female; just like in some African countries (23). This kind of attitude is in contrast to social stigma against obesity and obsession in some developed countries to remain lean (24). In 2019, Petry et al (15) reported that 18.3% and 11.1% of non-pregnant women, nationally, to be overweight and obese respectively, and 41.2% of the participants presented with history of diabetes. Of this, 75% were found to have MetS. In using the harmonized definition, MetS prevalence rose to 83.6%. Ogbera (9) reported a MetS prevalence of 86% using the harmonized definition in diabetic patients in Lagos, Nigeria. This high prevalence in a diabetic population is expected given the known association between MetS and increased risk of developing type 2 diabetes (25).

Components of MetS vary in their rates of occurrence. The most prevalent component of MetS in our total population was central obesity (increased WC). It

was found in 72.8% of the total participants; followed by raised FPG which was found in 69.9% of the participants. This is different from the most prevalent component reported by Nkum et al (6) which was raised BP found in 72.4% of their participants, followed by central obesity, per IDF definition, in 69.8% of their participants. Similar to our findings, Ogbera (9) and Omuse et al (11) also found central obesity as the most prevalent MetS component in their study participants. Central obesity being the most prevalent MetS component is not surprising given the fact it has been suggested to be the cardinal feature, and plays a central role in the development of MetS; and appears to precede the appearance of the other components (2, 26). Excess accumulation of adipose tissue, particularly visceral fat, contributes to the development of insulin resistance, central in the pathogenesis of MetS, resulting in symptoms characteristic of MetS which include: type 2 diabetes, dyslipidemia and hypertension (27, 28). The commonest component of the MetS that was present in our male participants was raised FPG (76.3%) while in females it was central obesity (78.2%). Nkum et al (6), too, found central obesity to be the most prevalent components in their female participants at 89.9% - indicating the significance of this component in The Gambia especially among the females.

MetS increases the risk of morbidity and mortality from CVD and type 2 diabetes (3, 16). Although each of the components of the MetS individually has been identified as risk factors for cardiovascular disease, the more component an individual has, three or more, the greater the risk (29). In our participants with MetS, only 2.7% presented with three components. The rest had at least four components; indicating a very risk of morbidity and mortality from CVD and type 2 diabetes in them. 6.5% (2.9% of the total participants) of those without MetS (without raised WC per IDF), had four components and would have been considered MetS per harmonized definition. 14.5% (6.6% of total participants) not diagnosed of MetS per IDF definition, would also have been considered MetS per the harmonized definition. And those with two components, representing (11.8%) of the total participants, are at the risk of developing MetS. In terms of association of the components with MetS, raised TG was found to be the strongest predictor of metabolic syndrome among our participants.

The strength of this study is that it is the first one in 21 years since the first and the only reported results on MetS in The Gambia was conducted. It could be stated that this was the first study primarily designed to investigate the MetS in The Gambia since the original study by Nkum and his team was designed to determine the association between insulin resistance and left ventricular hypertrophy (6). Our study providing the most recent data on MetS in the country, could serve as baseline from which other studies can be assessed; and would contrib-

ute to the sensitization and the prevention of the MetS in KM. The main weakness was it being a cross sectional study, in which causal inferences cannot be made. Other potential limitations would include the very low number of male participants (12.5%), introducing the possibility of a skewed data representation. Furthermore, diagnostic criteria for MetS, most especially the cut-off points for WC, used are not African specific. Therefore, the data on WC may therefore be underestimated or overestimated compared with alternative thresholds for abdominal obesity.

6. CONCLUSION

Our study discloses a very high prevalence of MetS among the participants, and a significant female predominance. Central obesity and raised fasting plasma glucose were the commonest components among the participants. The results also suggest that hypertriglyceridemia is the strongest predictor of MetS in our study participants. Our findings highlight the need for strategies for prevention of MetS and its associated components in KM. It is therefore imperative to put in place or strengthen preventive strategies to be directed at raising awareness of its risk factors and the risks associated with the syndrome itself; importance of achieving and maintaining a healthy weight, and eradicating harmful sociocultural beliefs about weight; promoting health lifestyles and regular physical activity especially among women. A larger community based cross sectional studies with larger sample size to study MetS in The Gambia would be recommended.

REFERENCES

1. Alberti KG, Zimmet P, Shaw J. Metabolic syndrome - a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med. 2006 May; 23(5): 469-480. doi: 10.1111/j.1464-5491.2006.01858.x.
2. Després JP, Lemieux I. Abdominal obesity and metabolic syndrome. Nature. 2006 Dec 14; 444(7121): 881-887. doi: 10.1038/nature05488.
3. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, Fruchart J-C, James WPT, Loria CM, Smith SC. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International. Circulation. 2009 Oct 20; 120(16): 1640-1645. doi: 10.1161/CIRCULATIONAHA.109.192644.
4. Misra A, Khurana L. Obesity and the metabolic syndrome in developing countries. J Clin Endocrinol Metab. 2008 Nov; 93(11 Suppl 1): S9-30. doi: 10.1210/jc.2008-1595.
5. Okafor CI. The metabolic syndrome in Africa: Current trends. Indian J Endocrinol Metab. 2012 Jan; 16(1): 56-66. doi: 10.4103/2230-8210.91191.
6. Nkum BC, Micah FB, Ankrah TC, Nyan O. Metabolic Syndrome in The Gambia: Comparison of the International Diabetes Federation and Adult Treatment Panel III Definitions. Open Science Journal of Clinical Medicine 2015; 3: 27-32.
7. Van der Sande MA, Bailey R, Faal H, Banya WA, Dolin P, Nyan OA, Ceesay SM, Walraven GE, Johnson GJ, McAdam KP. Nationwide prevalence study of hypertension and related non-communicable diseases in The Gambia. Trop Med Int Health. 1997 Nov; 2(11): 1039-1048. doi: 10.1046/j.1365-3156.1997.d01-184.x.
8. Cham B, Scholes S, Ng Fat L, Badjie O, Groce NE, Mindell JS. The silent epidemic of obesity in The Gambia: evidence from a nationwide, population-based, cross-sectional health examination survey. BMJ Open. 2020 Jun 1; 10(6): e033882. doi: 10.1136/bmjopen-2019-033882.
9. Ogbera AO. Prevalence and gender distribution of the metabolic syndrome. Diabetol Metab Syndr. 2010 Jan 12; 2: 1. doi: 10.1186/1758-5996-2-1.
10. Kruger MJ, Nell TA. The prevalence of the metabolic syndrome in a farm worker community in the Boland district, South Africa. BMC Public Health. 2017 Jan 11; 17(1): 61. doi: 10.1186/s12889-016-3973-1.
11. Omuse G, Maina D, Hoffman M, Mwangi J, Wambua C, Kagotho E, et al. Metabolic syndrome and its predictors in an urban population in Kenya: A cross sectional study. BMC Endocr Disord. 2017 Jul 4; 17(1): 37. doi: 10.1186/s12902-017-0188-0.
12. Marbou WJT, Kuete V. Prevalence of Metabolic Syndrome and Its Components in Bamboutos Division's Adults, West Region of Cameroon. Biomed Res Int. 2019 Apr 30; 2019: 9676984. doi: 10.1155/2019/9676984.
13. AlSaraj F, McDermott JH, Cawood T, McAteer S, Ali M, Tormey W, et al. Prevalence of the metabolic syndrome in patients with diabetes mellitus. Ir J Med Sci. 2009 Sep; 178(3):

309-313. doi: 10.1007/s11845-009-0302-z.

14. Erasmus RT, Soita DJ, Hassan MS, Blanco-Blanco E, Vergotine Z, Kegne AP, et al. High prevalence of diabetes mellitus and metabolic syndrome in a South African coloured population: Baseline data of a study in Bellville, Cape Town. S Afr Med J. 2012 Oct 8; 102(11 Pt 1): 841-844. doi: 10.7196/samj.5670.

15. Petry N, Jallow B, Sawo Y, Darboe MK, Barrow S, Sarr A, et al., Micronutrient Deficiencies, Nutritional Status and the Determinants of Anemia in Children 0–59 Months of Age and Non-Pregnant Women of Reproductive Age in The Gambia. Nutrients. 2019 Sep 23; 11(10): 2275. doi: 10.3390/nu11102275.

16. Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet. 2005 Apr 16-22; 365(9468): 1415-1428. doi: 10.1016/S0140-6736(05)66378-7.

17. Ordovás JM, Robertson R, Cléirigh EN. Gene-gene and gene-environment interactions defining lipid-related traits. Curr Opin Lipidol. 2011 Apr; 22(2): 129-136. doi: 10.1097/MOL.0b013e32834477a9.

18. Dubois L, Ohm Kyvik K, Girard M, Tatone-Tokuda F, Pe´russe D, Hjelmborg J, et al. Genetic and Environmental Contributions to Weight, Height, and BMI from Birth to 19 Years of Age: An International Study of Over 12,000 Twin Pairs. PLoS One. 2012; 7(2): e30153. doi: 10.1371/journal.pone.0030153.

19. Sheikh AB, Nasrullah A, Haq S, Akhtar A, Ghazanfar H, Nasir A, et al. The Interplay of Genetics and Environmental Factors in the Development of Obesity. Cureus. 2017 Jul 6; 9(7): e1435. doi: 10.7759/cureus.

20. Prentice A, Webb F. Obesity amidst poverty. Int J Epidemiol. 2006 Feb; 35(1): 24-30. doi: 10.1093/ije/dyi204.

21. Faijer-Westerink HJ, Kengne AP, Meeks KAC, Agyemang C. Prevalence of metabolic syndrome in sub-Saharan Africa: A systematic review and meta-analysis. Nutr Metab Cardiovasc Dis. 2020 Apr 12; 30(4): 547-565. doi: 10.1016/j.numecd.2019.12.012.

22. Siervo M, Grey P, Nyan OA, Prentice AM. A pilot study on body image, attractiveness and body size in Gambians living in an urban community. Eat Weight Disord. 2006 Jun; 11(2): 100-109. doi: 10.1007/BF03327758.

23. Scott A, Ejikeme CS, Clottey EN, Thomas JG. Obesity in sub-Saharan Africa: development of an ecological theoretical framework. Health Promot Int. 2013 Mar; 28(1): 4-16. doi: 10.1093/heapro/das038.

24. Litllewood R. Commentary: Globalization, culture, body image, and eating disorders. Cult Med Psychiatry. 2004 Dec; 28(4): 597-602. doi: 10.1007/s11013-004-1069-3.

25. Marott SC, Nordestgaard BG, Tybjærg-Hansen A, Benn M. Components of the Metabolic Syndrome and Risk of Type 2 Diabetes. J Clin Endocrinol Metab. 2016 Aug; 101(8) :3212-21. doi: 10.1210/jc.2015-3777.

26. Cameron AJ, Boyko EJ, Sicree RA, Zimmet PZ, Söderberg S, Alberti KG, et al. Central obesity as a precursor to the metabolic syndrome in the AusDiab study and Mauritius. Obesity (Silver Spring). 2008 Dec; 16(12): 2707-2716. doi: 10.1038/oby.2008.412.

27. Yamauchi T, Kamon J, Ito Y, Tsuchida A, Yokomizo T, Kita S, et al. Cloning of adiponectin receptors that mediate antidiabetic metabolic effects. Nature. 2003 Jun 12; 423(6941): 762-769. doi: 10.1038/nature01705.

28. Matsuzawa Y, Funahashi T, Kihara S, Himomura I. Adiponectin and metabolic syndrome. Arterioscler Thromb Vasc Biol. 2004 Jan; 24(1): 29-33. doi: 10.1161/01.ATV.0000099786.99623.EF.

29. Patel A, Barzi F, Jamrozik K, Lam TH, Ueshima H, Whitlock G, et al. Serum triglycerides as a risk factor for cardiovascular diseases in the Asia-Pacific region. Circulation. 2004 Oct 26; 110(17): 2678-2686. doi: 10.1161/01.CIR.0000145615.33955.83.