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 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 79797 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 (m²). Obesity was defined as a body mass index >30 kg/m².

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 Joint 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±13.73 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 | Male (n=136) | Female (n=119) | P Value* |
|----------|-------------|----------------|----------|
| Age (years) | 46.78±14.77 | 54.06±19.69 | 45.7±13.73 | 0.029 |
| SBP (mmHg) | 134.8±28.35 | 129.8±18.67 | 135.5±29.46 | 0.443 |
| DBP (mmHg) | 88.16±14.10 | 84.47±10.56 | 88.69±14.49 | 0.250 |
| DM (n (%)) | 67(49.3) | 10(58.8) | 57(42.0) | 0.399 |
| No | 69(50.7) | 71(41.2) | 62(58.2) | 0.029 |
| HTN (n (%)) | 67(49.3) | 10(58.8) | 57(42.0) | 0.399 |
| No | 69(50.7) | 71(41.2) | 62(58.2) | 0.029 |
| WC (cm) | 89.69±13.61 | 81.97±11.73 | 90.8±13.55 | 0.012 |
| Weight (kg) | 71.42±17.58 | 63.78±11.22 | 72.51±18.08 | 0.055 |
| Height (cm) | 163.81±6.84 | 168.65±7.91 | 163.11±6.41 | 0.002 |
| BMI (kg/m²) | 26.54±6.39 | 22.23±5.34 | 27.16±6.48 | 0.003 |
| FBS (mmol/L) | 8.12±4.01 | 6.97±3.16 | 8.28±4.10 | 0.209 |
| TG (mmol/L) | 1.58±0.37 | 1.36±0.40 | 1.61±0.35 | 0.008 |
| HDL (mmol/L) | 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.
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 ± 15.81 years); 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, 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, DBP, 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-
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) | Metabolic Syndrome (n=74) | Nonmetabolic Syndrome (n=62) | P value* |
|-----------|------------|----------------------|--------------------------|-----------------------------|----------|
| Age (years)* | 18-25 | 11(8.1) | 1(9.1) | 10(90.9) | 0.001 |
| | 26-35 | 24(17.6) | 7(29.2) | 17(70.0) | 0.001 |
| | 36-45 | 30(22.1) | 17(56.7) | 13(43.3) | 0.001 |
| | 46-55 | 26(19.1) | 19(73.2) | 7(26.9) | 0.001 |
| | 56-65 | 28(20.6) | 19(67.1) | 9(32.9) | 0.001 |
| | 65-75 | 17(12.5) | 11(64.7) | 6(35.3) | 0.001 |
| DM (n %)* | Yes | 56(41.2) | 42(75.0) | 14 (25.0) | < 0.001 |
| | No | 80(58.8) | 32 (40.0) | 48 (60.0) | 0.001 |
| HTN (n %)* | Yes | 67(49.3) | 49(73.1) | 18 (26.9) | < 0.001 |
| | No | 69(50.7) | 25(36.2) | 44 (63.8) | 0.001 |
| SBP (mmHg)* | SBP <130 | 67(49.3) | 19(28.4) | 48(71.6) | < 0.001 |
| | SBP ≥130 | 69(50.7) | 55(79.7) | 14(20.3) | 0.001 |
| DBP (mmHg)* | < 85 | 67(49.3) | 26(38.8) | 41(61.2) | < 0.001 |
| | ≥85 | 69(50.7) | 48(69.6) | 21(30.4) | 0.001 |

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 a T Test and b Chi-square/ Fisher’s Exact test; *P<0.05 is considered to be significant

| Variables | Categories | Total number (n=136) | Metabolic Syndrome (n=74) | Nonmetabolic Syndrome (n=62) | P value* |
|-----------|------------|----------------------|--------------------------|-----------------------------|----------|
| WC (cm)* | <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) | 0.001 |
| BMI (kg/m²)* | <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) | 0.001 |
| | 25.0–29.9 | 45(33.1) | 26(57.8) | 19(42.2) | 0.001 |
| | ≥30 | 33(24.3) | 31(93.9) | 2(6.1) | 0.001 |
| FPG mmol/L* | <5.6 | 41(30.1) | 9(22.0) | 32(78.0) | 0.001 |
| | ≥5.6 | 95(69.9) | 65(68.4) | 30(31.6) | 0.001 |
| TG (mmol/L)* | <1.7 | 1.58±0.37 | 1.81 ± 0.16 | 1.315 ± 0.37 | < 0.001 |
| | ≥1.7 | 78(57.4) | 70(89.7) | 8 (10.3) | 0.001 |
| HDL (mmol/L)* | <1.03 (M) OR <1.29 (F) | 78(57.4) | 64(82.1) | 14(17.9) | < 0.001 |

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 a T Test and b Chi-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
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### Table 5. Distribution of components according to the IDF criteria for participants with and without metabolic syndrome

| Variable       | Metabolic syndrome | Total number | Nonmetabolic syndrome |
|----------------|--------------------|--------------|-----------------------|
|                |                    | (n=136)      | (n=74)                |
| High TG        | OR                 | 95% CI       | P value*              |
| Low HDL        | 1.94               | 0.95-3.99    | <0.001                |
| High SBP       | 2.04               | 1.16-3.56    | <0.001                |
| High FPG       | 3.27               | 2.17-4.96    | <0.001                |
| High DBP       | 2.00               | 1.18-3.44    | <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

| Variable       | Metabolic syndrome |
|----------------|--------------------|
| High TG        | OR                 |
| Low HDL        | 1.94               |
| High SBP       | 2.04               |
| High FPG       | 3.27               |
| High DBP       | 2.00               |

### Table 7. Distribution of components according to the IDF criteria for participants

| Variables Categorie | Total number (n=136) | Metabolic Syndrome (n=74) | Nonmetabolic Syndrome (n=62) | P value* |
|---------------------|----------------------|---------------------------|-----------------------------|----------|
| 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)                      |          |

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 over-estimated 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 hypertri-glyceridemia 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.

Patient Consent Form: Written informed consent was obtained from all study participants.

Author’s contribution: K.S.B., D.L., and D.W. substantially contributed to the conception and design of the work. K.S.B. gave substantial contribution to data acquisition. K.S.B., D.L., H.S. and D.W. gave a substantial contribution to the analyses and interpretation of data of the work. K.S.B., D.L., D.W., O.A had a part in article preparing for drafting or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflicts of interest: There are no conflicts of interest.

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