Global Advanced Research Journal of Medicine and Medical Sciences (ISSN: 2315-5159) Vol. 2(11) pp. 238-246, November, 2013
Available online http://garj.org/garjmms/index.htm

Full Length Research Paper

Prevalence of metabolic syndrome and its components among civil servants in a metropolitan city in Northern Nigeria

Awosan, K.J.[1*], Ibrahim, M.T.O.[1], Arisegi, S.A.[2], Ejimadu, S.P.[3], Erhiano, E.E.[4], Aderahman, A.T.[5]

[1]Department of Community Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria.
[2]Department of Family Medicine, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria.
[3]Department of Chemical Pathology, Specialist Hospital, Sokoto, Nigeria.
[4]General Outpatient Department, Specialist Hospital, Sokoto, Nigeria.
[5]Department of Internal Medicine, Specialist Hospital, Sokoto, Nigeria.

Accepted 31 October, 2013

Metabolic syndrome has been described as a global time bomb, with a quarter of the world's adults estimated to be having the condition. Reports from studies show high prevalence of metabolic syndrome globally mirroring the rising prevalence of its components, a sequel to urbanization, industrialization and changes in lifestyle. This study sought to assess the prevalence of metabolic syndrome and its components in Sokoto, Nigeria. A cross sectional descriptive study was conducted among 270 civil servants selected by multistage sampling technique from October to November 2012. A proforma was used to collect data on participants' socio-demographic characteristics. Anthropometric measurement, blood pressure measurement, and estimation of fasting plasma glucose and lipid profile were done for the participants. Prevalence of the components of metabolic syndrome was high by the NCEP-ATP III / (IDF) definitions as follows; central obesity 30.7% (39.6%), low HDL cholesterol 37.8%, raised triglycerides 32.8%, raised fasting plasma glucose 10.7% (19.3%) and raised blood pressure 31.9%. Prevalence of metabolic syndrome was also high with a higher prevalence among females both by the NCEP-ATP III definition, 17.8% (males 8.6%, females 31.5%) and the IDF definition, 18.5% (males 13.0%, females 26.9%). This study demonstrated high prevalence of metabolic syndrome and its components among civil servants in Sokoto. Community based surveys in both rural and urban populations in the state to determine their burden; and public health interventions for their prevention and control are suggested.

Keywords: Prevalence, metabolic syndrome, components, civil servants

INTRODUCTION

Metabolic syndrome (MetS) has been described as a global time bomb, with a quarter of the world's adults estimated to be having the condition. People with MetS are twice as likely to die from, and thrice as likely to have a heart attack or stroke compared to people without it, they also have five folds greater risk of developing type 2 diabetes mellitus. It has also been estimated that up to 80% of the 200 million people with diabetes globally will die of cardiovascular diseases, thus putting MetS and diabetes mellitus ahead of HIV/AIDS in terms of morbidity and mortality (International Diabetic Federation (IDF), 2013).

*Corresponding Author. E-mail: awosankj1@yahoo.com

Metabolic syndrome is a cluster of cardiovascular disease risk factors of metabolic origin; the components included central obesity, dyslipidaemia (reduced high density lipoprotein cholesterol and elevated triglycerides), raised blood pressure and hyperglycemia (Alberti, 2005). Excess adipose-mediated insulin resistance related to risk factors such as aging, genetic factors, physical inactivity, drugs and endocrine factors, is believed to be the underlying factor in the aetiogenesis of the syndrome (Katzmaryk, et al., 2003; Pollex et al., 2006).

The epidemiological significance of MetS as a tool for identifying individuals at high risk for cardiovascular disease and type 2 diabetes (Eckel et al., 2005) and the increasing prevalence of the condition worldwide, have resulted in a re-invigorated interest in it by several bodies, thus culminating in different diagnostic definitions for MetS such as; the World Health Organization definition (Alberti et al, 1998), the National Cholesterol Education Programme –Adult Treatment Panel III definition (American Heart Association (AHA), 2002) and the International Diabetes Federation definition (Ford, 2005).

Efforts to address the challenges posed by the difficulties often experienced in making direct comparisons between the data from studies where different definitions have been used to identify the syndrome, and the need for a single universally accepted diagnostic tool that is easy to use in clinical practice and does not rely upon measurements only available in research settings, gave birth to the harmonization of the definitions as embodied in the joint statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung and Blood Institute; American Heart Association; World Heart Federation; International Artherosclerotic Society; and Internal Association for the Study of Obesity (Alberti et al., 2009).

Reports from studies show high prevalence of metabolic syndrome globally mirroring the rising prevalence of its components, a sequel to urbanization, industrialization and changes in lifestyle.

A study of the trend in MetS in the United States from 1999-2010, reported a marginal decrease in the prevalence of MetS from 25.5% to 22.9% (Beltran-Sanchez, et al., 2013). Another study in the adult population in Brazil reported a MetS prevalence of 32.0% (Dutra et al., 2012). Gyakobo et al. (2012) also reported a MetS prevalence of 35.9% in a rural population in Ghana.

In urban populations across Nigeria, while Ojji et al. (2012) reported a relatively low MetS prevalence of 13.0% in Abuja, Siminialayi et al. (2010) reported a high MetS prevalence of 35.4% in Rivers State.

The civil servants being a group with regular income patronize fast foods vendors while at work, inevitably consuming high energy dense foods and drinks. Also the work schedule of those working in offices among them is largely sedentary in nature. This combination of unhealthy dietary habit and physical inactivity place them at great risk of developing MetS and its complications.

A hospital based study among patients with type 2 diabetes mellitus at the Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria, had reported a full blown MetS prevalence of 20.5% (Isezuo et al., 2005), the public health significance of determining the community based prevalence of MetS in Sokoto as a baseline for developing strategies for its prevention and control, therefore, cannot be over emphasized. This study sought to assess the prevalence of metabolic syndrome and its components in Sokoto.

METHODOLOGY

Study design and population

This was a cross sectional descriptive study among civil servants in Sokoto metropolis, the capital of Sokoto state, in North Western Nigeria, from October to November 2012. The city has a population of 427, 760 by the 2006 National Census (National Population Commission (NPC), 2006). Hausa and Fulani constitute the predominant ethnic groups; other ethnic groups resident in the city include Igbo, Yoruba, Nupe, Ebira, Igala, etc. Farmers form the largest proportion of the population, while the rest are civil servants, traders, artisans and people of other occupations. The civil service in Sokoto state consists of 22 ministries and 19 departments. Commissioners and Special Advisers head the ministries and departments respectively; they are political office holders appointed by the Executive Governor of the State. The Permanent Secretaries (assisted by Directors, Deputy Directors, Assistant Directors and other officers), oversee the day to day administration of the ministries and departments; they are career civil servants. All personnel from the 22 ministries and 19 departments were considered eligible to participate in the study. Pregnant women, those with ascites, those who did not give consent for their blood sample to be taken, and those who did not comply with the instruction given to them to fast on the day scheduled for data collection (as approved by the management of the respective ministries and departments) were excluded. The sample size was estimated at 270 using the statistical formula for calculating sample size for cross sectional descriptive studies (Araoye, 2004), 21% prevalence of metabolic syndrome in an urban population from a previous study (Bouguerra et al., 2006), precision level of 5% and an anticipated response rate of 95%. The eligible participants were selected by multistage sampling technique. At the first stage 8 of 22 ministries and 7 of 19 departments were selected as study centers by simple random sampling using the ballot option. At the second stage, selection of study participants in each of the selected ministries and departments was done by

systematic sampling technique using the personnel list in the ministries and departments to constitute the sampling frame. Proportionate allocation (based on personnel population) was applied in the selection of study participants in the selected ministries and departments. A proforma was used to collect data on participants' socio-demographic characteristics. Anthropometric measurement, blood pressure measurement, and estimation of fasting plasma glucose and lipid profile were done for the participants. Waist circumference was measured to the nearest 0.5cm using a non-stretchable fibre-glass measuring tape applied around the waist at the level of the iliac crest (identified by palpation). The tape was applied tightly to the body, but not too tight to compress the skin. Participants were asked to exhale and relax their abdomen while taking the measurement. Blood pressure was measured using a sphygmomanometer (Dekamet MG3, England) and stethoscope (Littman quality) with all tight clothing and other similar materials removed from the arm and in the sitting position. The first measurement was taken after the participant had rested for at least 10 minutes in a sitting position with the arm rested on a table such that the middle of the forearm was about the level of the heart. The second measurement was taken after 10 minutes; the mean of the 2 readings was used in the analysis. Rayto RT-9200 semi-auto chemistry analyzer (spectrophotometer) was used for analysis of fasting plasma glucose and lipid profile.

Four medical officers, two nurses and two laboratory scientists assisted in data collection after pre-training on the objectives, selection of participants and use of survey instruments. Institutional ethical clearance was sought from the Ethical committee of Specialist Hospital Sokoto; permission was obtained from the Management of the selected ministries and departments, and informed written consent was also obtained from the participants before data collection.

Operational definition of terms

Metabolic syndrome was defined using both the National Cholesterol Education Programme -Adult Treatment Panel III (NCEP-ATP III) and the International Diabetes Federation (IDF) definitions (Bener et., 2009).

By the NCEP-ATP III definition, diagnosis of MetS was made by the presence of any 3 of the following:

- Central or abdominal obesity: waist circumference > 102cm in men, or > 88cm in women.
- Raised triglycerides: triglycerides > 1.7mmol/l (150mg/dL), or specific treatment for this lipid abnormality.
- Reduced high density lipoprotein (HDL) cholesterol: HDL cholesterol < 1.03mmol/l (40mg/dL) in men, or < 1.29mmol/l (50mg/dL) in women, or specific treatment for this lipid abnormality.
- Raised blood pressure: systolic BP > 130mmHg, or diastolic BP > 85mmHg, or treatment of previously diagnosed hypertension.
- Raised fasting plasma glucose: fasting plasma glucose > 6.1mmol/l (110mg/dL), or previously diagnosed type 2 diabetes.

By the IDF definition, diagnosis of MetS was made by the presence of abdominal or central obesity (waist circumference > 94cm in men, or > 90cm in women) plus any 2 of the following:

- Raised triglycerides: triglycerides > 1.7mmol/l (150mg/dL), or specific treatment for this lipid abnormality.
- Reduced high density lipoprotein (HDL) cholesterol: HDL cholesterol < 1.03mmol/l (40mg/dL) in men, or < 1.29mmol/l (50mg/dL) in women, or specific treatment for this lipid abnormality.
- Raised blood pressure: systolic BP > 130mmHg, or diastolic BP > 85mmHg, or treatment of previously diagnosed hypertension.
- Raised fasting plasma glucose: fasting plasma glucose > 5.6mmol/l (100mg/dL), or previously diagnosed type 2 diabetes.

Data analysis

Data was analyzed using the SPSS version 17 computer statistical software package. Frequency distribution tables were constructed; cross tabulations were done to examine relationship between categorical variables. The Chi-square test was used to compare differences between proportions. The independent student's t-test was used for comparison of mean differences between results of the two diagnostic definitions, while agreement between them was assessed with Kappa statistics. Logistic regression analysis was used to determine the variables that predict metabolic syndrome among the participants. All statistical analysis was set at 5% level of significance (i.e. $p < 0.05$).

RESULTS

The study participants comprised of 270 civil servants between the ages of 21 and 58 years (Mean = 34.26; SD = 8.04). Majority of the participants were in the 20 to 29, and 30 to 39 years age groups. Most of the participants were males (60.0%), married (61.9%), and had tertiary education (66.7%). Islam was the predominant religion (59.6%) among the participants as shown in Table 1.

Table 1. Socio-demographic profile of participants

Socio-demographic profile	Frequency (%)
Age groups (in years)	
20-29	94 (34.8)
30-39	109 (40.4)
40-49	52 (19.3)
50-59	15 (5.6)
Sex	
Male	162 (60.0)
Female	108 (40.0)
Marital status	
Single	102 (37.8)
Married	167 (61.9)
Separated	1 (0.4)
Education	
Primary and below	38 (14.1)
Secondary	52 (19.3)
Tertiary	180 (66.7)
Religion	
Christianity	109 (40.4)
Islam	161 (59.6)

Prevalence of components of metabolic syndrome among participants

Table 2 shows the prevalence of components of metabolic syndrome among the participants. About one third of the participants had central obesity or large waist circumference (30.7% and 39.6% by the NCEP-ATP III and IDF definitions respectively). Central obesity was statistically significantly more prevalent among females than males by both the NCEP-ATP (males 14.2%, females 55.6%; χ^2 = 52.060, p < 0.001) and IDF (males 32.1%, females 50.9%; χ^2 = 9.601, p 0.002) definitions. The prevalence of central obesity increased progressively (but not statistically significant) across the age groups among the participants by the NCEP-ATP III definition. The prevalence of central obesity among the participants in their 20s, 30s, 40s and 50s by the NCEP-ATP III definition were; 20.2%, 35.8%, 36.5% and 40.0% respectively (χ^2= 7.619, p = 0.055). No uniform pattern was observed in the variations in the prevalence of central obesity with age among the participants by the IDF definition. The prevalence of central obesity among the participants in their 20s, 30s, 40s and 50s by the IDF definition were; 23.4%, 48.6%, 48.1% and 46.7% respectively (χ^2= 2.960, p = 0.410).

One hundred and two (37.8%) of the 270 participants had reduced high density lipoprotein (HDL) cholesterol level. Reduced HDL cholesterol was statistically significantly thrice as prevalent among females (63.0%) than males (21.0%); χ^2 48.571, p < 0.001. No uniform pattern was observed in the variations in the prevalence of reduced HDL cholesterol with age among the participants. The prevalence of reduced HDL cholesterol among the participants in their 20s, 30s, 40s and 50s were; 47.9%, 32.1%, 32.7% and 33.3% respectively (χ^2= 6.623, p = 0.100).

Eighty eight (32.8%) of the 270 participants had elevated triglycerides, with a slightly higher prevalence among females (35.2%) than males (31.3%) but the difference was not statistically significant. The prevalence of elevated triglyceride increased progressively (but not statistically significant) across the age groups among the participants. The prevalence of raised fasting plasma glucose among the participants in their 20s, 30s, 40s and 50s were; 25.5%, 34.9%, 36.5% and 46.7% respectively (χ^2= 4.110, p = 0.25).

The prevalence of raised fasting plasma glucose was 10.7% and 19.3% by the NCEP-ATP III and IDF definitions respectively, with a higher prevalence (though not statistically significant) among females by both the NCEP-ATP III definition (males 8.6%, females 13.9%) and IDF definition (males 17.9%, females 21.9%). The prevalence of raised fasting plasma glucose increased progressively (but not statistically significant) across the

Table 2. Prevalence of components of metabolic syndrome among participants

Variable	Diagnostic definitions					
	NCEP - ATP III definition			IDF definition		
	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)	Total N (%)
Central obesity	23 (14.2)	60 (55.6)*	83 (30.7)	52 (32.1)	55 (50.9)*	107 (39.6)
Reduced high density lipoprotein cholesterol	34 (21.0)	68 (63.0)*	102 (37.8)	34 (21.0)	68 (63.0)*	102 (37.8)
Elevated triglycerides	50 (31.3)	38 (35.2)	88 (32.8)	50 (31.3)	38 (35.2)	88 (32.8)
Raised fasting plasma glucose	14 (8.6)	15 (13.9)	29 (10.7)	29 (17.9)	23 (21.9)	52 (19.3)
Raised blood pressure	55 (34.0)	31 (28.7)	86 (31.9)	55 (34.0)	31 (28.7)	86 (31.9)

*Statistically significant ($p < 0.05$)

Table 3. Clustering of components of metabolic syndrome among participants

No of component(s)	Diagnostic definitions					
	NCEP - ATP III definition			IDF definition		
	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)	Total N (%)
None	49 (30.6)	8 (7.4)	57 (21.3)	41 (25.3)	7 (6.5)	48 (17.8)
One	62 (38.8)	34 (31.5)	96 (35.8)	52 (32.1)	31 (28.7)	83 (30.7)
Two	35 (21.9)	32 (29.6)	67 (25.0)	43 (26.5)	36 (33.3)	79 (29.3)
Three	13 (8.1)	24 (22.2)	37 (13.8)	22 (13.6)	25 (23.1)	47 (17.4)
Four	1 (0.6)	8 (7.4)	9 (3.4)	4 (2.5)	8 (7.4)	12 (4.4)
Five	0 (0)	2 (1.9)	2 (0.7)	0 (0)	1 (0.9)	1 (0.4)

age groups by the NCEP-ATP definition among the participants. The prevalence of raised fasting plasma glucose among the participants in their 20s, 30s, 40s and 50s by the NCEP-ATP III definition were; 7.4%, 9.2%, 17.3% and 20.0% respectively (χ^2= 5.023, p = 0.100). The IDF definition did not show any uniform pattern in the variations in the prevalence of raised fasting plasma glucose with age among the participants. The prevalence of raised fasting plasma glucose among the participants in their 20s, 30s, 40s and 50s by the IDF definition were; 16.0%, 18.3%, 26.9% and 20.0% respectively (χ^2= 2.687, p = 0.443).

The prevalence of raised blood pressure was 31.9% with a slightly higher prevalence among males (males 34.0%, females 28.7%). While the difference in the prevalence of raised blood pressure between males and females was not statistically significant, the prevalence of raised blood pressure increased progressively and statistically significantly across the age groups. The prevalence of raised BP among the participants in their 20s, 30s, 40s and 50s were; 14.9%, 35.8%, 44.2% and 66.7% respectively (χ^2 = 25.275, p < 0.001).

Clustering of components of metabolic syndrome among participants

A few, 48 (17.8%) and 57 (21.3%) of the 270 participants by the IDF and NCEP-ATP III definitions respectively had none of the components of metabolic syndrome. Majority of the participants had one or two components, and fewer proportions had three or four components of the syndrome. None of the males had all the five components, while one and two of the females had all the five components of the syndrome by the IDF and NCEP-ATP III definitions respectively as shown in Table 3. There was no statistically significant difference in the clustering of components of metabolic syndrome among the participants by both the NCEP-ATP III definition (Mean = 1.44; SD = 1.12) and IDF definition (Mean = 1.61; SD = 1.12); t = 1.81, p = 0.07.

Prevalence of metabolic syndrome among participants

The overall prevalence of metabolic syndrome among the participants was 17.8% by the NCEP-ATP III definition and 18.5% by the IDF definition. Metabolic syndrome was statistically significantly more prevalent among females than males by both the NCEP-ATP definition (males 8.6%, females 31.5%; χ^2 = 23.125, p < 0.001) and IDF definition (males 13.0%, females 26.9%; χ^2 = 8.284, p = 0.004) as shown in Table 4.

The prevalence of metabolic syndrome increased progressively (but not statistically significant) across the

Table 4. Prevalence of metabolic syndrome among participants

Prevalence of metabolic Syndrome	Males N (%)	Females N (%)	Total N (%)
By NCEP-ATP III definition	14 (8.6)	34 (31.5)*	48 (17.8)
By IDF definition	21 (13.0)	29 (26.9)*	50 (18.5)

* Statistically significant ($p < 0.05$)

Table 5. Predictors of metabolic syndrome among participants

Variables	Diagnostic definitions					
	NCEP - ATP III definition			IDF definition		
	Odds ratio	p value	95% CI	Odds ratio	p value	95% CI
Age (40 years and above versus below 40 years)	0.963	0.336	-0.004 to 0.010	0.499	0.618	-0.005 to 0.009
Sex (females versus males)	5.208	< 0.001	0.151 to 0.335	3.157	0.002	0.058 to 0.251
Marital status (married versus single and separated	2.116	0.035	0.009 to 0.239	2.253	0.025	0.017 to 0.260
Religion (Islam versus Christianity)	0.638	0.524	-0.065 to 0.127	0.456	0.649	-0.078 to 0.124
Education level (secondary and tertiary versus primary and below)	0.337	0.737	-0.050 to 0.071	0.411	0.681	-0.050 to 0.077

Table 6. Comparison of results of NCEP-ATP III and IDF definitions

NCEP-ATP III Definition	IDF definition		
	Normal N (%)	Metabolic syndrome present N (%)	Total N
Normal	211 (95.9)**	11 (22.0)	222
Metabolic syndrome present	9 (4.1)	39 (78.0)*	48
Total	220 (100.0)	50 (100.0)	270

*Sensitivity = 78.0%, **Specificity = 95.9%.
Measure of agreement, k = 0.751, $p < 0.001$.

age groups by the NCEP-ATP definition among the participants. The prevalence of MetS among the participants in their 20s, 30s, 40s and 50s by the NCEP-ATP III definition were; 11.7%, 20.2%, 21.2% and 26.7% respectively (χ^2= 4.022, p = 0.259). The IDF definition did not show any uniform pattern in the variations in the prevalence of MetS with age among the participants. The prevalence of MetS among the participants in their 20s, 30s, 40s and 50s by the IDF definition were; 10.0%, 23.9%, 21.2% and 20.0% respectively (χ^2= 6.185, p = 0.103).

In logistic regression models female sex and being married were the predictors of metabolic syndrome among the participants by both the NCEP-ATP III and IDF definitions (Table 5).

Comparison of results of NCEP-ATP III and IDF definitions

The IDF definition appears to be more sensitive than the NCEP-ATP III definition in identifying metabolic syndrome among the participants, but there was good agreement between the two definitions (*k* statistics = 0.751, p < 0.001). The NCEP-ATP III definition had a sensitivity and specificity of 78% and 95.5% respectively compared to the IDF definition (Table 6).

DISCUSSION

A high prevalence of most of the components of metabolic syndrome was recorded in this study. About a third of the participants in this study had central obesity by both the NCEP-ATP III (30.7%) and IDF (39.6%) definitions, with a higher prevalence among females. The higher prevalence of central obesity among females compared to males in this study by both the NCEP-ATP III (males 14.2%, females 55.6%) and IDF (males 32.1%, females 50.9%) definitions supports the gender differences in metabolic risk factors that have been demonstrated in studies in Kenya (Kaduka et al., 2012) and South Africa (Smith et al., 2009). The progressive and statistically significant increase in the prevalence of central obesity with advancement in participants' age in this study is similar to the findings in a study in Abakaliki,

Nigeria, that reported higher prevalence of obesity among civil servants aged 40 years and above compared with those aged below 40 years (Ugwuja et al., 2013). Apart from weight gain being mainly in the abdominal region in adulthood, reduced physical activities resulting in weight gain has been associated with advancement in age (Amoah, 2003).

Reduced high density lipoprotein was statistically significantly ($p < 0.05$) thrice as prevalent among women (63.0%) than men (21.0%). This is alarming and gradually approaching the 100% prevalence of reduced high density lipoprotein reported in a study by Maoujoud et al. (2011) among patients on haemodialysis. While the high prevalence of elevated triglyceride in both sexes (males 31.3%, females 35.27) obtained in this study is in concordance with the findings in a study in India that reported a prevalence of 32.3% among males and 28.6% among females (Gupta et al., 2004), it is at variance with the findings in a study by Fezau et al. (2007) that reported zero prevalence of elevated triglycerides among participants drawn from rural and urban communities in Cameroon. The high prevalence of reduced high density lipoprotein and elevated triglyceride recorded in this study could be related to the high prevalence of central obesity among the participants. Weight loss in patients with other co-morbid conditions has been shown to increase serum high density lipoprotein cholesterol and decrease serum triglyceride (Williams et al., 2000).

The high prevalence of raised fasting plasma glucose among the participants in this study by both the NCEP-ATP III (10.7%) and IDF (19.3%) definitions is comparable with the findings in a study by Erasmus et al. (2012) that reported 18.6% prevalence of undiagnosed type 2 diabetes and 28.2% crude diabetes type 2 prevalence in a South African colored population. Importantly, the high prevalence of raised fasting plasma glucose recorded in both sexes in this study by the NCEP-ATP III (males 8.6%, females 13.9%) and IDF (males 17.9%, females 21.9%) definitions is of serious concern when compared with the much lower prevalence of 7.7% in males and 5.7% in females reported in a study in Port Harcourt, Southern Nigeria (Ebenezer et al., 2003). The high prevalence of raised fasting plasma glucose obtained in this study could be related to the staple diet of carbohydrates prevalent in Sokoto, as well as consumption of sugar cane and other bottled or canned drinks with high sugar contents.

Similar to the 32.8% prevalence of raised blood pressure reported in a study in rural and semi-urban population of Enugu, Nigeria by Ofuya et al. (2007), the prevalence of raised blood pressure among the participants in this study was 31.9%. The progressive and statistically significant increase in the prevalence of raised blood pressure with advancement in participants' age in this study, agrees with the findings in a study by Ulasi et al. (2011) that reported an increase in the prevalence of hypertension with age from 5.4% in participants aged less than 20 years to 80% in participants aged 70 years and above.

The 17.8% and 18.5% prevalence of MetS recorded in this study by the NCEP-ATP III and IDF definitions respectively are higher than the 12.1% MetS prevalence reported by Adegoke et al. (2010) in a rural Nigerian community, on a par with the 18% MetS prevalence reported by Ulasi et al. (2010) in a semi-urban Nigerian community, and lower than the 36.7% MetS prevalence reported by Ghazali et al. (2010) in an urban Nigerian community. These findings support the submissions of Ntandou et al. (2009) in a study that verified the hypothesis of a positive rural-urban gradient in the overall prevalence of metabolic syndrome; linked to socio-economic status, sedentary lifestyle and poor diet quality.

The higher prevalence of MetS recorded among females in this study by both the NCEP-ATP III (males 8.8%, females 31.5%) and IDF (males 13.0%, females 26.9%) definitions are in agreement with the findings in a study by Mabry et al. (2010) that reported a higher prevalence of MetS among females (males 20.7%, females 32.1%), but differ from the findings in a study by Novac et al. (2011) that reported a higher prevalence of MetS among males (males 26%, females 16%). The female sex and being married were the predictors of MetS in this study, this could be due to the higher prevalence of the components of MetS among females compared to males, and the care married females enjoy from their spouses; they could engage in unhealthy dietary habit and are less likely to be allowed to engage in outdoor leisure exercises, even if there are no facilities for moderate physical activities where they live.

Unlike the findings in this study whereby the progressive increase in the prevalence of MetS with advancement in age by the NCEP ATP III definition was not statistically significant and the IDF definition did not show any uniform pattern, a study by Hildrum et al. (2007) reported a progressive and statistically significant increase in IDF defined prevalence of MetS with advancement in age from 11.0% in the age group 20-29 years to 47.2% in the age group 80-89 years among males; and from 9.2% in the age group 20-29 years to 64.4% in the age group 80-89 years among females.

Similar to the findings in this study whereby a higher prevalence of metabolic syndrome was recorded by the IDF definition (18.5%) compared to the NCEP-ATP III definition (17.8%) with good agreement between the two definitions ($k = 0.75$), a study by Zainuddin et al. (2011) also reported a higher prevalence of MetS by the IDF definition (32.2%) compared to the NCEP-ATP III definition (28.5%) with moderate agreement between the two definitions ($k = 0.63$). On the contrary, a study by Chackrewarty et al. (2013) reported a higher prevalence of MetS by the NCEP-ATP III definition (46.1%) compared to the IDF definition (38.9%) with a very good agreement between the two definitions ($k = 0.84$). The statistically significantly good agreement ($k = 0.751$, $p <$

0.001) recorded between the two definitions in this study; and the high sensitivity (78.0%) and specificity (95.9%) of the NCEP-ATP III definition compared to the IDF definition support the use of either of them in community based surveys.

CONCLUSION

This study demonstrated high prevalence of metabolic syndrome and its components among civil servants in Sokoto. Community based surveys in both rural and urban populations in the state to determine their burden; and public health interventions for their prevention and control are suggested.

ACKNOWLEDGEMENTS

The authors would like to thank the Management of the ministries and departments that were used as study centers, and all the civil servants that participated in the study for their cooperation.

REFERENCES

Adegoke OA, Adedoyin RA, Balogun MO, Adebayo RA, Bisiriyu LA, Salawu AA (2010). Prevalence of metabolic syndrome in a rural community in Nigeria. Metab. Syndr. Relat. Disord. 8(1): 59-62.

Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, Fruchart JC, James HP, Loria CM, Smith SC Jr, IDF, NHLBI, AHA, WHF, IAS, IASO (2009). Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung and Blood Institute; American Heart Association; World Heart Federation; International Artherosclerotic Society; and International Association for the Study of Obesity. Circ. 120: 1640-5.

Alberti KG, Zimmet P, Shaw J (2005). The metabolic syndrome – a new world definition. Lanc. 366(9491): 1059-1062.

Alberti KG, Zimmet PZ (1998). Definition, diagnosis and classification of diabetes mellitus and its complications Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet. Med. 15(7): 539-553.

American Heart Association (2002). Third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in adults (Adults Treatment Panel III). Final Report. Circ. 106: 3143 – 3421.

Amoah AG (2003). Sociodemographic variations in obesity among Ghanaian adults. Pub. Hlth. Nutr. 6(8): 751-757.

Beltran-Sanchez H, Harhay MO, Harhay MM, Mc Elligotts S (2013). Prevalence and trends of metabolic syndrome in the adult US population 1999-2010. J. Am. Coll. Cardiol. 62(8): 697-703.

Berner A, Zirie M, Musallam M, Khader YS, Al-Hamaq AO (2009). Prevalence of metabolic syndrome according to Adult Treatment Panel III and International Diabetes Federation criteria: a population-based study. Metab. Syndr. Relat. Disord. 7(3): 221-229.

Bouguerra, R. Ben Salem, L. Alberti, H. Ben Rayana, C. El Atti, J. Blouza, S. Gaigi, S. Achour, A. Ben Slama, C. Zouari, B (2006). Prevalence of metabolic abnormalities in the Tunisian adults: a population based study Diab. Metab. 32(3): 215-21.

Chakrewarty S, Gunasekara D, Pathmeswaren A, Wijekoom CN, Ranuwaka UK, Kato N, Takeuchi F, Wickremasinghe P (2013). A comparison between revised NCEP-ATP III and IDF definitions in diagnosing metabolic syndrome in an urban Sri Lankan population: the Ragama Health Study. ISRN Endocrinol. 320176.

Dutra ES, de Carvalho KM, Miyazaki E, Harman EM, Ito MK (2012). Metabolic syndrome in central Brazil population and correlates in adult population. Diabetol. Metab. Syndr. 4(1): 20.

Ebenezer AN, Osaretin JO, Anele EI (2003). Type 2 diabetes in adult Nigerians: a study of its prevalence and risk factors in Port Harcourt, Nigeria. Diab. Res. Clin. Prac. 62: 177-185.

Eckel RH, Grundy SM, Zimmet PZ (2005). The metabolic syndrome. Lanc. 365: 1415-1428.

Erasmus RT, Soita DJ, Hassan MS, Blanco-Blanco E, Vergotine Z, Kegne AP, Matsha TE (2012). High prevalence of diabetes mellitus and metabolic syndrome in a South African coloured population: baseline data of a study in Bellville Cape Town. S. Afr. Med. J. 102(11): 841-844.

Ford ES (2005). Prevalence of the metabolic syndrome defined by the International Diabetes Federation among adults in the U.S. Diabet. Care. 28(11): 2745-2749.

Ghazali SM, Sanusi RA (2010). Waist circumference, waist to hip ratio, and body mass index in the diagnosis of metabolic syndrome in the Nigerian subjects. Nig. J. Physio. Sci. 25: 187-95.

Gupta R, Deedwania PG, Gupta A, Rastogi S, Panwar RB, Kothan K (2004). Prevalence of metabolic syndrome in an Indian urban population. Int. J. Cardiol. 97(2): 257-61.

Gyakobo M, Amoah AG, Martey-Marbell DA, Snow RC (2012). Prevalence of metabolic syndrome in a rural population in Ghana. BMC Endocr. Disord. 12: 25

Hildrum B, Mykletun A, Hole T, Midthjell K, Dahi AA (2007). Age specific prevalence of the metabolic syndrome defined by the International Diabetic Federation and the National Cholesterol Education Program: the Norwegian HUNT 2 study. BMC Pub. Hlth. 7: 220.

IDF (2013). IDF world-wide definition of the metabolic syndrome. International Diabetes Federation. Available at: http://www.idf.org/metabolicsyndrome

Isezuo SA, Ezunu E (2005). Demographic and clinical correlates of metabolic syndrome in Native African type 2 diabetic patients. J. Natl. Med. Assoc. 97(4): 557-563.

Kaduka LU, Kombe Y, Kenya E, Kuria E, Bore JK, Bukana ZN, Mwang M (2012). Prevalence of metabolic syndrome among an urban population in Kenya. Diab. C. 35(4): 887-893.

Katsmaryk PT, Leon AS, Wilmore JH, Skinner JS, Rao DC, Kankinen T, Bouchard C (2003). Targetting the metabolic syndrome with exercise: evidence from Heritage family study. Med. Sci. Spo. Exerc. 35(10): 1703-9.

Mabry RM, Reeves MM, Eakin EG, Owen N (2010). Gender differences in prevalence of metabolic syndrome in Gulf Cooperative Council Countries: a systematic review. Diabet. Med. 27(5): 593-597.

Maoujoud O, Ahid S, Asseraji M, Bahadi A, Aatif T, Zajari Y, Qualim Z (2011). Prevalence of metabolic syndrome in chronic haemodialysis patients in Morocco. East. Med. Hlth. J. 17(1): 56-61.

Novac M, Bjorck L, Welin L, Welin C, Manhem K, Rosengrer A (2011). Gender differences in the prevalence of metabolic syndrome in 50 year old Swedish men and women with hypertension born in 1953. J. Hypertens. 27: 56-61.

NPC (2006). National Population Commission of Nigeria. Available at: http://www.population.gov.ng

Ntandou G, Delisle H, Agueh V, Fayomi B (2009). Abdominal obesity explains the positive rural-urban gradient in the prevalence of the metabolic syndrome in Benin, West Africa. Nutr. Res. 29(3): 180-189.

Ofuya Z (2007). The incidence of hypertension among a select population of adults in the Niger Delta region of Nigeria**.** S. E. As. J. Trop. Med. Pub. Hlth. 38(5):947-949.

Ojji DB, Ajayi SO, Mamven MH, Alabi P (2012). Prevalence of metabolic syndrome among hypertensives in Abuja, Nigeria. Eth. Dis. 22(1): 1-4.

Pollex RL, Hegele RA (2006). Genetic determinants of the metabolic syndrome. Nat. Clin. Prac. Cardiovasc. Med. 3(9): 482-489.

Siminialayi IM, Eme-Chioma PC, Odia OJ (2010). Prevalence of metabolic syndrome in urban and sub-urban Rivers State, Nigeria. Niger. Postgrad. Med. J. 17 (2): 147-53.

Smith C, Essop MF (2009). Gender differences in metabolic risk factors prevalence in a South African student population. Cardiovsc. J. Afr. 20(3): 178-82.

Ulasi II, Ijoma CK, Onodugo OD (2010). A community based study of hypertension and cardiometabolic syndrome in semi-urban and rural communities in Nigeria. BMC Hlth. Ser. Res. 10: 71.

Ulasi II, Ijoma CK, Onwubere BJC, Arodiwe E, Onodugo O, Okafor C (2011). High prevalence and low awareness of hypertension in a market population in Enugu, Nigeria. Inter. J. Hypertens. Article ID 869675.

Williams KV, Kelley DE (2000). Metabolic consequences of weight loss on glucose metabolism and insulin action in type 2 diabetes. Diab. Obes. Metab. 2: 121-129.

Zainuddin LR, Isa N, Muda WM, Mohammed HJ (2011). The prevalence of metabolic syndrome according to various definitions and hypertriglyceridemic waist in Malaysian adults. Int. J. prev. Med. 2(4): 229-237.