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Original Research Article

Prevalence and Associated Factors of Metabolic Syndrome among Adults Attending Medical Clinic at Bugando Medical Centre, Tanzania

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Abstract: ***Background*:** Metabolic syndrome (MetS) is a cluster of cardiometabolic abnormalities associated with cardiovascular disease and diabetes. This study assessed the prevalence, distribution of metabolic syndrome components, and associated factors among adults attending the medical outpatient clinic at Bugando Medical Centre (BMC), Mwanza, Tanzania. ***Methods*:** This hospital-based cross-sectional study was conducted from May to June 2022 among adults aged ≥18 years attending the BMC medical outpatient clinic. Participants were selected by systematic sampling. Sociodemographic, lifestyle and clinical information was collected using a structured questionnaire. Blood pressure, body weight, height and waist circumference were measured, and fasting blood samples were analyzed for glucose, triglycerides, high-density lipoprotein cholesterol, C-reactive protein and serum uric acid. MetS was defined using International Diabetes Federation (IDF) and National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria. Univariable and multivariable logistic regression were used to assess associated factors. ***Results*:** Of 219 patients screened, 197 were eligible and 181 consented to participate. The median age was 58 years and 107 (59.1%) were female. MetS was present in 84 (46.6%) participants by IDF criteria and 69 (38.1%) by ATP III criteria. Hypertension was the most common component (159, 87.8%), followed by central obesity by IDF criteria (115, 63.5%). Physical activity of less than 150 minutes/week was associated with higher odds of MetS (odds ratio [OR] 4.17, 95% confidence interval [CI] 1.49–11.11; p=0.008). Obesity (body mass index [BMI] ≥30 kg/m²) was also associated with higher odds of MetS (OR 8.44, 95% CI 2.35–30.25; p=0.001). ***Conclusion*:** MetS was common among adults attending the BMC medical outpatient clinic. Obesity and low physical activity were important associated factors, highlighting the need for routine cardiometabolic screening and lifestyle-focused interventions in outpatient care.

Keywords: Hypertension, Metabolic Syndrome, Obesity, Physical Activity, Tanzania.

INTRODUCTION

Metabolic syndrome (MetS) comprises a cluster of cardiometabolic abnormalities, including central obesity, elevated blood pressure, hyperglycaemia and dyslipidaemia, that collectively increase the risk of atherosclerotic cardiovascular disease and type 2 diabetes mellitus. The syndrome has important vascular consequences and is associated with increased cardiometabolic morbidity [1–4].

The prevalence of MetS varies substantially across populations worldwide, and its distribution is influenced by demographic and lifestyle factors [5].

In Tanzania, available evidence has described MetS mainly in selected populations, including people living with HIV and their partners, while data from general medical outpatient populations remain limited [6, 7].

The medical outpatient clinic at Bugando Medical Centre (BMC) serves patients with a broad range of chronic and acute medical conditions, making it an important setting for assessing the burden of cardiometabolic risk.

The present study therefore aimed to determine the prevalence of MetS, describe the distribution of its components, and identify factors associated with MetS

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among adults attending the medical outpatient clinic at BMC.

METHODS

Study Design and Setting

This was a hospital-based cross-sectional study conducted at Bugando Medical Centre, a tertiary referral and teaching hospital in Mwanza, northwestern Tanzania. The medical outpatient clinic provides care through general and specialty clinics including nephrology, gastroenterology, endocrinology, infectious diseases, haematology, neurology, cardiology and general medicine. Data were collected between May and June 2022.

Study Population and Eligibility

Adults aged ≥18 years attending the BMC medical outpatient clinics during the study period were eligible. Patients with diabetes mellitus, pregnant women and patients with ascites were excluded.

Sample Size and Sampling

Sample size was calculated using the Leslie–Kish formula, assuming a prevalence of 7.8%, a 95% confidence level and an absolute precision (margin of error) of approximately 3.6%, giving a sample size of 219. Systematic sampling was used, with every tenth eligible client approached for enrolment.

Data Collection and Measurements

An interviewer-administered structured questionnaire captured demographic, socioeconomic, lifestyle and clinical information. Physical activity was categorized as <150 or ≥150 minutes/week. Standardized measurements included blood pressure, height, weight and waist circumference. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Fasting blood samples were collected for glucose, triglycerides, high-density lipoprotein (HDL) cholesterol, C-reactive protein (CRP) and serum uric acid. Laboratory analyses were performed using the Cobas Integra 400 Plus analyzer. Hyperuricaemia was defined as serum uric acid >8.5 mg/dL for males or >7.3 mg/dL for females; CRP ≥3 mg/L was considered elevated.

Definition of Metabolic Syndrome

MetS was assessed using both the International Diabetes Federation (IDF) and National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria. Under the IDF definition, central obesity was required together with at least two additional components: raised triglycerides, reduced HDL cholesterol, elevated blood pressure or raised fasting plasma glucose. Under NCEP ATP III, MetS was defined as the presence of at least three of five components: central obesity, elevated triglycerides, reduced HDL cholesterol, elevated blood pressure or elevated fasting glucose [3].

Statistical analysis

Data were entered, cleaned and analyzed using SPSS version 25. Continuous variables were summarized using medians and categorical variables using frequencies and proportions. Associations with MetS were first examined using univariable logistic regression. Variables with $p<0.05$ were entered into multivariable logistic regression. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported, with $p<0.05$ considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the joint Bugando Medical Centre/Catholic University of Health and Allied Sciences (BMC/CUHAS) Ethics Review Committee (CREC/558/2022), and permission to conduct the study was granted by the Bugando Medical Centre administration. Written informed consent was obtained from participants; a thumbprint was used for participants unable to provide a written signature. Participants retained the right to withdraw without affecting their care.

RESULTS

Participant Enrolment and Characteristics

A total of 219 patients were screened. Twenty-two were ineligible (3 aged <18 years, 12 with diabetes mellitus and 7 with ascites), leaving 197 eligible adults; 16 did not consent. Thus, 181 participants were enrolled and analyzed. Baseline characteristics of the study participants are summarized in Table 1.

The median age was 58 years; 107 (59.1%) participants were female. Ninety-three (51.4%) lived in urban areas, 131 (72.4%) were employed, and 144 (79.6%) reported less than 150 minutes of physical activity per week. Obesity (BMI ≥30 kg/m²) was present in 122 (67.4%) participants.

Prevalence and Distribution of Metabolic Syndrome

MetS was identified in 84 (46.6%) participants using IDF criteria and 69 (38.1%) using ATP III criteria (Table 2; Figure 1). Hypertension was the most common component, affecting 159 (87.8%) participants. Central obesity was present in 115 (63.5%) according to IDF criteria and in 91 (50.3%) according to ATP III criteria. Low HDL cholesterol was present in 110 (60.8%) and elevated triglycerides in 59 (32.6%) participants (Table 2; Figure 2).

Factors Associated with Metabolic Syndrome

In univariable logistic regression analysis, urban residence, selected education categories, physical activity <150 minutes/week, alcohol history, obesity and hyperuricaemia were associated with MetS. Variables with $p<0.05$ were considered for inclusion in the multivariable logistic regression model. The univariable

and multivariable analyses are presented in Tables 3 and 4.

In multivariable analysis, physical activity <150 minutes/week was associated with higher odds of MetS (OR 4.17, 95% CI 1.49–11.11; p=0.008), while obesity (BMI ≥30 kg/m²) was associated with higher odds of MetS (OR 8.44, 95% CI 2.35–30.25; p=0.001). Alcohol intake, hyperuricaemia, education and urban residence were not independently associated with MetS.

Table 1: Selected baseline characteristics of participants (N=181)

Characteristic	n (%)
Female sex	107 (59.1)
Male sex	74 (40.9)
Urban residence	93 (51.4)
Employed	131 (72.4)
Physical activity <150 min/week	144 (79.6)
Obesity (BMI ≥30 kg/m²)	122 (67.4)
Hypertension history	131 (72.4)
HIV positive	4 (2.2)

Table 2: Prevalence and major components of metabolic syndrome

Measure	n (%)
MetS by IDF	84 (46.6)
MetS by ATP III	69 (38.1)
Hypertension component	159 (87.8)
Central obesity by IDF	115 (63.5)
Central obesity by ATP III	91 (50.3)
Low HDL cholesterol	110 (60.8)
Elevated triglycerides	59 (32.6)

Abbreviations: MetS, metabolic syndrome; IDF, International Diabetes Federation; ATP III, Adult Treatment Panel III; HDL, high-density lipoprotein.

Table 3: Baseline factors associated with metabolic syndrome by univariable analysis (N=181)

Characteristic / comparison	MetS n (%)	Without MetS n (%)	OR (95% CI)	P-value
Age <40 years	4 (4.8)	13 (13.4)	2.50 (0.66–9.40)	0.180
Age 41–50 years	13 (15.5)	17 (17.5)	3.40 (0.98–11.60)	0.060
Age 51–60 years	28 (33.3)	27 (27.8)	3.20 (0.95–10.60)	0.060
Age >60 years	39 (46.4)	40 (41.2)	1.50 (0.80–2.70)	0.189
Female sex	30 (35.7)	44 (45.4)	0.67 (0.37–1.22)	0.189
Male sex	54 (64.3)	53 (54.6)	Reference	—
Urban residence	35 (41.7)	58 (59.8)	2.10 (1.10–3.80)	0.016
Primary education	35 (41.7)	45 (46.4)	1.30 (0.79–2.14)	0.020
Secondary education	18 (21.4)	25 (25.8)	0.18 (0.05–0.63)	0.007
College education	6 (7.1)	14 (14.4)	0.33 (0.14–0.82)	0.016
University education	4 (4.8)	4 (4.1)	0.35	0.350
Employed	58 (69.0)	73 (75.3)	0.70 (0.38–1.40)	0.352
Tap-water source	48 (57.1)	69 (71.1)	1.70 (0.90–3.10)	0.078
Electricity as energy source	51 (60.7)	68 (70.1)	1.50 (0.95–2.25)	0.086
Modern flush toilet	46 (54.8)	65 (67.0)	1.70 (0.92–3.07)	0.093
Smoking history	8 (9.5)	22 (22.7)	3.60 (0.39–32.58)	0.260
Physical activity <150 min/week	76 (90.5)	68 (70.1)	4.17 (1.67–10.00)	0.001
Alcohol history	8 (9.5)	22 (22.7)	2.80 (1.17–6.65)	0.021
Overweight BMI 25–<30 kg/m²	12 (14.3)	23 (23.7)	2.96 (0.72–12.13)	0.130
Obese BMI ≥30 kg/m²	69 (82.1)	53 (54.6)	8.44 (2.35–30.25)	0.001
Hyperuricaemia	52 (61.9)	43 (44.3)	1.96 (1.08–3.50)	0.027
Elevated CRP ≥3 mg/L	56 (66.7)	58 (60.0)	1.30 (0.11–15.70)	0.819

Abbreviations: MetS, metabolic syndrome; OR, odds ratio; CI, confidence interval; BMI, body mass index; CRP, C-reactive protein. Reference categories are indicated where applicable.

Table 4: Factors independently associated with metabolic syndrome by multivariable analysis

Variable	OR	95% CI	P-value
Alcohol intake	2.58	0.92–7.21	0.070
Physical activity <150 min/week	4.17	1.49–11.11	0.008
Hyperuricaemia	1.00	0.46–2.17	1.000
Primary education	0.42	0.16–1.14	0.140
Secondary education	0.60	0.19–1.85	0.371
College education	0.36	0.08–1.57	0.176
University education	1.94	0.27–13.70	0.507
BMI 25–<30 kg/m²	2.96	0.72–12.13	0.130
BMI ≥30 kg/m²	8.44	2.35–30.25	0.001
Residence (urban)	1.42	0.68–2.98	0.349

Abbreviations: OR, odds ratio; CI, confidence interval; BMI, body mass index. Reference categories: no alcohol intake, physical activity ≥150 min/week, no hyperuricaemia, incomplete primary education, BMI <25 kg/m² and rural residence.

DISCUSSION

This study found a high burden of MetS among adults attending a tertiary medical outpatient clinic in northwestern Tanzania. Depending on the diagnostic definition used, 38.1% of participants met ATP III criteria and 46.6% met IDF criteria. The difference is expected because the IDF definition emphasizes central obesity and requires it as a core component, whereas ATP III permits diagnosis based on any three of five components [3].

Hypertension was the most common metabolic abnormality, affecting 87.8% of participants. Central obesity was also frequent, particularly among women, a pattern that has been reported in studies from the United States, Cameroon, Nigeria and South Africa [8–11].

The prevalence of low HDL cholesterol and elevated triglycerides was lower in this study than that reported among urban patients living with HIV receiving antiretroviral therapy in Tanzania, where antiretroviral treatment and the underlying population may contribute to a different lipid profile [6].

Physical activity emerged as an independent factor. Participants reporting <150 minutes of physical activity per week had higher odds of MetS than those reporting ≥150 minutes per week. In multivariable analysis, the odds of MetS were approximately four times higher among participants with physical activity <150 minutes per week (OR 4.17, 95% CI 1.49–11.11; p=0.008). This finding is consistent with studies from Tanzania, the United States, Madrid and Ethiopia that reported associations between low physical activity or sedentary lifestyle and MetS [6–14].

Obesity was independently associated with MetS after adjustment, with substantially higher odds among participants with BMI ≥30 kg/m² (OR 8.44, 95% CI 2.35–30.25; p=0.001). This finding is consistent with previous studies from Cameroon, the United States, Madrid and Iran that reported significant associations between higher BMI and MetS [9-17].

High serum uric acid was not independently associated with MetS in this study, in contrast to findings from Thailand. The difference may partly reflect the higher serum uric acid threshold used in the present study [15].

Several factors associated with MetS in univariable analysis were no longer independently associated after adjustment. This included age, sex, residence, education, alcohol consumption and cigarette smoking, findings that differ from reports from the United States, Cameroon, Ethiopia, Kenya and Tanzania [6-16].

Strengths and Limitations

Strengths of the study included systematic sampling, standardized anthropometric and blood-pressure measurements, and direct laboratory assessment of several metabolic risk markers. However, the study had limitations. First, sociodemographic and lifestyle information was collected by questionnaire and may be affected by recall bias. Second, the tertiary-hospital setting introduces the possibility of referral bias. Third, the single-centre design limits generalizability to other populations and healthcare settings. Finally, the cross-sectional design precludes conclusions about temporality or causality.

CONCLUSION

Metabolic syndrome was common among adults attending the medical outpatient clinic at Bugando Medical Centre, with prevalence estimates of 46.6% by IDF criteria and 38.1% by ATP III criteria. Hypertension was the most common component, while obesity and physical activity <150 minutes/week were important independent factors associated with MetS. Routine screening for cardiometabolic risk, together with interventions targeting obesity, blood pressure and physical inactivity, should be strengthened in medical outpatient settings.

Implications for Clinical Practice

- Integrate routine metabolic syndrome screening into medical outpatient assessment, particularly

for patients with multiple cardiometabolic risk factors.
- Emphasize assessment and management of obesity, blood pressure and physical inactivity as part of cardiovascular risk reduction.
- Use multidisciplinary approaches involving physicians, nurses, nutrition professionals and other relevant health workers.
- Undertake larger, multicentre prospective studies to assess progression and clinical outcomes associated with metabolic syndrome in Tanzania.

Declarations

Ethical Approval

Ethical clearance for the study was obtained from the Joint Bugando Medical Centre/Catholic University of Health and Allied Sciences (BMC/CUHAS) Ethics Review Committee, certificate number CREC/558/2022. Permission to conduct the study was obtained from the Bugando Medical Centre administration.

Consent to Participate: Written informed consent was obtained from all participants; thumbprints were accepted for participants unable to provide written signatures.

Consent for Publication: Not applicable.

Availability of Data and Materials

The dataset is not publicly available to maintain participant confidentiality. Data may be available from the corresponding author on reasonable request, subject to appropriate approvals.

Competing Interests: The authors declare no competing interests.

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Authors' contributions: DBM, SEK and LR conceptualized and designed the study, participated in data analysis and interpretation, and contributed to manuscript preparation.

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