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Prevalence of Metabolic Syndrome among Adult Patients with Type II Diabietic Mellitus at Amana Referral Hospital in Ilala Municipality in Dar Es Salaam in Tanzania

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ABSTRACT

Background: Metabolic syndrome is defined as a pattern of metabolic disturbances including central obesity, insulin resistance with hyperglycemia, dyslipidemia, and hypertension (Alexander and Isomaa, 2001). Although the prevalence and associated risk factors of metabolic syndrome have been extensively studied in other parts of the world, little work has been done on this subject in Tanzania. The study determined the prevalence of metabolic syndrome among adult patients with type II diabetes mellitus at Amana Referral Hospital in Ilala municipality of Dar es salaam region in Tanzania. **Methods:** A cross-sectional quantitative study. The study area was Amana Referral Hospital. The participants were randomly selected from type II diabetic adult patients attending diabetes clinic at Amana Referral Hospital in Ilala municipality. Questionnaires with questions on Anthropometric data were used. 12 hours fasting blood glucose level was determined by use of glucometer and Five milliliters (5mls) of blood was collected by vein puncture method using a syringe and needle for the spectrophotometric analysis of lipid profile. **Results:** The sample size was 202**.** Most of the participants (48%) were aged 36-50 years, 129(64%) were females, most (55.4%) of the participants were obese while 26.7% had a healthy weight. The females who had a waist: hip ratio of over 0.8 were classified as centrally obese (55%) while 49% of the males had a waist: hip ratio of 0.9, which was also classified as central obese. Most of the participants were hypertensive (60%) while 9% had hypertensive emergencies. Most of the participants (65.3%) had blood sugar above normal while only 34.7% of the respondents had normal blood sugar. The HDL levels were normal in 55% while the LDL levels were significantly increased in 60% of the participants. **Conclusions:** The participants had mostly two indicators of metabolic syndrome present. 36.7% of the participants had 3 and 4 indicators and thus fit the classification of Metabolic Syndrome.

INTRODUCTION

Metabolic syndrome is defined as a pattern of metabolic disturbances including central obesity, insulin resistance with hyperglycemia, dyslipidemia, and hypertension [1] was originally intended to identify individuals at risk of cardiovascular disease but the term has since been expanded to capture those at risk of Type 2 Diabetes Mellitus (T2DM), with which it is thought to have a stronger association [2]. World Health Organization (WHO) suggested the existence of a syndrome in the late 1980s, in which insulin resistance was the primary defect, associated with hyperinsulinemia and proposed that the insulin resistance syndrome is titled syndrome X. Later this syndrome was strongly associated with other aberrations, most notably visceral obesity, and called "the deadly quartet" or the glucose intolerance, hypertension, visceral/general obesity and central obesity syndrome or the metabolic cardiovascular syndrome (metabolic syndrome)[3].

Although the clinical utility, diagnostic criteria and underlying etiology of metabolic syndrome has been the subject of continuous debate and controversy in recent years, there is incontrovertible evidence that individuals identified with metabolic syndrome are at high risk of future development of type II diabetes (T2D) and cardiovascular disease (CVD) [4]. In addition, an expanding body of evidence has linked the metabolic syndrome with several emerging on non- traditional risk factors, including markers of hepatic fat, chronic inflammation (such as C-reactive protein (CRP) and adipocytes dysregulation (such as low circulating levels of adiponectin)[5]. Interestingly, many of these features of metabolic syndrome are also associated with gestational diabetes mellitus (GDM) [6].

Diabetes Mellitus type II is accompanied by hyperglycemia and often by hyperlipidemia [7]. The Hyperlipidemia results because Very Low-Density Lipoprotein and chylomicrons are not cleared by the enzyme lipoprotein lipase which is dependent on insulin; the high levels of free fatty acids then impair insulin action further. A new research suggests that reduced secretion of adiponectin along with tumor necrosis factor alpha (TNFα) and a protein called resistin act to impair insulin receptor function [7]. A poorly controlled glucose level is then found along with hyperinsulinemia in these cases. Finally, the insulin resistance and hyperinsulinemia can stimulate salt reabsorption in the kidneys causing hypertension [8]. Hypertension, or elevated

blood pressure, and its force on artery walls make them vulnerable to plaque build-up and narrowing that can ultimately lead to hardening of the arteries or atherosclerosis [9].

The exact etiology of metabolic syndrome remains unclear, and much remains unknown about it and its causes. Because of these uncertainties and a lack of clinical evidence, there is no consensus on screening for metabolic syndrome or on the treatment of people with metabolic syndrome who do not have diabetes, hypertension, or dyslipidemia. Nevertheless, metabolic syndrome is believed to be a result of a complex interaction between genetic, metabolic and environmental factors. Among the environmental factors, there are dietary habits such as excessive carbohydrate and fat intake and lifestyles such as living a sedentary life and alcohol consumption [10]. Some genetic factors that have been advanced include mutations leading to short telomeres and some genetic diseases. The factors lead to conditions like a pro-inflammatory state, increased C- reactive protein (CRP) fibrinogen, insulin resistance, and obesity. These, in turn, lead to conditions like hypertension, cardiovascular diseases, Hyperlipidaemia, hyperglycemia (diabetes mellitus) and other cardiovascular complications which are characterized by increased morbidity and mortality [11].

The global prevalence of chronic non-communicable diseases (NCDS) is on the rise, with the majority of the growth occurring among populations in developing countries. In Sub–Saharan Africa, chronic non-communicable diseases (NCDS) are projected to surpass infectious diseases by 2030 [12]. It was estimated that, in 2016, about 6.4 percent of adults will be having diabetes mellitus, affecting 285 million in the world, and that it will increase to 7.7 percent by 2030, affecting 439 million adults. Of special note is that there will be a 67 percent increase in the prevalence of diabetes in developing countries from 2010 to 2030 [13].

Cardiovascular disease (CVD) accounts for half of non-communicable disease deaths worldwide which amounted to 16.7 million in 2002. Although CVD risk is perceived to be low in economically developing countries, ischemic heart disease and stroke were two of the three leading causes of mortality in these countries in the 1990s. Although the prevalence of CVD risk factors has reduced in economically developed countries, the corresponding prevalence has increased in economically developing countries [14]. Interventions for metabolic syndrome can be both behavioral and medical. Behavioral interventions include changes in dietary and lifestyle

habits including regulated carbohydrate and fat intake as well having physical exercises [15], while medical interventions include use of antihypertensive, hypoglycemic and hypolipidemic agents. A combination of these results in normal body weight and blood pressure; normal lipid levels and sugar levels, which in turn result in reduced morbidity and mortality from complications of metabolic syndrome.

Despite the high magnitude of the threat posed by metabolic syndrome, information concerning its prevalence among the African population in Sub–Saharan Africa is sparse, as most studies have been conducted in North America, Europe, and Asia. It is based on this background that this study was designed, targeting, in particular, the urban population of Ilala in Dar Es Salaam region of Tanzania.

Obesity is also a serious problem among young adults. The number of obese young adults is increasing in developing countries while at the same time, important associations among central obesity, insulin resistance, hypertension, and dyslipidemia, together known as the metabolic syndrome, have been reported in adults individuals with metabolic syndrome are at increased risk for cardiovascular disease [16]. The combination of hypertension, hyperglycemia, and hyperuricemia, as symptoms for metabolic disorders, was reported as early as the 1920s [17]. There is now substantial evidence that resistance to insulin-stimulated glucose uptake is a common phenomenon associated with glucose intolerance, dyslipidemia, high blood pressure and coronary heart disease. Furthermore, these metabolic abnormalities tend to cluster together in some individual [18].

MATERIALS AND METHODS:

Study design:

This was a cross-sectional quantitative study on the prevalence of metabolic syndrome and associated risk factors among patients with type II diabetes mellitus in Amana Referral Hospital. It involved the determination of five indicators of metabolic syndrome, which included; general obesity (BMI), central obesity (waist: hip ratio), blood pressure (SBP and DBP), dyslipidemia (Lipid profile) among type II diabetic patients, and from these, the prevalence of the metabolic syndrome in the study population was worked out.

Site:

The study area was Amana Referral Hospital located in Ilala municipality in Dar es Salaam region, in Tanzania. Regional Referral Hospital found a 500 bedded within Ilala Municipality. Diabetes clinic runs twice a week (Mondays and Thursdays), then hypertensive clinic is on (Tuesdays, Wednesdays, and Fridays).The Diabetes clinic has 5 medical doctors and 10 Nurses. The clinic has a record of 410 diabetic patients under control for the last two years.

Population:

The participants were selected from type II diabetic adult patients 18 years and above attending diabetes clinic at Amana Referral Hospital in Ilala municipality.

Anthropometric measurements:

The participants were weighed on a platform-type balance weighing machine with a capacity of up to 160 kgs, with the help of two qualified registered nurses in the department of Internal Medicine, Amana hospital, who explained the procedure to the participants. The weight measurements were made with the participant wearing light clothes and without shoes, standing upright at the center of the balance, with their arms extended down the sides of the body and the head positioned perpendicular to the floor. The height measurement was taken using a graduated scale (in centimeters) attached to a wooden set square with a lock, fixed against the wall and the reading was recorded in centimeters and afterward converted into meters. The body mass index (BMI) was expressed in kg/m^2. (BMI was calculated as the weight of the individual in kilogram divided by the square of the height in meters). Waist and hip circumference was determined using a graduated tape measure with respondents wearing light clothes and the waist to hip ratios calculated from the measurements.

Blood Pressure measurement:

The Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) was determined by measuring two times the arterial blood pressure in the right arm using a mercury sphygmomanometer, before the filling of the questionnaire and after filling the questionnaire with the participant in a seated position. The first and fifth Korotkoff sounds were used to represent SBP and DBP respectively and then the average of the two measurements was used.

Hypertension was defined as any blood pressure (Systolic and/or Diastolic) that was greater than or equal to 130/90mmhg (WHO 2009).

Fasting Blood Glucose level and spectrophotometric analysis of lipid profile:

Two qualified nurses were recruited from the department of Internal medicine assisted in determining Fasting blood glucose level by use of glucometer and Five milliliters (5mls) of blood was collected by vein puncture method using a syringe and needle for the spectrophotometric analysis of lipid profile. This included the serum levels of low-density lipoprotein, high-density lipoprotein, triglycerides, and cholesterol. The blood for lipid profile was collected from the patients and analyzed within the Amana hospital laboratory. The samples were run in duplicates to ensure the accuracy of the results. The blood samples were discarded after results were justified.

Data presentation:

The data collected from the study area was presented in form of tables and figures after calculations of means and standard errors of the means.

Statistical Analysis:

Results were expressed as percentages, frequencies and mean ± SD. The data was analyzed using IBM SPSS Statistics software version 20 and excel. Pearson's correlation coefficients were obtained for each of the metabolic syndrome components and the respective indicators of metabolic syndrome.

Ethical considerations:

Ethical approval was obtained from the Institutional Research and Ethics Committee (IREC) of Kampala International University, Mbarara University of Science and Technology and Amana Hospital Ethical committee, before the commencement of the research. Participants signed an informed consent form for their participation after a thorough explanation of the procedure and importance of the study to them. Every participant had the right to refuse to participate by not signing the consent form or was to withdraw from the study if they felt uncomfortable at some stage. For the purpose of confidentiality, questionnaires were used with identification codes and

not names. Two qualified nurses were recruited from the department of Internal medicine who assisted in taking anthropometric measurements and collecting of blood samples from the patients in a private room within the Diabetes Clinic in the department of Internal medicine and the blood was not transported out of the hospital facilities instead it was analyzed within the Amana hospital laboratory facilities. The blood samples were discarded after results were justified. The blood biochemistry was analyzed for free without payment and the results were given to the department of Internal medicine Amana hospital and individual patients as per the agreement with the hospital administration. The patients with high parameters were advised accordingly by the physician in-charge of the diabetes clinic. In case of any deterioration of health caused by delay in treatment, the participants will be compensated by paying for the treatment given thereafter. The research was self-sponsored and facilitation from the friends.

RESULTS

In this study, the prevalence of metabolic syndrome among type II diabetes mellitus patients was determined by measuring the blood pressure, BMI, WHR, Fasting Blood Glucose (FBG) and lipid profile (LDLC, HDLC, TGs and Total Cholesterol). Respondents were regarded to have metabolic syndrome if they had three or more of the indicator components. Fasting Blood Glucose (FBG): ≥ 7.6mmol/l Blood pressure: ≥ 130/90 mmHg (systolic blood pressure: ≥130mmhg, and diastolic blood pressure: ≥ 90mmhg. Dyslipidemia: triglycerides (TG): ≥ 2 mmol/L, and high-density lipoprotein cholesterol (HDL): ≥1.6 mmol/L, low-density lipoprotein (LDL): ≥ 3.34mmol/l and cholesterol (CHO): ≥5mmol/l. Central obesity: waist: hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m^2. Normal weight, overweight, and obesity were defined as a BMI less than 25, 25 to 27, and >27, respectively.

Demographic data of participants

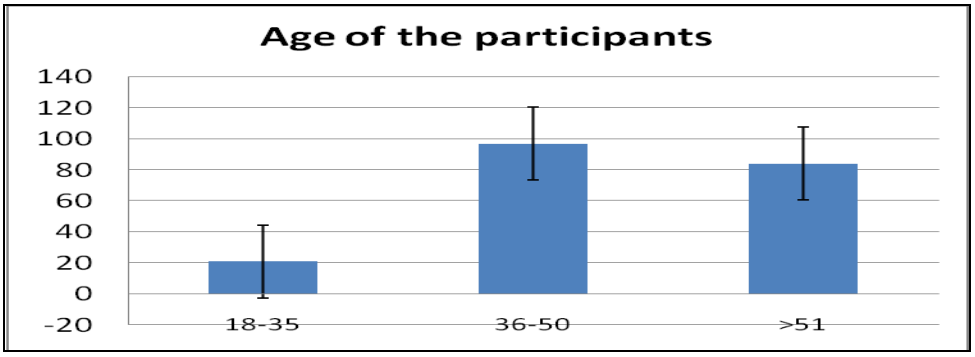

Figure 1: Age of the participants.

Most of the participants (48%) were aged 36-50 years, followed by those over 51 years (41.6%) and the least were aged 18-35 years (10.4%).

Sex of the participants:

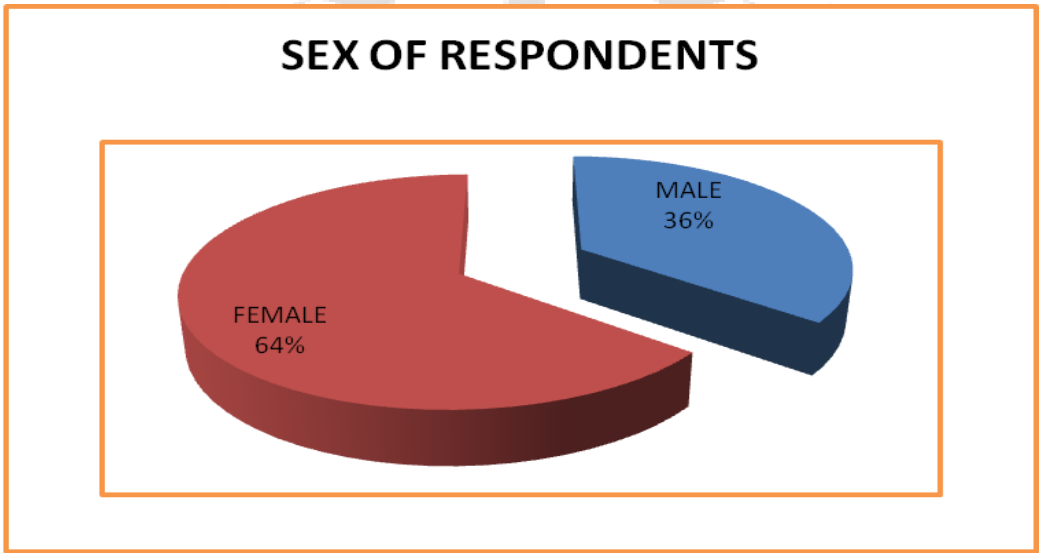

Figure 2: Shows gender of participants.

Figure 2 above shows that most of the respondents 129(64%) were females and 73(36%) were males.

BMI, Waist-Hip ratio and Blood Pressure

Table 1: BMI of the participants.

BMI	Category	Frequency	Percentage %
18.00 - 25.00	Healthy weight	54	26.7
25.10 - 30	Overweight	36	17.8
>30.00	Obese	112	55.4
Total		202	100

Most (55.4%) of the participants were Obese while 26.7% had a healthy weight as shown in the table 1 above.

Waist-Hip ratio:

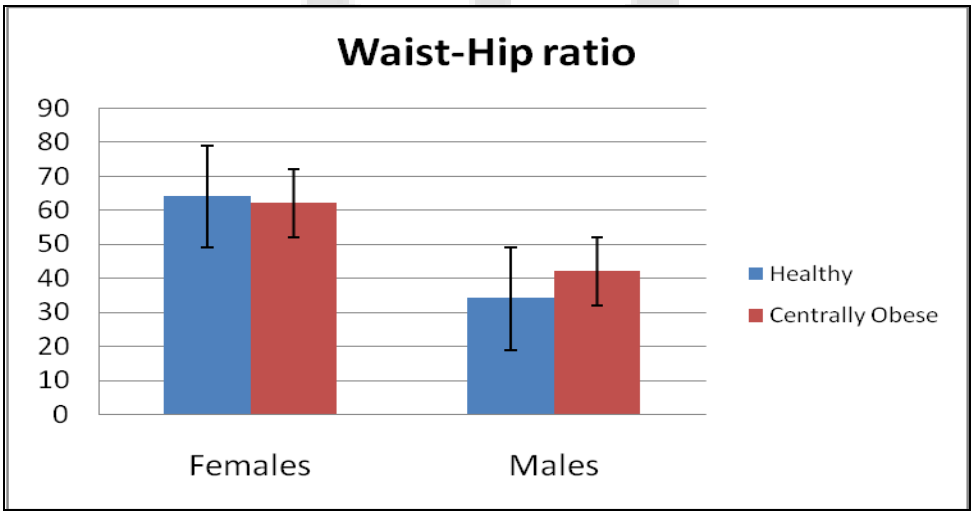

Figure 3: Waist-Hip ratio of the participants.

The females who had a Waist-hip ratio of over 0.8 were classified as centrally obese (55%) while 49% of the males had a waist-hip ratio of 0.9, which was also classified as central obese.

Blood Pressure:

Table 2: Blood Pressure of the participants.

Blood pressure	Category	Frequency	Percentage
90/60-130/90	Healthy	62	31
131/91-179/109	Hypertensive	121	60
>180/110	Hypertensive emergency	19	9

Most of the participants were hypertensive (60%) while 9% had hypertensive emergencies.

Blood picture

Fasting blood glucose:

Table 3: Fasting blood sugar of the participants.

Blood sugar	Category	Frequency	Percentage
<7.6mmol/l	**Normal**	**70**	**34.7%**
>7.7mom/l	**Above normal**	**132**	**65.3%**

Most of the participants (65.3%) had blood sugar above normal while only 34.7% of the respondents had normal blood sugar.

Lipid profile:

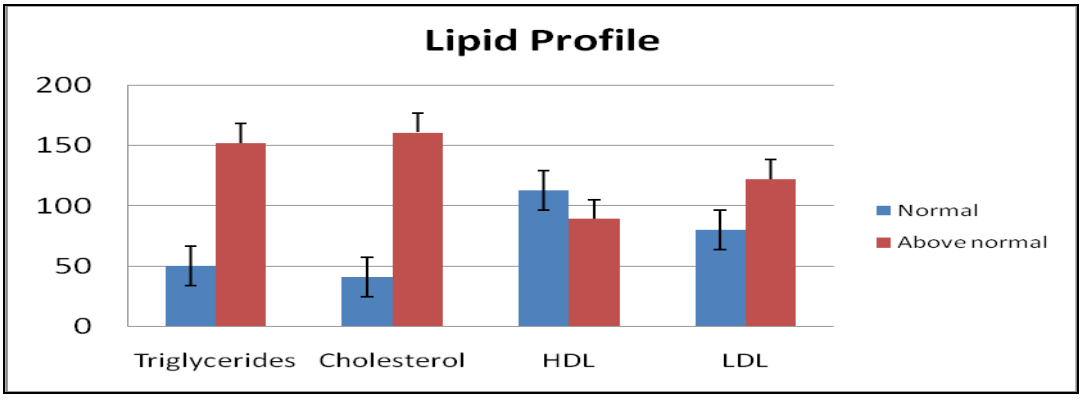

Figure 4: Lipid Profile of the participants.

The triglyceride and cholesterol levels of the participants were significantly higher at a P<0.05. The HDL levels were normal in 55% while the LDL levels were significantly increased in 60% of the participants.

Prevalence of Metabolic Syndrome

Prevalence of indicators of metabolic syndrome:

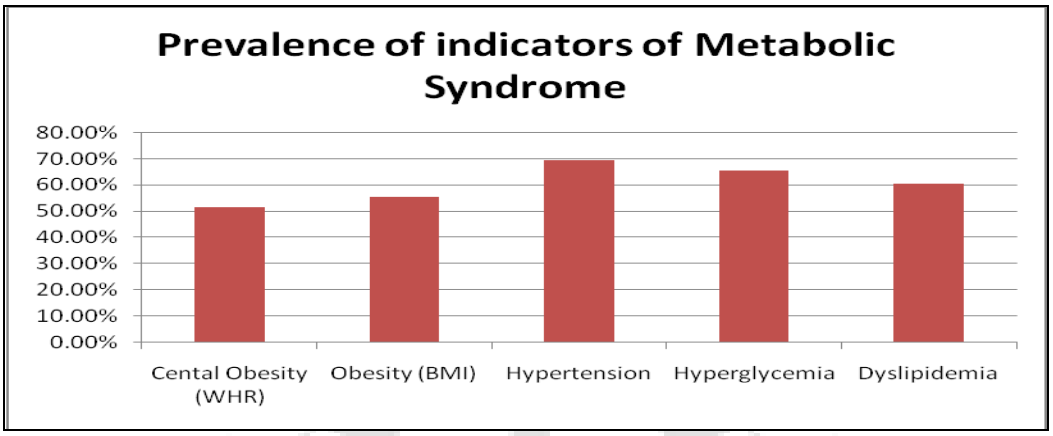

Figure 5: Indicators of Metabolic Syndrome.

Most of the participants were hypertensive (69%) while 50% had central obesity. General obesity, hyperglycemia, and dyslipidemia were also common among the participants.

Prevalence of Metabolic Syndrome:

Table 4: prevalence of Metabolic Syndrome present in the participants.

Indicators present	Frequency	Percentage
1	39	19.4%
2	89	44%
3	44	21.8%
4	30	14.9%
Total	202	100%

The participants had mostly two indicators of metabolic syndrome present. A total of 36.7% of the participants had 3 and 4 indicators and thus fit the classification of Metabolic Syndrome.

DISCUSSION

Metabolic syndrome is believed to be a result of a complex interaction between genetics, metabolic disorders, and environmental factors [19]. All the participants in the present study were patients suffering from Type 2 Diabetes mellitus, whose incidence peaks in at the age of 40 years and above. The majority of the participants were aged above 35 years. This agrees with studies carried out in other populations that showed that metabolic syndrome has an age dependency [20].

According to the study finding, it shows that 64% of respondents were females compared to 36% who were males. Genetics and menopause in females may be a contributing factor for this increase. Gender differences in the prevalence of the metabolic syndrome after age 50 may be related to the higher prevalence of abdominal obesity and prominent weight gain associated with aging in women compared with men in Ilala municipality in Dar es Salaam.

Most of the respondent had their BMI more than 30kg/m^2 and were classified as having general obesity. Our results are much higher than those reported in other studies worldwide that predict obesity to be 9.1% worldwide by 2020 [21]. Another study has shown obesity as one of the major contributors to the prevalence of metabolic syndrome due to its pathophysiological link to other cardiovascular risks such as hypertension and diabetes [22].

Findings on waist-hip ratio show that most of the respondent had their waist to hip ratio more than 0.85 in females and 0.90 in males respectively and were classified as having central obesity.

One explanation for the increased incidence of metabolic syndrome among type II diabetes mellitus patients in Ilala municipality may be due to the high prevalence of central obesity in this community. The importance of waist circumference as a measure of central adiposity has recently been emphasized as one of the major components of metabolic syndrome [23]. Moreover, visceral adiposity has been shown to be significantly associated with all components of metabolic syndrome, including insulin resistance and abnormal inflammatory responses, which are both related to metabolic syndrome [24], [25].

Our findings slightly differ from other studies, which have shown central obesity to be the most common component of metabolic syndrome while in ours it is the second [26].

Our study revealed that most of the participants were hypertensive, that is; diastolic pressure above 90mmHg and systolic pressure above 130mmHg. This could be due to the insulin resistance in diabetes mellitus that has a pathognomic hallmac in metabolic syndrome (Okafor 2014). The insulin resistance and hyperinsulinemia can stimulate salt reabsorption in the kidneys causing hypertension [27]. Hypertension was the most common indicator of metabolic syndrome in the participants. This is, however, higher than the findings in Botswana where hypertension was a second indicator for metabolic syndrome [28].

According to the study findings, majority of the respondents had their fasting blood glucose level of more than 7.6 mmol/l. All the participants were diabetic patients on treatment. This could explain why some of the patients had normal fasting blood glucose levels. There is no doubt that insulin resistance predisposes to the hyperglycemia of type II diabetes mellitus. Multiple metabolic pathways have also been proposed to link insulin resistance and compensatory hyperinsulinemia to the other metabolic risk factors [29].

Dyslipidemia has been commonly demonstrated in subjects with metabolic syndrome. According to our study findings, most of the respondents had their low-density concentration in blood of more than 3.34 mmol/L, which predispose the subjects to dyslipidemia. The atherogenic potential of lipoprotein remnants and small LDL could be confounded in part by their common association with an increased total number of apoβ-containing lipoproteins in circulation; this increased number is reflected by an elevation of serum total apoB. Among triglyceride-rich lipoproteins, remnant lipoproteins almost certainly are the most atherogenic (Grundly *et al*, 2005). Many studies further suggest that the smallest particles in the LDL fraction carry the greatest atherogenicity (Grundly *et al*, 2005). Finally, the lipoprotein field widely holds that low levels of HDL are independently atherogenic; multiple mechanisms are implicated to explain this relationship [30].

Study findings show that most of the participants had their high-density lipoprotein more than 1.6 mmol/L but some had their high-density lipoprotein below 1.00 mmol/L. Therefore low high-density lipoprotein is at risk because of high-density lipoprotein (HDL). HDL or "good," cholesterol picks up excess cholesterol and takes it back to your liver [31]. This may be due to;

inactivity, obesity, and an unhealthy diet — contribute to high LDL cholesterol and low HDL cholesterol. Factors beyond your control may play a role, too. For example, your genetic makeup may keep cells from removing LDL cholesterol from your blood efficiently or cause your liver to produce too much cholesterol [32].

The study finding shows that majority of the respondents had their triglycerides blood concentration levels more than 2.00 mmol/L, therefore according to [33], they had elevated triglycerides. Although it is unclear whether elevated TGs independently contribute to cardiovascular disease, they are associated with multiple metabolic abnormalities that contribute to CAD (e.g. diabetes, metabolic syndrome) [34].

The study findings show that most of the respondents had their blood cholesterol level more than 5.01 mmol/L. one of the studies suggested that high cholesterol (hypercholesterolemia) can be inherited [35], but it's often the result of unhealthy lifestyle choices which is observed within the study population of Ilala municipality, and thus preventable and treatable.

A healthy diet, regular exercise, and sometimes medication can go a long way toward reducing high cholesterol. When you have high cholesterol, you may develop fatty deposits in your blood vessels. Eventually, these deposits make it difficult for enough blood to flow through your arteries [36].

The prevalence of indicators of metabolic syndrome shows that hypertension was the highest in the study population while hyperglycemia, dyslipidemia, and general obesity were also common among the participants.

CONCLUSIONS

The participants had mostly two indicators of metabolic syndrome present. 36.7% of the participants had 3 and 4 indicators and thus fit the classification of Metabolic Syndrome. Metabolic syndrome is highly prevalent at 36.7% among type II diabetes mellitus patients in Amana hospital Ilala Municipality in Dar es Salaam for the patients above 18 years of age. Hypertension was the highest among the participants. General obesity, abdominal obesity, diabetes mellitus, was present in the study population and was important risk factors for the metabolic syndrome. The study identified distinct modifiable risk factors that threaten the health

status of these communities, namely general obesity, abdominal obesity, hypertension, physical inactivity and diabetes mellitus.

RECOMMENDATIONS

Since we found a greater preponderance of risk factors of metabolic syndrome in overweight and obese among the study population in this study, our results point to the need for measures to prevent and treat obesity in this and other high-risk groups. Interventions for metabolic syndrome can be both behavioral and medical. Behavioral interventions include changes in dietary and lifestyle habits including regulated carbohydrate and fat intake as well as having physical exercise, while medical interventions include the use of antihypertensive, hypoglycemic and hypolipidemic agents. Weight reduction deserves first priority in individuals with abdominal obesity and the metabolic syndrome, which should be practiced in Ilala municipality respondents. Achieving the recommended amount of weight loss will reduce the severity of most or all of the metabolic risk factors.

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