



Prevalence and Risk Factors of Metabolic Syndrome among Individuals Living with HIV and Receiving Antiretroviral Treatment in Tanzania

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Authors' contributions

This work was carried out in collaboration between all authors. Authors GBK, GDK, CNM, AMK, RMM, AFS, AKK, AMK, ESN, GSM, SGM and MTM were involved with conception and designing the study. Authors GBK, MTM, ESN, GDK, AKK and AMK implemented the study on the field. Authors GBK, MTM, ESN, AKK, GDK and SGM were involved in data analysis. Authors GBK, GDK, CNM, AMK, RMM, AFS, AKK, AMK, ESN, GSM, SGM, MTM prepared the first draft of the manuscript. Authors GBK, GDK, CNM, AMK, RMM, AFS, AKK, AMK, ESN, GSM, SGM and MTM all co-authors reviewed the manuscript critically and accepted the final version.

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ABSTRACT

Aim: To estimate the prevalence and risk factors for metabolic syndrome (MetS) among HIV positive patients on antiretroviral therapy (ART) in Tanzania.

Study Design: A cross sectional study was conducted among adults aged ≥ 18 years living with

HIV-infection and receiving ART.

Place and Duration of Study: The study participants were recruited from 12 care and treatment clinics in Dar es Salaam (urban) and Mbeya (rural) regions between October 2011 and February 2012.

Methodology: The prevalence of MetS was assessed using International Diabetes Federation's criteria. Biochemical assays, anthropometric measurements, demographic characteristics and lifestyle behavioural data were collected.

Results: Study response rate was 351/377(93.1%) and 177 (50.4%) recruited participants were from urban settings and 238 (67.8%) were females. The prevalence of MetS was 25.6% and was higher among participants from urban than those from rural areas (35.6% vs 15.5%, $p<.001$). The components of MetS including raised triglyceride (43.5% vs 21.3%, $p<.001$), low high density lipoprotein (85.9% vs 28.2%, $p<.001$) and raised blood fasting glucose (10.2% vs 5.2%, $p=.04$) were more common among participants from urban than those from rural settings. MetS Risk factors including; consumption of fruits/vegetables <5 days/week (77.0% vs 59.3%, $p<.001$), not participating on vigorous intensity activities (65.5% vs 29.4% $p<.001$) and consuming mixed cooking oil (animal/vegetable) (15.5% vs 8.5%, $p=.03$) were higher among participants from rural than those from urban areas. In rural, only consumption of vegetables/fruits <5 days/week (AOR=5.50, 95%CI 1.21-24.95, $p=.005$) predicted the prevalence of MetS. In urban; sex (female) (AOR=3.01, 95%CI 1.31-6.85, $p=.002$), having primary/no formal education (AOR=0.32, 95%CI 0.12-0.89, $p=.04$) and ex- or current alcohol drinker (AOR=2.43, 95%CI 1.17-5.06, $p=.02$) were significant predictors of MetS.

Conclusion: Prevalence, components and predictors of MetS prevailed more in urban than in rural settings. Interventions targeting prevention of MetS to reduce diabetes and cardiovascular diseases should consider settings diversification.

Keywords: Metabolic Syndrome; human immunodeficiency virus (HIV); antiretroviral therapy; risk factors; rural; urban; Tanzania.

1. INTRODUCTION

Metabolic Syndrome (MetS) disorder confers the risk of developing non-communicable diseases such as cardiovascular diseases and diabetes mellitus among individuals living with HIV-infections and being on anti-retroviral treatments (ART) [1]. HIV has been documented to cause lipid abnormalities including high triglycerides and low HDL cholesterol [2]. Apart from HIV; antiretroviral medications are linked with metabolic and body shape changes [3,4]. Such vicious relationship increases the chance of exposure to MetS which is the risk factor for diabetes mellitus and other cardiovascular diseases among individuals living with HIV-infection especially those who are on ART. This is because of an increased risk of MetS due to the known side effects associated with ART [5]. Studies have shown that prevalence estimates of MetS were estimated 18%, 20% and 21.1% for the people living with HIV in the Australia, Malaysia and South West Ethiopia [6-8] respectively. In Latin America, the prevalence of MetS in HIV patients on ART is 20.2% [9]. In Africa, an increase in the prevalence of MetS is thought to be due to departure from traditional African to western lifestyles [10-12]. In the general population, the prevalence of metabolic

syndrome is estimated to be between 17% and 25% [13]. In Sub-Saharan Africa (SSA), human immunodeficiency virus (HIV) pandemic and use of ART exacerbated MetS [9,14-16]. HIV infection is associated with changes in blood biochemical and metabolic parameters which show relationship with the antiretroviral regimens [1]. The prevalence of MetS among individuals living with HIV-infection and being on ART in many parts of SSA varies from 10% to 50% [17,18]. In Cameroon, studies show that MetS is more prevalent in individuals living with HIV-infected and being on treatment than not on treatment; and overall, the prevalence of MetS was 18.3% in females while in males it was only 4.6% [17]. In Ethiopia, MetS was diagnosed in 25% of individuals living with HIV-infection receiving ART [18]. Despite increasing number of studies on MetS in relation to HIV infection and ART in many parts of the world, this information is lacking in most of low-income countries including Tanzania, which has 1,135,390 people living with HIV-infection [19].

Several criteria for the metabolic syndrome have been developed with controversy [20-22] following the first by the World Health Organization (WHO) in 1998 [23]. These criteria include The European Group for the Study of

Insulin Resistance (1999) that requires insulin resistance [24], The US National Cholesterol Education Program Adult Treatment Panel III (2001) [25] and American Heart Association [26]. In this study, the International Diabetes Federation (IDF) definition of the metabolic syndrome (2006) was used. The IDF definition is based on central obesity (waist circumference) and any two of the following factors such as raised blood level of triglycerides; reduced blood level of HDL cholesterol, raised blood pressure (BP) and raised fasting blood glucose (FPG) [20]. However, the new IDF definitions developed during a unique consensus workshop for MetS (which excludes BMI), provides medical practitioners with quick tools to identify risk individuals with options of comparison across nations and ethnic group [27].

In Tanzania, fewer studies have investigated the association between MetS and HIV infection among patients on ART using a comprehensive set of risk factors. In other instances, these risk factors have often been evaluated individually instead of using a set of several variables in order to identify source of MetS in a combination of risk factors. The objective of this study was to estimate the prevalence of metabolic syndrome using IDF criteria and explore the fuelling risk factors for the problem in both rural and urban settings. Findings from this study are expected to contribute to the limited information on the prevalence of MetS and related risk factors in rural and urban settings of Tanzania and other low-income countries.

2. METHODOLOGY

This study is part of project which was assessing magnitude and risk factors for non-communicable diseases among people living with HIV in Tanzania, whose methods have been described elsewhere [15]. A brief description for study area and population, sampling and study procedures, data collection and analysis is summarized below.

2.1 Study Area and Population

We conducted a cross-sectional study in two regions of Mbeya and Dar es Salaam that represents rural and urban settings respectively. These two regions were chosen because they had the largest number of population living with HIV-infection aged 18 years and above enrolled in care and treatment clinics (CTCs) and receiving ART in the country [28].

2.2 Sampling Procedures

Two districts were randomly selected from each region: Ilala and Kinondoni districts from Dar es Salaam and Kyela and Rungwe districts from Mbeya. A list of all care and treatment clinics (CTCs) arranged according to the level of facility (dispensary, health centre and hospital) was made available per site. From each stratum one CTC was randomly selected using a randomly selection Table [29]. A total of 12 CTCs (three from each district) were therefore selected. A separate list of people living with HIV (PLWHIV) and who were on ART was obtained. The list provided a sampling frame of the patients. The proportion allocation statistical technique which is described by randomly selection Table [29] was used to obtain sub-sample from different levels of health facilities i.e. dispensaries, health centres and hospitals from each district.

2.3 Data Collection

Pilot tested questionnaires were used to collect information from each study subject on demographic characteristics, metabolic syndrome risk factors, anthropometric and biochemical measurements such as blood glucose and lipid profile. All physical measurement data (weight, height, waist circumference and blood pressure) was collected by the research team using calibrated equipments. Blood sample for biochemical tests for High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (HDL-C), Total Cholesterol (TC), Triglycerides Cholesterol (TG-C) and Fasting Blood Glucose were collected and analysed by qualified laboratory technologists.

2.3.1 Blood pressure (BP) measurements

Blood pressure was measured while patients were in a sitting position, using an M4 Omron® automatic blood pressure device. The blood pressure reading was consistently taken from the left arm, three times at 3 minutes interval [30]. The average of the two last readings was estimated and used in the analysis. High blood pressure was classified as systolic BP \geq 130 mmHg or diastolic BP BP \geq 85 mmHg, or on BP treatment [23,31].

2.3.2 Waist circumference

Measurement was taken at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest as described in WHO guidelines [32]. We used the European cut off to interpret the waist

circumference measurements for the Sub-Saharan African People as per the World Health Organizations (WHO) and International Diabetes Federation (IDF) recommendations. According to the above guidelines the range of abnormal waist circumference of male and female are ≥ 94 cm and ≥ 80 cm respectively [27,33].

2.3.3 Laboratory test

The study subjects were requested to return to the clinics to provide fasting blood samples for blood glucose and cholesterol measurements in the following morning. Patients were provided with return transport fare Tanzanian Shillings 3,000/= (equivalent to 2 USD) to facilitate the return visits. All patients were provided with a feedback of their results and advised accordingly.

2.3.4 Fasting blood glucose measurement

Patients were instructed to fast for at least 8 hours before the test. All tests were performed by trained laboratory technicians. Blood sample was taken by finger prick (capillary) and measured using Hemoque® 201 analyzer. Diagnosis of diabetes mellitus was done according to WHO classification [34].

2.3.5 Lipid profile estimations

Blood was taken for lipid measurements which included: High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C), Total Cholesterol (TC), Triglycerides Cholesterol (TG-C) and Low-Density Lipoprotein Cholesterol (LDL-C). Blood sample of 4mls for lipid profile were taken from a venipuncture and placed in a plain vacutainer. Blood was kept at room temperature and was analyzed the same day, within hours of sample collection. Samples were analyzed using fully automated biochemistry analyzers by the direct end point enzymatic method.

2.4 Assessment of Metabolic Syndrome

Metabolic syndrome was defined using IDF criteria. The criteria were waist circumference (central obesity) ≥ 80 cm in women and ≥ 94 cm in men plus two of the following: raised triglycerides level ≥ 1.7 mmol/l, reduced HDL cholesterol level in male < 1.03 mmol/L and in females < 1.29 mmol/L, raised fasting glucose ≥ 5.6 mmol/l and raised systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg. A person was classified to have metabolic syndrome if was found having abnormal waist circumference and at least two of any other of the above criteria [27].

In this study, a patient who reported that he/she was diabetes before ART initiation; was excluded from the study.

2.5 Data Analysis

Data collected was coded and double entered by two independent data entry clerks using Epidata Version 3.1. Double entrance was done anonymously as a way to ensure accuracy and correctness of the data entered in the database. Data was then exported to Statistical Package for Social Sciences version 18 for windows (SPSS Inc, Chicago, USA) and Stata version 11 (STATA Corp Inc., TX, USA) for crosschecking and cleaning purpose. The processes of crosschecking and cleaning of data were done to detect possible errors which are normally generated from the field or during the stage of data entry. The above two statistical software were also used for data analysis. Pearson Chi square statistics test was used to compare group differences for categorical variables. The mean difference between variables was ascertained by using T-Test. Logistic regression was used for modelling multiple risks for metabolic syndrome. Crude and Adjusted Odds Ratios (OR) with 95% confidence intervals (CI) were reported. Variables that were considered significant in the univariate analysis were analyzed using multivariate analysis. Forward stepwise selection with removal testing was used, which based on probability of the likelihood ratio statistic. The significance level of a likelihood ratio statistic was compared to a cut-off value of 0.1. Ten variables were considered in the initial model in each setting i.e. rural and urban. For the rural setting only one out of the four variables that were significant in the univariate analysis was considered significant in the multivariate analysis; hence no likelihood test revealed significant results. While for the urban three out of five variables which were significant in the univariate analysis were significant in multivariate analysis based on the p-value for likelihood ratio ($-2 \text{ Log likelihood} = 5.08$, $p = .02$) with common odds ratio of 3.54(1.50-8.35). Associations and difference were considered statistically significant if $p < .05$.

3. RESULTS

3.1 Demographic Characteristic

A total of 377 individuals living with HIV-infection and being on ART were recruited from 12 care and treatment clinics (CTCs). Of these, 351 (93.1%) participants consented and had no missing data for waist circumference. Out of all respondents, 177 (50.4%) were from urban

settings. The age of the patients ranged from 18 to 72 years with the mean (SD) of 40.6(9.3) years. The mean (SD) age for male and female was 43.0(0.5) and 39.5(0.6) years respectively and the difference in mean age between sex was significant ($p=.001$). More than two-third 238(67.8%) of the study participants were female. About three quarter and 43% of the study participants had primary level of education and were married respectively. About 41% of the study participants were self employment (Table 1).

3.2 Metabolic Syndrome

Overall prevalence of metabolic syndrome (MetS) was 25.6%. The prevalence was significantly high among individuals from the urban than those from rural settings (35.6% vs 15.5%, $p<.001$). The proportion of participants from urban settings with at least two components/criteria of MetS was significantly high (67.8% vs 21.8%, $p<.001$) than those from rural settings. The prevalence of three out of five components of metabolic syndrome was significantly higher among participants from urban than those from the rural settings. These

components included: raised blood levels of triglyceride (43.5% vs 21.3%, $p<.001$), reduced blood level of HDL (85.9% vs 28.2%, $p<.001$) and raised fasting blood glucose (10.2% vs 5.2%, $p=.04$) (Table 2).

3.3 Risk Factors for Metabolic Syndrome

The proportion of patients from rural settings who consumed fruits/vegetables for <5 days in a week (77.0% vs 59.3%, $p<.001$), those who were not participating on vigorous intensity activities(65.5% vs 29.4%, $p<.001$) as well as those who used mixed cooking oil (animal/vegetable) (15.5% vs 8.5%, $p=.03$) and those who were exposed to ART for one year and above (79.3% vs 62.1%, $p<.001$) was significantly high as compared with those from urban areas. On the other hand; the proportion of participants from urban areas with primary or no formal education (17.5% vs 6.9%, $p=.002$) as well as those with raised blood levels of low-density lipoprotein (LDL) (74.0 vs 23.0%, $p<.001$) was high as compared with those from rural settings (Table 3).

Table 1. Social and demographic characteristics of PLWHIV on ART between urban and rural

Characteristics	Both, n (%)	Urban, n (%)	Rural, n (%)
Response rate	351/377(93.1)	177/189(93.7)	174/188(92.6)
Age group			
18-34	100(28.5)	56(31.6)	44(25.3)
35-44	144(41.0)	77(43.5)	67(38.5)
45-54	75(21.4)	30(16.9)	45(25.9)
55+	32(9.1)	14(7.9)	18(10.3)
Sex			
Male	113(32.2)	52(29.4)	61(35.1)
Female	238(67.8)	125(70.6)	113(64.9)
Education level			
No formal education	42(12.0)	15(8.5)	27(15.5)
Adult education	2(0.6)	1(0.3)	1(0.3)
Primary education	264(75.2)	130(73.4)	134(77.0)
Secondary education	37(10.5)	28(15.8)	9(5.2)
College/University	6(1.7)	3(1.7)	3(1.7)
Marital status			
Single	43(12.3)	31(17.5)	12(6.9)
Married	150(42.7)	69(39.0)	81(46.6)
Separated	44(12.5)	24(13.6)	20(11.5)
Divorced	7(2.0)	5(2.8)	2(1.5)
Widow/Widower	82(23.4)	28(15.8)	54(31.0)
Cohabiting	25(7.1)	20(11.3)	5(2.9)
Occupation			
Farmer	114(32.5)	6(3.4)	108(62.1)
Self-employed	142(40.5)	94(53.1)	48(27.6)
Employed	26(7.4)	23(13.0)	3(1.7)
Others	69(19.7)	54(30.5)	15(8.6)

3.4 Multivariate Analysis for Multiple Risk Factors of Metabolic Syndrome by Setting

Univariate and multivariate analysis of the risk factors for metabolic syndrome by setting among HIV positive participants on ART is shown on (Table 4). With multiple logistic regression analysis only consumption of vegetables/fruits less than 5 days in a week predicted the

prevalence of metabolic syndrome among rural participants (AOR=5.50, 95%CI 1.21-24.95, p=.005). While in urban areas the factors which predicted the prevalence of the metabolic disorders included sex (female) (AOR=3.01, 95%CI 1.31-6.85, p=.002), having primary or no formal education (AOR=0.32, 95%CI 0.12-0.89, p=0.04) and ex- or current alcohol drinker (AOR=2.43, 95%CI 1.17-5.06, p=.02).

Table 2. Prevalence of metabolic syndrome and it's components by rural and urban among HIV positive participants on ART

Criterion of metabolic syndrome	Rural, n=174 (%)	Urban, n=177 (%)	χ^2	P- value
Central obesity (≥ 94 cm men & ≥ 80 cm female)	94(54.0)	93(52.5)	0.77	0.43
Triglycerides ≥ 1.7 mmol/L, or on treatment for this lipid abnormality	37(21.3)	77(43.5)	19.79	<.001
Low HDL (<1.03 mmol/l Male, < 1.29 Female) or treatment for this lipid abnormality	49(28.2)	152(85.9)	34.31	<.001
Raised blood pressure: systolic BP = 130 or diastolic BP = 85 mm Hg, or on BP treatment	80(46.0)	87(49.2)	0.355	0.31
Raised fasting glucose (≥ 5.6 mmol/L), or previously diagnosed type 2 diabetes	9(5.2)	18(10.2)	3.08	0.04
Having at least one of the above components/criteria of MetS	128(73.6)	168(94.9)	30.27	<.001
Having at least two of the above components/criteria MetS	38(21.8)	120(67.8)	74.87	<.001
Prevalence of Metabolic syndrome	27(15.5)	63(35.6)	18.55	<.001

Table 3. Association between settings (rural and urban) and prevalence of selected risk factors for metabolic syndrome among HIV positive participants on ART from rural and urban setting (n=351)

Risk factors	Rural, n=174 (%)	Urban, n=177 (%)	χ^2	P-value
Aged 40 years and above	84(48.3)	70(39.5)	2.71	0.06
Primary or no formal education	12(6.9)	31(17.5)	9.20	0.002
Ex or currently smoking tobacco	38(21.8)	38(21.5)	0.73	0.52
Ex- or current alcohol drinker	62(35.6)	50(28.2)	2.20	0.08
Consume fruits/vegetables <5 days in a week	134(77.0)	105(59.3)	12.64	<.001
¹ Never participate on vigorous intensity activity	114(65.5)	52(29.4)	46.00	<.001
Use animal/vegetable cooking oil	27(15.5)	15(8.5)	4.13	0.03
Exposed to ART for ≥ 1 year	138(79.3)	110(62.1)	12.72	<.001
High low-density lipoprotein (LDL) (>2.6mmol/l)	40(23.0)	131(74.0)	95.75	<.001

¹Vigorous intensity activity; included running, sports, cycling, digging, manual construction works

Table 4. Multivariate logistic regression analysis to assess relationship between prevalence of metabolic syndrome and associated risk factors among HIV positive participants on ART

Risk factors	Rural				Urban			
	COR	P-value	AOR	P-value	COR	P-value	AOR	P-value
Sex(female)	1.66(0.66-4.18)	0.283			3.09(1.42-6.71)	0.004	3.47(1.55-7.77)	0.002
Aged (>40)	3.00(1.23-7.28)	0.015			1.01(0.53-1.89)	0.978		
Having primary or no formal	4.55(1.32-15.59)	0.016			0.37(0.15-0.97)	0.043	0.35(0.13-0.93)	0.036
Ex or currently smoking tobacco	0.58(0.19-1.79)	0.341			0.33(0.14-0.81)	0.116		
Ex- or current alcohol drinker	1.29(0.56-3.00)	0.547			1.85(0.95-3.62)	0.071	2.27(1.11-4.67)	0.025
Not participating vigorous intensity activities	1.05(0.39-2.81)	0.918			0.96(0.51-1.80)	0.905		
Consumed vegetables/fruits <5 days/week	8.14(1.86-35.71)	0.005	8.15(1.86-35.71)	0.005	0.51(0.24-1.03)	0.060		
Use animal/vegetable cooking oil	0.39(0.09-1.75)	0.220			0.63(0.19-2.08)	0.454		
Exposed to ART for ≥1 years	7.20(0.94-55.15)	0.058			0.89(0.47-1.71)	0.737		
High low-density lipoprotein (LDL) >2.6mmol/l -2LR	1.55(0.68-3.54)	0.301			1.45(0.77-2.74)	0.254	5.08	0.024
Mantel-Haenszel (common odds ratio)							3.54(1.50-8.35)	

4. DISCUSSION

Prevalence of metabolic syndrome (MetS) in our study participants was estimated at about 26% which is similar to the one reported in Hispania (16) which was 27% and the one which was reported from urban, midwestern US [35] which was 25.5%. However, the prevalence observed in this study is higher than those reported elsewhere [36,37]. Although studies that have compared magnitude of MetS between urban and rural settings are limited, our study observed significantly high prevalence of MetS among participants from urban than amongst those from rural settings. The high prevalence of MetS in the urban settings might be due to significant proportion (73.6%) of study subjects observed in the same areas with at least two components of MetS. Furthermore, the high prevalence of MetS observed in this study among study participants from the urban settings may also be associated with significant high proportion of study participants from these settings with raised fasting blood glucose, raised blood levels of triglyceride, raised low-density lipoprotein (LDL) and reduced blood levels of high density lipoprotein (HDL) as compared with those from rural settings. The high prevalence of MetS may also be associated with the urban environmental and lifestyle risk behaviors as have been reported from other studies [9,38-40].

Despite of high prevalence of the components of MetS observed in this study among participants from the urban setting, we also observed that much of the traditional MetS risk factors including consumption of fruits/vegetables <5 days in a week, not participating on vigorous intensity activities as well as use of mixed cooking oil (animal/vegetable cooking oil or those who don't know the type of oil used) were more prevalent among participants from rural than urban settings. This suggests that rural population is also at risk of developing such MetS (diabetes mellitus and cardiovascular diseases) if timely and appropriate interventions are not implemented. Findings from the study conducted elsewhere by Hosseinpour et al. [41] showed that highest intake of cereal fibre had lower odds of MetS compared to the their counter group.

Predicting risk factors observed among study participants from rural were different from those observed amongst participants from urban settings. Risk factors reported from the later group sex (female), having secondary and above level of education and being ex- or current drinker. Similar findings have been reported from

studies conducted in Latin America, Southern Ethiopia and Thai, [9,18,40]. Findings from this study showed that level of education was directly associated with MetS. Similar findings have also been reported in urban India where the prevalence of MetS was significantly greater among study participants with highest level of education [42] whereas; Alencastro et al reported education to be an independent predictor of MetS [43]. Further, as it was reported Malawi [39], our study also observed alcohol as one of the predictors of MetS.

5. CONCLUSION

In this study we observed that the prevalence of metabolic syndrome was higher in urban than rural areas. We also observed that the components of metabolic syndrome including high blood level triglycerides, low blood levels of HDL and raised fasting blood glucose were significantly high among study participants from urban than among those from the rural settings. The traditional predicting risk factors including high level of education, sex (female) and being past or current alcohol consumer significantly predicted the prevalence of metabolic syndrome among participants in the urban settings. Contrary to rural areas, only eating vegetable less than five days a week predicted the prevalence of metabolic syndrome. We recommend that intervention targeting prevention of metabolic syndrome and its associated risk factors have to consider locality diversifications. Early identification of participants at risk and those already affected with metabolic syndrome through screening and monitoring activities is of paramount importance. Lifestyle interventions addressing the components and traditional risk of metabolic syndrome, diabetes and cardiovascular diseases are also recommended to be designed and implanted by the ART programme managers. Those interventions may include among many things the importance and of reduction of body weight, eating of healthy diet and participating on moderate or vigorous intensity activities.

CONSENT

Written informed consent was obtained from all the participants involved after individual and private introduction of the aim and purpose of the study, risks and benefits of participating in the study, and that, his/her participation was purely voluntary. If the study participant was found to have either MetS or high MetS risk factor, the information was communicated to the CTC in-

charge for further management and monitoring. Moreover, all authors declare that 'written informed consent was obtained from the participants for publication of this research article.

ETHICAL STATEMENT

Protocol for this study was reviewed and approved by the Medical Research and Coordinating Committee (MRCC) of the National Institute for Medical Research (NIMR)-Tanzania (certificate No NIMR/HQ/R.8a/Vol.IX/1130). In addition, a written permission was obtained from the in-charges of respective dispensaries, health centers and hospitals.

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COMPETING INTERESTS

The authors declare that they have no both financial and non financial competing interests.

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