

Assessment of Cardiometabolic Risk Factors: the Case of Ethiopian Public Health Institute Staff Members

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Research

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Abstract

Background: Non-communicable diseases (NCDs) are increasingly becoming the global cause of premature death encompassing cardiovascular diseases (CVDs), cancer, respiratory diseases and diabetes mellitus. However, early identification of cardiometabolic risk factors in the general population, especially among the high-risk groups has rarely been assessed in Ethiopia.

Purpose: The study aimed to assess the magnitude and associated risk factors of cardiometabolic diseases among Ethiopian Public Health Institute (EPHI) staff members.

Methodology: An institutional-based cross-section study was conducted from March to June 2018 among EPHI staff members. A total of 450 study participants were involved in the study, and the World Health Organization NCD STEPS survey instrument version 3.1 was used for the assessment. The biochemical parameters were analyzed by using COBAS 6000 analyzer. Statistical package for the social science (SPSS) version 20 was used for data analysis. Both bivariate and multivariate logistic regression analyses were used to identify associated risk factors. P-value <0.05 was considered for statistical significance.

Results: Based on IDF criteria, the prevalence of metabolic syndrome was 27.6%. Central obesity, low HDL and hypertension had a prevalence of 80.2%, 41.3%, and 23.6%, respectively. Increasing age and larger body mass index were significantly associated with metabolic syndromes

Conclusion: The magnitude of metabolic syndrome was relatively high in the study participants. Preventive intervention measure should be designed on the modification of lifestyle, nutrition and physical activities, and early screening for early identification of cardiometabolic risks factors should be practised to reduce the risk of developing cardiovascular diseases.

Introduction

Non-communicable diseases (NCDs) are increasingly becoming the leading cause of morbidity and mortality involving every country worldwide (1). According to World Health Organization (WHO) 2017 report, NCDs, such as cardiovascular diseases (CVDs), cancers, diabetes, and chronic respiratory diseases are the global leading causes of deaths which are responsible for 70% of all deaths worldwide (2). From 36 million annual NCD deaths, CVDs stand the first place and accounts for 17.5 million followed by cancers (8.2 million), respiratory diseases (4.0 million) and diabetes mellitus (1.5 million) (3). These NCDs shared common and key modifiable behavioural risk factors like unhealthy diet, lack of physical activity, use of alcohol, tobacco which in turn leads to overweight/obesity, raised blood pressure, raised cholesterol, raised blood glucose. and finally chronic diseases (2). These risk factors have shown clustering and synergizing effects through time and then associated with a higher prevalence of NCDs, including CVDs and related mortality (4, 5).

The cardiometabolic syndrome is a combination of metabolic dysfunctions, including insulin resistance, impaired glucose intolerance, dyslipidemia, hypertension and central obesity which are associated with an increased risk of CVDs and type 2 diabetes (6). This complex, cardiometabolic disorders, are becoming a major worldwide public health problem because of their association with increased risk of type 2 diabetes mellitus, atherosclerotic cardiovascular disease and mortality (7). With the rise of cardiometabolic risks factors, such as obesity, hyperglycemia, hypertension, and dyslipidemia, CVDs become the leading causes of premature mortality (8). Modifiable risk factors like high rates of smoking, alcohol consumption, poor diet and limited physical activities have been commonly practised and believed to be major risk factors of getting cardiometabolic diseases (8, 9) Exposure to prolonged sitting in the workplace have become common, particularly who spend in office environments (10). Ethiopian Public health Institute was mandated for activities which exposed to limited physical activities that are the major proximate determinants of NCDs and metabolic syndrome. However, to the extent of our knowledge, little researches were available on the magnitude and associated factors of cardiometabolic diseases among healthy office workers in Ethiopia. Understanding this gap in the literature and given the importance of timely identification of cardiometabolic risk factors to initiate preventive strategies before end-organ damage occurs; we aimed to assess the magnitude of cardiometabolic diseases and associated factors among EPHI Staff Members.

Materials And Methods

Study population and area

An institutional-based cross-sectional study was conducted using the WHO stepwise survey tool from March 2018 to June 2018. The study involved 450 individuals aged 18–69 years who are staff members at EPHI. We excluded female staff members who were pregnant during data collection period.

Anthropometric Measurements

Physical measurements, such as weight, height, waist circumference, hip circumference and blood pressure were registered using standardized methods and adjusted equipment by trained health professionals. Weight was measured in kilograms with lightweight clothes and no wearing of shoes; the participants' height was measured in centimeter using height board with no shoes wearing and in an upright position. Waist circumference was measured in centimeter at the narrowest point between the lower costal border and the iliac crest with a measuring tape. Then, BMI and waist to height ratio (WHtR) were calculated to determine the obesity status of the participants. The BMI was calculated as the weight in kilograms divided by the square of the height in meters (11). WHtR was calculated as the WC (waist circumference) in centimeters divided by the height in centimetres and used to classify central/abdominal obesity (12). Blood pressure measurement was taken at the midpoint of the left arm after participants rest for at least five minutes or 30 minutes for those who took hot drinks like coffee. Three blood pressure readings were performed for all participants and then the mean blood pressure value was taken.

Physical activity was assessed according to WHO STEPS, in which physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure. Physical activity was categorized into vigorous, moderate and sedentary (low) activity. A vigorous-intensity activity was defined as any activity that causes a large increase in breathing or heart rate if continued for at least 10 minutes (e.g. running, carrying or lifting heavy loads, digging or construction work) at least for three days per week. The moderate-intensity activity was defined as any activity that causes a small increase in breathing or heart rate if continued for at least 10 minutes (brisk walking or carrying light loads) or three or more days of vigorous-intensity activity of at least 20 minutes per day; or five or more days of moderate-intensity activity or walking for at least 30 minutes per day. Physical activity related to work, transportation and leisure time was assessed in terms of minutes that caused them to be breathless or feel palpitation. Low-level physical activity involves a person not meeting any of the above-mentioned criteria for the moderate- or high-level categories (13).

The questionnaire includes face to face questions that assess the socio-demographic characteristic, such as age, sex, educational level, income per month, and behavioural risk factors (alcohol consumption, physical inactivity, low fruit and vegetable intake, Cigarette smoking). WHO identified risk factors of NCDs with expanded and optional questions to suit local needs were also included in the questionnaire like Khat chewing. Participants who were smoking cigarettes and chewing Khat in any amount at the time of the study were taken as current smoker and chewer. Participants who consume any amount of alcohol in the past 30 days were considered as alcohol consumer (14).

Data Collection and Quality Assurance

Data were collected digitally using personal digital assistants (PDAs). The data collectors were trained professionals and investigators who were trained before data collection. Blood sample collection was done through standardized, calibrated, and sterile techniques after overnight fasting. Data collected in PDAs was transferred to the central server using an internet file streaming system (IFSS) and was exported to Microsoft Excel to a personal computer for analysis. The biochemical analysis (glucose, cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL)) were performed by calibrated COBAS 6000 (c501) analyzer (Roche Diagnostics GmbH, Mannheim, Germany), after daily internal quality control (IQC) was done. The tests were done by well trained and experienced professionals with strictly followed laboratory standard operating procedure.

Cutoff of Points for Defining Metabolic Syndrome

The definition criteria were based on the International Diabetes Federation (IDF) (15) and the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) (16). The presence of any three of the following five factors is required for a diagnosis of Metabolic Syndrome: abdominal obesity, (Waist circumference ≥ 90 cm for men and ≥ 85 cm for women), dyslipidemia (triglycerides ≥ 150 mg/dl); low HDL cholesterol (HDL cholesterol ≤ 40 mg/dl for men and ≤ 50 mg/dl for women); elevated blood pressure (systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg or current use of antihypertensive drugs); impaired fasting glucose (fasting plasma glucose ≥ 100 mg/dl) according to

NCEP ATP III criteria. The IDF criteria of MetS uses central obesity (waist circumference ≥ 90 cm for men or ≥ 80 cm for women) as a mandatory criterion and the presence of at least two of the other four criteria which are identical to those provided by NCEP ATP III.

Data Processing and Analysis

The statistical data analysis was conducted using the statistical package for the social science (SPSS) version 20 software. Descriptive data analyses were presented in tables and/or graphs with means, proportions and frequency distributions. Bivariate and multivariate logistic regression analyses were used to determine the potential strength of associated factors with cardiometabolic syndromes. All variables that have been associated with the independent variable at $P < 0.2$ with bivariate analysis were further analyzed with multivariate logistic regression analysis. Adjusted odds ratio (AOR) was used to determine the strength of association. The assumption was done through the chi-Square test. P -value < 0.05 was considered to be statistically significant.

Results

General Characteristics of the Study Participants

A total of 450 study participants were recruited in this study, of whom 232/450 (51.6%) were males. The mean age in year \pm SD of study participants was 36.5 ± 10 years, and about 186/450 (41.3%) were in the age range of 29–38 years. About 220/450 (48.9%) study participants attend their education up to College/University level. Regarding the marital status of the participants, 295/450 (58.9%) were married while 156/450 (34.7%) were never married (Table 1).

Table 1

Socio demographic characteristics of the study participants stratified by sex, EPHI, Addis Ababa, Ethiopia, 2018 (n = 450)

Characteristics		Total	Sex	
			Male N (%)	Female N (%)
Study Participant n (%)		450	232 (51.6)	218 (48.4)
Mean age y (SD)		36.5 (10)	38 (10)	35 (10)
Age of Respondent	18–28	21.6	34(35.1)	(63)64.9
	29–38	41.3	(57.5)107	(42.5)79
	39–48	21.3	(52)54.2	(44)45.8
	49–58	12.2	(29)52.7	(26)47.3
	59–69	3.6	(10)62.5	(6)37.5
Marital Status	Never married	34.7	(73)46.8	(83)53.2
	Married	58.9	(156)58.8	(109)41.1
	Separated/Divorced/Widowed	6.4	(3)10.3	(26)89.7
Level of Educational Status	Less than Primary School	6.9	(9)29	(22)71
	Primary School Completed	10.7	(21)43.8	(27)56.2
	Secondary School Completed	14.4	(24)36.9	(41)63.1
	College/University Completed	48.9	(114)51.8	(106)48.2
	Post Graduate Degree	19.1	(64)74.4	(22)25.6
Quartile of Income per Month	Quartile1	23.8	(27)25.2	(80)74.8
	Quartile2	26	(50)42.7	(67)57.3
	Quartile3	24	(72)66.7	(36)33.3
	Quartile4	26.2	(83)70.3	(35)29.7
<i>Quartile 1 = < 1500 Birr, Quartile 2 = 1500-3173-birr, Quartile 3 = 3174-6676-birr Quartile 4 = > 6677 birr</i>				

Behavioral, Clinical and Biochemical Characteristic of the Study Participants

Table 2 showed that out of the total study 450 participants, 19/450 (4.2%) were tobacco product smokers whereas 19/450 (4.2%) were chewing Khat at the time of the study. About 350/450 (66.7%) participants were consumed alcohol in the past 30 days before the study with high proportion of males, 172/300 (57.3%). The proportion of study participants who consumed fruit and vegetable for five and more days per week were 36/450 (8%) and about 448/450 (99.6%) were consumed less than five servings of fruit and vegetable daily. As it is presented in (Table 2) among the study participants about 31/450 (7%) were found to be obese and 167/450 (37%) were overweight. About 361/450 (80.2%) of the study participants had central obesity. 106/450 (23.6%) of the study participants had raised blood pressure, 11/450 (2.4%) Diabetes, 127/450 (28.2%) had raised fasting cholesterol and 186/450 (41.3%) of the participants had low HDL. High level of fasting triglycerides was found among male study participants, 71/87 (81.6%). We also found that 117/450 (25.1%) of the participants had high LDL.

Table 2
Prevalence of Behavioral Clinical and Biological Characteristics of Study Participant, EPHI, Addis Ababa, Ethiopia, 2018 (n = 450)

Characteristics		% of Total	Sex	
			Male n (%)	Female n (%)
Smoking Status	Never Smoke	90	190 (46.9)	215 (53.1)
	Current Smoker	4.2	18 (94.7)	1 (5.3)
	Previous Smoker	5.8	24 (92.3)	2 (7.7)
Alcohol drinking status of respondents	No	33.3	60(40)	90(60)
	Yes	66.7	172(57.3)	128(43.7)
Physical activity level (WHO recommendation)	Vigorous	29.6	74(55.6)	59(44.4)
	Moderate	65.6	149(50.5)	146(49.5)
	Low	4.8	9(40.9)	13(59.1)
Khat chewing status of respondents	Never Chewed	84.2	166(43.8)	213(56.2)
	Current Chewer	4.2	(19)100	0(0)
	Previous Chewer	11.6	47(90.4)	5(9.6)
Days of fruit & vegetable intake per week (WHO recommendation)	≥ 5	8	18(50)	18(50)
	3–5	14	31(49.2)	32(50.8)
	< 3	78	183(52.1)	168(47.9)
Serving of fruit and vegetable per day (WHO) recommendation	≥ 5	0.4	1(50)	1(50)
	< 5	99.6	231(51.6)	217(48.4)
Body Mass Index (BMI*)	Normal	56	128(50.8)	124 (49.2)
	Overweight	37.1	97(58.1)	70(41.9)
	Obese	6.9	7(22.6)	24(77.4)
Blood pressure	Normal	76.4	172(50)	172(50)
	Hypertensive	23.6	60(56.6)	46(43.4)
Lipid profiles	Cholesterol < 200 mg/dl	71.8	158(48.9)	165(51.1)
	Cholesterol ≥ 200 mg/dl	28.2	74(58.3)	53(41.7)

	Triglyceride < 150 mg/dl	80.7	161(44.4)	202(55.6)
	Triglyceride > = 150 mg/dl	19.3	71(81.6)	16 (18.4)
	Normal HDL mg/dl	58.7	141(53.4)	123(46.6)
	Low HDL mg/dl	41.3	91(48.9)	95(51.1)
	Normal LDL(< 130) mg/dl	74.9	166(49.3)	171(50.7)
	High LDL (> 130) mg/dl	25.1	66(58.4)	47(41.6)
Blood glucose	Normal	97.6	224(51)	215(49)
	Hyperglycemia	2.4	8(72.7)	3(27.3)
Dyslipidemia based on NCEP-ATPII	Normal	50.4	113(49.8)	114(50.2)
	Dyslipidemia	49.6	119(53.4)	104(46.6)
Central Obesity (CO) based on IDF	Normal	19.8	28(31.5)	61(68.5)
	Obese	80.2	204(56.5)	157(43.5)
<i>Abbreviations:- *BMI- Body Mass Index, , LDL- Low density Lipoprotein, HDL- High Density Lipoprotein, HDL low <40/50mg/dl (M/F) CO (central Obesity Waist Circumference >=94/80cm Male/Female);</i>				

Prevalence of Blood Pressure, Blood Glucose, Lipid Profile Abnormalities, and Central Obesity

Among the study participants the prevalence of hypertension, diabetes, dyslipidemia, and central obesity were 106/450 (23.6%), 11/450 (2.4%), 223/450 (49.6%) and 361/450 (80.2%), respectively. The prevalence of hypertension and diabetes was highest in the age group of 58-69 years which was 10/16 (62.5%) and 2/16 (12.5%), respectively. The prevalence of hypertension and diabetes in male study participants was 60/232 (26%) and 8/232 (3.4%), respectively. A proportion of hypertensive in previous smokers and Khat chewer were 10/26 (38.5%) and 14/52 (26.9%), respectively. While the proportion of diabetes in smokers and Khat chewers at the time of the study were 3/19 (15.8%) and 1/19 (5.3%), respectively when compared with those who never smoked cigarettes and chewed Khat. We found that hypertension and diabetes among the participants who consumed alcohols were 83/300 (27.7%) and 10/300 (3.3%), respectively.

The study also showed that dyslipidemia in the previous smoker, Khat chewer, and low-level physical activities were 15/26 (57.7%), 30/52 (57.7%) and 12/22 (54.5%), respectively. In obesity class based on BMI, the prevalence of hypertension in obese was 18/21 (85.7%) and the prevalence in obese was 92/320 (28.8%) based on WHtR. While, based on BMI, the prevalence of diabetes among overweight and obese was (2.4%) and (9.7%), respectively. Participants with hyperglycemia had 7/11 (63.6%) prevalence of hypertension. The study showed that Dyslipidemia was prevalent in overweight 102/167 (61.1%), obese 17/31 (54.8%) and had raised hsCRP 174/324 (53.4%). From those participants who had central obesity (80.2%) based on IDF criteria, all participants with 59-69 years age group had central obesity. Male participants had a prevalence of central obesity 204/232 (87.9%) (Table 3 Found as an additional file 1).

Association of risk factors with Raised (blood Pressure, Blood Glucose), Dyslipidemia and Central Obesity

The prevalence of hypertension was statistically significant in the age groups of 39-48 years (AOR=4.27, (95% CI; 1.8-10.31)), 49-58 years (AOR= 4.53, (95% CI; 1.77-11.6)) and 59-69 years (AOR= 8.62, (95% CI; 2.36-31.5)).

Following adjustment for confounding factors with multiple logistic regressions, the study showed that hyperglycemia was significantly associated with current smokers with (OR= 10.34, (95% CI; 2.2-48.7)) in which the odds of being current smokers had 10.34 times to have the likelihood of diabetes than study participants who never smoke in their lifetime. The odds of being hypertensive were nearly five times to have hyperglycemia (AOR=4.8, (95% CI; 1.24-18.62)). Overweight based on BMI and raised WHtR had a significant association with dyslipidemia in a multi logistic regression model with OR as follows overweight (AOR=1.68, (95% CI; 1.07-2.63)) and raised WHtR (AOR=1.74, (95% CI; 1.07-2.81)). Based on IDF definition of central obesity, expressed with raised waist circumference had significant association with age categories 29-38 years, 39-48 years and 49-58 years of age (AOR=3.33, (95% CI; 1.78-6.27)), (AOR=5.16 (95% CI; 2.0-13.3)) and (AOR=4.12 (95% CI; 1.32-12.85)), respectively. Overweight (AOR=4.87 (95% CI; 2.23-10.6)), Obesity (AOR= 9.29 (95% CI; 1.07-80.7)) and raised WHtR (AOR=312 (95% CI; 78-1245)) had significant association with central obesity based on IDF criteria (Table 4 found as an additional file 2).

Proportions of metabolic syndromes

From the total study participants, 27.6% had metabolic syndrome based on IDF criteria while 16.7% had metabolic syndrome based on NCEP ATP III. Metabolic syndrome based on both IDF and NCEP criteria was high in male participants, 83/232 (35.8%) and 45/232 (19.4%), respectively. The study also showed that the prevalence of metabolic syndrome was high with increasing age and the age group of 59-69 years, 10/16 (62.5%) had the highest metabolic syndrome proportion based on IDF (Figure 1).

Risk Factors of Metabolic syndrome

With multivariate analysis, sex, age, BMI, raised blood glucose, raised blood pressure and dyslipidemia were shown to be significant risk factors for metabolic syndrome based on IDF criteria (Table 5). The odds of being females were 32% times less likely to develop metabolic syndrome than males. (AOR= 0.32, (95% CI: 0.16-0.64)). Study participants with age groups 39-48, 49-58, 59-69 and overweight were individual predictors for metabolic syndrome (AOR = 5.38, (1.72-16.8)), (AOR =4.0, (1.09-14.7)), (AOR= 81.2(9.4-669)) and (AOR= 4.67, (95% CI 2.27-17.6)), respectively. From our research result raised blood pressure and blood glucose and dyslipidemia were also significant risk factors for metabolic syndrome with AOR= 28 (95% CI; 9.46-86.9), AOR= 126 (95% CI; 6.7-2374) and AOR= 210 (95% CI; 52-849), respectively. Almost similar results were observed using ATP III criteria on the significance of risk factors for metabolic syndrome. Central obesity was the constant component for IDF criteria while according to ATP III criteria it was a statistically significant risk factor for metabolic syndrome with (AOR= 9.56 (95% CI; 4.11-22.3)). Regarding sex difference, there was no statistical association for metabolic syndrome based on ATP III criteria (Table 5 found as Additional file 3).

Summary of combined cardiometabolic risk factors

Among the total study participants, only 24.2% had no risk factors for cardiometabolic diseases. Male participants were greater proportions of, 65/109 (59.6%) based on NCEP ATP III criteria. As shown in figure 2, more than three risk factors were three times more prevalent in male participants, 10/13 (79.6%) than to female 3/13 (23.1%), having a crude percentage of 13/450 (2.9%). Most of the study participants, 341/450 (75.8%) had at least one risk factor for metabolic syndrome and cardiometabolic risks. About 189/450 (42%) of the study participants had two or more risk factors with balanced proportions between male (49%) and female (51%) (Figure 2).

Discussion

Metabolic syndrome is a constellation of risk factors associated with a 5-fold increase in incidence of Type 2 diabetes and 2-3-fold increase in the incidence of CVDs (17).

Based on our findings concerning anthropometric measurement, obesity based on BMI, about 44% of the study populations were overweight/obese, in which 6.9% were obese and 37.1% were overweight. This finding is higher than similar studies conducted in Ethiopia national survey (1.2% obese and 5.2% overweight) (18), northern Ethiopia Mekele (4.1% obese and 26% overweight) (19) and Northwest Ethiopia Jimma obese (5.1%) and overweight (10.4%) (20). The possible explanation for the higher prevalence of overweight/obesity in our study may be due to the difference in physical activity, sample size, sedentary behavior, and lifestyle.

Hypertension, the second most common criteria for metabolic syndrome with the frequency of 23.6% was higher than those reported in earlier studies 15.8% conducted in Ethiopia in 2015 national survey(18),

9.3% at Gilgel Gibe field research center (21) and 20% in male and 14% in female among working adults in Addis Ababa (22). Possible explanations for the difference in hypertension were, in addition to stress condition, lifestyle and genetic difference; the alcohol consumption behavior of our study participants was more prevalent as compared to these studies. This showed that there is a need for appropriate interventions to reduce the burden of alcohol use, which could help to lower blood pressure levels (23). The prevalence of hypertension was also higher when compared to a study done in Angola, 17.9% among workers in private tertiary center (24) but lower in comparisons with studies done in Eastern Ethiopia among adults lived in Jigijiga city 28.3% (25), Nigeria Lagos 38.2% among urban slum dwellers (26) and in Ghana 55.3% among urban & rural adults in the Keta Municipality (27). The possible explanation for the disparities of hypertension prevalence among different studies was due to family history, socio-demography, attitude, and awareness and geographic location and/or may be life style of study participants.

The result of our research showed that the prevalence of Diabetes Mellitus was 2.4% which is in line with a study done in rural Koladiba town northwest Ethiopia (28). Our result was slightly similar to the 2010 global estimate of the prevalence of Diabetes in the Ethiopian population, 2.0% (29) and study has done in South Western Nigeria population that found a prevalence of Diabetes Mellitus, 2.5% (30). However, our result was lower than that of a study done in the Ethiopian national crude prevalence rate 3.2% (31) and study done in Northern Ethiopia among public employees 10.1% (31). This may be because of biochemical analysis differences since in our study we had used only fasting blood glucose to define the prevalence of diabetes but the study done by Gebremariam et al. (19) used a combination of FBG and HgA1c, which results in observed prevalence differences.

Dyslipidemia, especially low HDL levels with 41.3% was a common finding in our study participants next to central obesity 80.2% based on IDF criteria. The prevalence of low HDL in our study is in line with the study done by Martinez Torres and his colleagues among Colombian college students, 40.3% (32), by Oladapo and his colleagues among rural Southwestern Nigerian population 43.1% (30) and with the study done among Saudi University employees 36.8% (33). The similarity of this result may be explained with the mean age group of study participants in Saudi Arabia University employee was 40.4 ± 9.8 years which was comparable to our study mean age (36.5 ± 10) years and also volunteering based sampling method was used which was similar to our study. On the contrary, a higher prevalence of low HDL was observed in Ethiopian national survey (68%) and among public employees in northern Ethiopia (71.3%) (19, 31). Environmental factors, physical activity status, nutrient intake and sample size and age of study participants may be used as part of an explanation for this difference.

Regarding the prevalence of hypertriglyceridemia, which is (19.3%) in our study is nearly similar with a result reported in the Ethiopian national survey. But higher prevalence is found in the following studies Northern Ethiopia (55%), Saudi University Employee (36.1%), and among Jordanian adults (50.2%) (19, 33, 34). Dietary intake, level of physical activity, lifestyle difference, and level of awareness may be part of a possible explanation for this variation.

Abdominal obesity drives the development of cardiometabolic risks through altered secretion of adipocyte-derived active substances called adipokines, including free fatty acids, adiponectin, interleukin-6, tumour necrosis factor-alpha, and plasminogen activator inhibitor-1, and through exacerbation of insulin resistance and associated cardiometabolic risk factors (35). In the present study, we demonstrated that elevation of waist circumference based on IDF criteria was the most prevalent criterion with a total frequency of 80.2% which is 87.9% and 72% among males and females, respectively that was the superior component to yield larger metabolic syndrome prevalence. This result is higher than the community-based study done among Andean highlanders (75.9%) (36) and the study done in South African Asian Indians who found a prevalence of (73.1%) even though harmonized criteria was used (37). This may be due to differences in sample size, level of physical activity difference, and dietary intake. Concerning sex- difference, it is noted that males had a higher frequency of central obesity (87.9%). The reason for this difference may be the majority (65%) of female participants were younger as compared to male (35%) and central obesity increases with increasing age (38).

Findings from this study showed that the prevalence of metabolic syndrome among staff members of EPHI was 16.7% using NCEP ATP III criteria while the IDF criteria yielded a higher prevalence of 27.6%. This higher prevalence of metabolic syndrome based on IDF criteria was due to a higher prevalence of central obesity which is one of the pre-request criteria for defining metabolic syndrome. Our result was fairly comparable to study conducted in systematic review of Madagascar (27.7%), Nigeria (28.1%), Spain (24.3%), South Asia (29.8%), and Australia (30.7%) based on IDF criteria (39–43). The prevalence of metabolic syndrome in our study was less than from other studies conducted in Kenya among urban population (34.6%), Nigeria among apparently healthy adults in Ogun state (36.8%), among Turkey adults (44%), among Jourdan adults (51%) (34, 44–46). Differences in the age of study subjects, sample size, socioeconomic status, residence & lifestyle, dietary intake, and physical activity may contribute to the different prevalence of metabolic syndrome in these different studies.

High prevalence of metabolic syndrome has been linked to urbanization, westernization, nutritional and epidemiological transition (47). Our result was also lower than the recent study conducted in Northern Ethiopia involving public employees in Mekele found a prevalence of metabolic syndrome to be 40% using IDF criteria (19). The explanation for this discordant may be due to the environmental and sampling methods in which we had used random sampling. However, the finding in this study was higher than other community-based studies conducted among working adults in Addis Ababa Ethiopia (17.9% using IDF criteria and 12.5% using ATP criteria), in Jimma town (16.7%) using IDF criteria) and a community-based study conducted in Ethiopia in 2015 (4.8%) (18, 20, 22). Our result is also showed higher prevalence from studies conducted among adults in the rural area of West China (10.8%) and the study conducted among health professionals in Brazil (4.5%) (48, 49). This could be due to a result of differences in socioeconomic backgrounds, lifestyle variations and the difference in ethnicity.

The result also showed that the prevalence of metabolic syndrome was 35.8% in males and 18.8% in females based on IDF criteria. This was in line with the study reported in Colombia who observe that the prevalence of metabolic syndrome in males was three times higher than in the females (32). The possible

explanation for the higher prevalence of metabolic syndrome in males is because; the majority of female participants are younger as compared to males (38). The other possible explanation for higher metabolic syndrome prevalence in males can be because of central obesity which was more prevalent in males (72%) than females (28%). However, our result was contradicted with a study that found greater occurrences of metabolic syndrome were observed in females. Our result finding also showed that the prevalence of metabolic syndrome was high in older age. Increasing age group from 39–48, 49–58 and 59–69 years was significantly associated with metabolic syndrome which showed that five, two, four, one and eighty-one times, respectively increased getting the odds risk of metabolic syndrome compared to age group of 18–28 years. This is in line with different studies (20, 50). This is because of ageing is characterized by a progressive deterioration in physiological functions and metabolic processes that generate reactive oxygen species as a by-product of biological oxidation. The oxidative damage of reactive oxygen species induces cellular dysfunction playing an important role in many pathological conditions like chronic low-level inflammation-induced metabolic syndrome (51). The predisposing factors for having metabolic syndrome in this study, includes being under overweight (OR = 4.67, (95% CI; 2.27–9.6)), having raised blood pressure (OR = 28, (95% CI; 9.46–86.9)), raised fasting blood glucose (OR = 126, (95% CI; 6.7–2374)) and dyslipidemia (OR = 210, (95% CI; 52–849)) were also in line with another studies (20, 32, 50). Overweight characterized by unbalanced energy intake and expenditure which could result in continues raised blood glucose level (52, 53). These further results in hyper-secretion of insulin and leading to insulin resistance over time. Once insulin resistance occurs in different target organs metabolic process dysregulation will be initiated such as lipid profile abnormalities, endothelial dysfunction, and inflammatory reactions (54, 55)

Three fourth of the participants had at least one component of metabolic syndrome. This result revealed that characteristics, including smoking habits, alcohol consumption, physical activity and serving of fruit and vegetables per week were not individual predictors for metabolic syndrome. Even though the study participants were not apparently healthy, our result was consistent with the finding from Hawassa University Hospital and Jimma health centre among peoples living with HIV/AIDS (56, 57). The study done by Owolabi and his colleagues among adults attending healthcare in Eastern Cape South Africa contradicts our findings. They found that smoking, alcohol use, fruit, and vegetable consumption were statistically significant factors for metabolic syndrome (47). The discordant with smoking and alcohol use might be because of the amount and type of alcohol and smoking products taken by the study populations. However, sex, age, BMI, raised blood pressure, raised blood glucose, dyslipidemia and raised hsCRP had statistical significance with metabolic syndrome in bivariate analysis. After adjusting confounders in logistic regression only age, BMI, raised blood glucose, raised blood pressure and dyslipidemia were independent predictors for metabolic syndrome. This was also in line with the study done by Salas et al. among Mexican adult population and Brazilian health professionals (49, 59) In general prevalence of central obesity expressed as increased waist circumference was the most common abnormality, followed by low HDL and raised Blood pressure were acquiesced with many researchers (34, 60). It is assumed that the modern luxurious lifestyle lies behind abdominal obesity and dyslipidemia being the most common components of metabolic syndrome (61). The high prevalence of

abdominal/central obesity, low HDL and raised blood pressure emphasizes the susceptibility of the study population to CVD and Type 2 DM, especially in older age. Controlling weight and body fat with physical activity and a more appropriate diet were important in reducing the risk of CVDs (62). The prevalence also has been linked to urbanization, westernization, nutritional and epidemiological transition and this calls for urgent action by the policymakers and health managers to further emphasize the need for routine screening for all the components of Metabolic syndrome.

Conclusion

From this study, it is possible to conclude the following: the prevalence of metabolic syndrome and its components were significantly high among the study population. Central obesity, followed by dyslipidemia and hypertension were the most frequent components of metabolic syndrome. The prevalence of hypertension was found substantial as compared to the national survey report. Being male, over 39 years old, overweight, raised blood pressure elevated fasting blood glucose and dyslipidemia were significantly associated with metabolic syndrome. Twenty-four percent of the study participants were free from any risk factors for metabolic syndrome. About 16.7% of the study participants had ≥ 3 risk factors based on NCEP ATP III defining criteria.

Strength And Limitation Of The Study

The major limitation of this study has a limitation associated with cross-sectional nature of study design. Thus, findings may not be generalized to a broader Ethiopian population since our study participants were an employee of single public institute.

Declarations

Ethical consideration:-

Ethical clearance was obtained from Addis Ababa University Biochemistry Department ethics and research committee (DRERC). All study participants provided written informed consent. The identity of participants was not revealed, and an identification number was allocated.

Data availability:-

The whole data supporting this study are included within the manuscript

Consent for Publication: -

Not applicable

Funding:-

No funding was obtained for this study

Disclosure:-

The authors declare that they have no competing interests.

Contributorship:-

ZG, DS, AB and MD designed and conceived the study. ZG, AB, FC, MG and MDM were responsible for participant recruitment, data collection and data analysis. TL, MS, BN, YT, TG and YD analyzed test parameters and interpreted results. ZG wrote the first draft of the manuscript and all authors reviewed and edited the article and approved the final version of the manuscript.

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References

1. Ekpenyong, C.E., Udokang, N.E., Akpan, E.E., Samson T. Double Burden , Non-Communicable Diseases And Risk Factors Evaluation In Sub-Saharan Africa : The Nigerian Experience . Eur J Sustain Dev. 2012;
2. Diseases N. Progress monitor 2017. 2017.
3. on noncommunicable diseases. 2014;
4. Alzeidan R, Rabiee F, Mandil A, Hersi A, Fayed A. Non-Communicable Disease Risk Factors among Employees and Their Families of a Saudi University : An Epidemiological Study. 2016;1–13.
5. Kaukua J, Turpeinen A, Uusitupa M, Niskanen L. Clustering of cardiovascular risk factors in type 2 diabetes mellitus: Prognostic significance and tracking. Diabetes, Obes Metab. 2001;
6. Paper R. The Cardiometabolic Syndrome and Cardiovascular Disease. 2006;
7. Ala A, Adelin A, Michèle G. Cardiometabolic Syndrome.
8. Carney R, Cotter J, Bradshaw T, Firth J, Yung AR. Cardiometabolic risk factors in young people at ultra-high risk for psychosis : A systematic review and meta-analysis. Schizophr Res [Internet]. 2016;170(2–3):290–300. Available from: <http://dx.doi.org/10.1016/j.schres.2016.01.010>
9. Krishnadas R, Jauhar S, Telfer S, Shivashankar S, Mccreadie RG. Nicotine dependence and illness severity in schizophrenia. 2012;306–12.
10. Hadgraft NT, Healy GN, Owen N, Winkler EAH, Lynch BM, Sethi P, et al. Of fi ce workers ’ objectively assessed total and prolonged sitting time: Individual-level correlates and worksite variations. PMEDR [Internet]. 2016;4:184–91. Available from: <http://dx.doi.org/10.1016/j.pmedr.2016.06.011>
11. National Institutes of Health. The practical guide: identification, evaluation, and treatment of overweight and obesity in adults. US Dep Heal Hum 2000;

12. Ashwell M, Gibson S. Waist to height ratio is a simple and effective obesity screening tool for cardiovascular risk factors: Analysis of data from the british national diet and nutrition survey of adults aged 19-64 years. *Obes Facts*. 2009;
13. Emro WHO. 5–17 years old. :2–3.
14. Bonita R, Winkelmann R, Douglas KA, de Courten M. The WHO Stepwise Approach to Surveillance (Steps) of Non-Communicable Disease Risk Factors. In: *Global Behavioral Risk Factor Surveillance*. 2003.
15. Zimmet P, Magliano D, Matsuzawa Y, Alberti G, Shaw J. The metabolic syndrome: a global public health problem and a new definition. *J Atheroscler Thromb*. 2005;12(6):295–300.
16. Third Report of the National Cholesterol Education Program. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on. 01-3670. 2001;
17. Epidemiology F, Heart N, Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, et al. Harmonizing the Metabolic Syndrome International Atherosclerosis Society; and International Association for the Study of Obesity. 2009;1640–5.
18. ETHIOPIA STEPS REPORT ON RISK FACTORS FOR NON-COMMUNICABLE DISEASES AND PREVALENCE OF SELECTED NCDs ETHIOPIA STEPS REPORT ON RISK FACTORS FOR CHRONIC NON-COMMUNICABLE DISEASES AND. 2016;(December).
19. Gebremariam LW, Chi C, Yatsuya H, Haregot E. Non-communicable disease risk factor profile among public employees in a regional city in northern Ethiopia. 2018;(June):1–11.
20. Rajesh PN, Mossie A, Mezgebu Y. Prevalence Of Metabolic Syndrome And Its Components In Jimma. 2016;3(3):1685–704.
21. Tefera TB, Woldemichael K, Tessema F, Alemseged F. Epidemiology of Non-communicable Disease Risk Factors Among Adults Residing in Gilgel Gibe Field Research. 2015;3(4):124–8.
22. Tran A, Gelaye B, Girma B, Lemma S, Berhane Y, Bekele T, et al. Prevalence of Metabolic Syndrome among Working Adults in Ethiopia. 2011;2011.
23. Rehm J, Anderson P, Angel J, Prieto A, Armstrong I, Aubin H, et al. Towards new recommendations to reduce the burden of alcohol-induced hypertension in the European Union. 2017;1–10.
24. Manuel V, Manuel A, Béu G. Prevalence of cardiovascular risk factors among workers at a private tertiary center in Angola. 2016;497–503.
25. Asresahegn H, Tadesse F, Beyene E. Prevalence and associated factors of hypertension among adults in Ethiopia : a community based cross - sectional study. *BMC Res Notes* [Internet]. 2017;1–8. Available from: <https://doi.org/10.1186/s13104-017-2966-1>
26. Daniel OJ, Adejumo OA, Adejumo EN, Owolabi RS, Braimoh RW. Prevalence of Hypertension among Urban Slum Dwellers in Lagos , Nigeria. 2013;
27. June M-, Atinyi R, Takramah W, Axame WK, Owusu R, Parbey PA, et al. Prevalence and awareness of Hypertension among urban and rural Adults in the Keta Municipality , Ghana. 2017;3(3):155–63.

28. Worede A, Alemu S, Gelaw YA, Abebe M. The prevalence of impaired fasting glucose and undiagnosed diabetes mellitus and associated risk factors among adults living in a rural Koladiba town , northwest Ethiopia. *BMC Res Notes*. 2017;1–7.
29. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract*. 2010;87(1):4–14.
30. Oladapo OO, Salako L, Sodiq O, Shoyinka K, Adedapo K, Falase AO. A prevalence of cardiometabolic risk factors among a rural Yoruba south-western Nigerian population: A population-based survey. *Cardiovasc J Afr*. 2010;21(1):26–31.
31. Gebreyes YF, Goshu DY, Geletew TK, Argefa TG, Zemedu TG, Lemu KA, et al. Prevalence of high bloodpressure , hyperglycemia , dyslipidemia , metabolic syndrome and their determinants in Ethiopia: Evidences from the National NCDs STEPS. 2018;1–18.
32. Martínez-Torres J, Correa-Bautista JE, González-Ruíz K, Vivas A, Triana-Reina HR, Prieto-Benavidez DH, et al. A cross-sectional study of the prevalence of metabolic syndrome and associated factors in colombian collegiate students: The fuprecol-adults study. *Int J Environ Res Public Health*. 2017;14(3).
33. Amin TT, Al Sultan AI, Mostafa OA, Darwish AA, Al-Naboli MR. Profile of non-communicable disease risk factors among employees at a Saudi University. *Asian Pacific J Cancer Prev*. 2014;15(18):7897–907.
34. Obeidat AA, Ahmad MN, Haddad FH, Azzeh FS. Alarming high prevalence of metabolic syndrome among jordanian adults. *Pakistan J Med Sci*. 2015;31(6):1377–82.
35. Farzadfar F, Finucane MM, Danaei G, Pelizzari PM, Cowan MJ, Paciorek CJ, et al. National, regional, and global trends in serum total cholesterol since 1980: Systematic analysis of health examination surveys and epidemiological studies with 321 country-years and 3·0 million participants. *Lancet* [Internet]. 2011;377(9765):578–86. Available from: [http://dx.doi.org/10.1016/S0140-6736\(10\)62038-7](http://dx.doi.org/10.1016/S0140-6736(10)62038-7)
36. Herrera-Enriquez K, Narvaez-Guerra O. Discordance of metabolic syndrome and abdominal obesity prevalence according to different criteria in Andean highlanders: A community-based study. *Diabetes Metab Syndr Clin Res Rev* [Internet]. 2017;11:S359–64. Available from: <http://dx.doi.org/10.1016/j.dsx.2017.03.016>
37. Prakaschandra R, Naidoo DP. Increased waist circumference is the main driver for the development of the metabolic syndrome in South African Asian Indians. *Diabetes Metab Syndr Clin Res Rev* [Internet]. 2017;11:S81–5. Available from: <http://dx.doi.org/10.1016/j.dsx.2016.12.011>
38. Kuk JL, Ardern CI. Age and sex differences in the clustering of metabolic syndrome factors: Association with mortality risk. *Diabetes Care*. 2010;
39. Aryal N, Wasti SP. The prevalence of metabolic syndrome in South Asia: A systematic review. *Int J Diabetes Dev Ctries*. 2016;36(3):255–62.
40. Kingue S, Rakotoarimanana S, Rabearivony N, Bompera FL. Prevalence of selected cardiometabolic risk factors among adults in urban & semi-urban hospitals in four sub-Saharan African countries.

Cardiovasc J Afr. 2017;28(3):147–53.

41. Oguoma VM, Nwose EU, Richards RS. Prevalence of cardio-metabolic syndrome in Nigeria: A systematic review. *Public Health [Internet]*. 2015;129(5):413–23. Available from: <http://dx.doi.org/10.1016/j.puhe.2015.01.017>
42. Cameron AJ, Magliano DJ, Zimmet PZ, Welborn T, Shaw JE. The Metabolic Syndrome in Australia: Prevalence using four definitions. *Diabetes Res Clin Pract*. 2007;77(3):471–8.
43. Vidigal FDC, Bressan J, Babio N, Salas-salvadó J. Prevalence of metabolic syndrome in Brazilian adults: a systematic review. 2013;
44. Kaduka LU, Kombe Y, Kenya E, Kuria E, Bore JK, Bukania ZN, et al. Prevalence of Metabolic Syndrome among an Urban Population in Kenya. *Diabetes Care*. 2012;35(4):887–93.
45. Gundogan K, Bayram F, Gedik V, Kaya A, Karaman A, Demir O, et al. Metabolic syndrome prevalence according to ATP III and IDF criteria and related factors in Turkish adults. *Arch Med Sci*. 2013;9(2):243–53.
46. Adeyemi YA, Onabanjo OO, Sanni SA, Ugbaja RN, Afolabi DO, Oladoyinbo CA. Prevalence of metabolic syndrome among apparently healthy adults in Ogun state , Nigeria. 2017;
47. Owolabi EO, Ter Goon D, Adeniyi OV, Adedokun AO, Seekoe E. Prevalence and Correlates of Metabolic Syndrome Among Adults Attending Healthcare Facilities in Eastern Cape, South Africa. *Open Public Health J*. 2017;10(1):148–59.
48. Zhao Y, Yan H, Yang R, Li Q, Dang S, Wang Y. Prevalence and determinants of metabolic syndrome among adults in a rural area of northwest China. *PLoS One*. 2014;9(3).
49. De Carvalho Vidigal F, Ribeiro AQ, Babio N, Salas-Salvadó J, Bressan J. Prevalence of metabolic syndrome and pre-metabolic syndrome in health professionals: LATINMETS Brazil study. *Diabetol Metab Syndr*. 2015;7(1):1–9.
50. Kaur J. Assessment and Screening of the Risk Factors in Metabolic Syndrome. *Med Sci*. 2014;2(3):140–52.
51. Salminen A, Ojala J, Kaarniranta K, Kauppinen A. Mitochondrial dysfunction and oxidative stress activate inflammasomes: Impact on the aging process and age-related diseases. *Cellular and Molecular Life Sciences*. 2012.
52. Laakso M, Kuusisto J. Insulin resistance and hyperglycaemia in cardiovascular disease development. *Nat Rev Endocrinol [Internet]*. 2014;10(5):293–302. Available from: <http://dx.doi.org/10.1038/nrendo.2014.29>
53. Wagner A, Dallongeville J, Haas B, Ruidavets JB, Amouyel P, Ferrières J, et al. Sedentary behaviour, physical activity and dietary patterns are independently associated with the metabolic syndrome. *Diabetes Metab [Internet]*. 2012;38(5):428–35. Available from: <http://dx.doi.org/10.1016/j.diabet.2012.04.005>
54. González-Muniesa P, Martínez-González MA, Hu FB, Després JP, Matsuzawa Y, Loos RJJ, et al. Obesity. *Nat Rev Dis Prim*. 2017;3.

55. Adamczak M, Wiecek A. The Adipose Tissue as an Endocrine Organ. *Semin Nephrol* [Internet]. 2013;33(1):2–13. Available from: <http://dx.doi.org/10.1016/j.semnephrol.2012.12.008>
56. Bosho DD, Dube L, Mega TA, Adare DA, Tesfaye MG, Eshetie TC. Prevalence and predictors of metabolic syndrome among people living with human immunodeficiency virus (PLWHIV). *Diabetol Metab Syndr* [Internet]. 2018;10(1):1–9. Available from: <https://doi.org/10.1186/s13098-018-0312-y>
57. Tesfaye DY, Kinde S, Medhin G, Megerssa YC, Tadewos A, Tadesse E, et al. Burden of metabolic syndrome among HIV-infected patients in Southern Ethiopia. *Diabetes Metab Syndr Clin Res Rev* [Internet]. 2014;8(2):102–7. Available from: <http://dx.doi.org/10.1016/j.dsx.2014.04.008>
58. Folchetti LD, Monfort-Pires M, De Barros CR, Martini LA, Ferreira SRG. Association of fruits and vegetables consumption and related-vitamins with inflammatory and oxidative stress markers in prediabetic individuals. *Diabetol Metab Syndr*. 2014;6(1):1–8.
59. Salas R, Bibiloni MDM, Ramos E, Villarreal JZ, Pons A, Tur JA, et al. Metabolic syndrome prevalence among Northern Mexican adult population. *PLoS One*. 2014;9(8).
60. Review AS, Banik SD. Prevalence of Metabolic Syndrome in Mexico: 2018;XX(Xx):1–11.
61. Mabry RM, Reeves MM, Eakin EG, Owen N. Short Report Gender differences in prevalence of the metabolic syndrome in Gulf Cooperation Council Countries: a systematic review. 2010;593–7.
62. Ntandou G, Delisle H, Agueh V, Fayomi B. Abdominal obesity explains the positive rural-urban gradient in the prevalence of the metabolic syndrome in Benin , West Africa. *Nutr Res* [Internet]. 2009;29(3):180–9. Available from: <http://dx.doi.org/10.1016/j.nutres.2009.02.001>

Figures

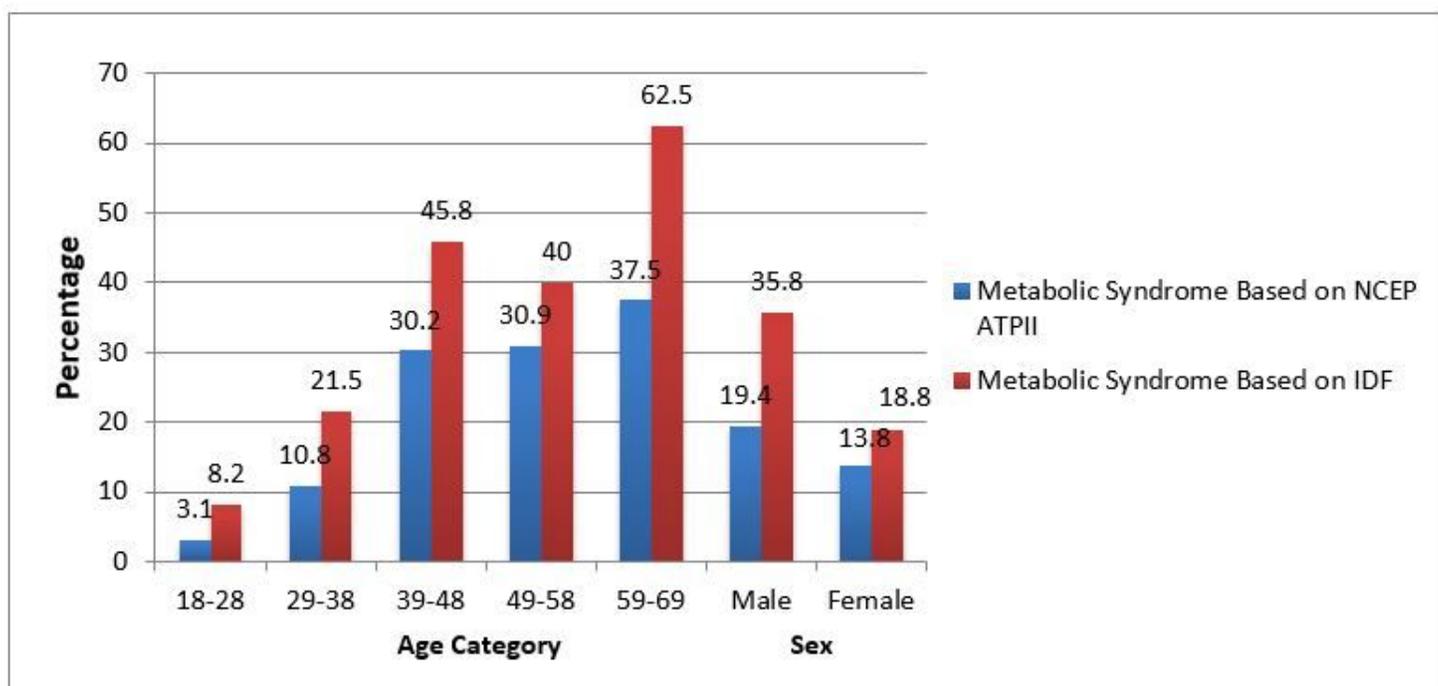


Figure 1

Proportions of Metabolic Syndrome Based on NCEP ATP III and IDF criteria stratified by Age Group and Sex of Participants EPHI, Addis Ababa, Ethiopia, 2018.

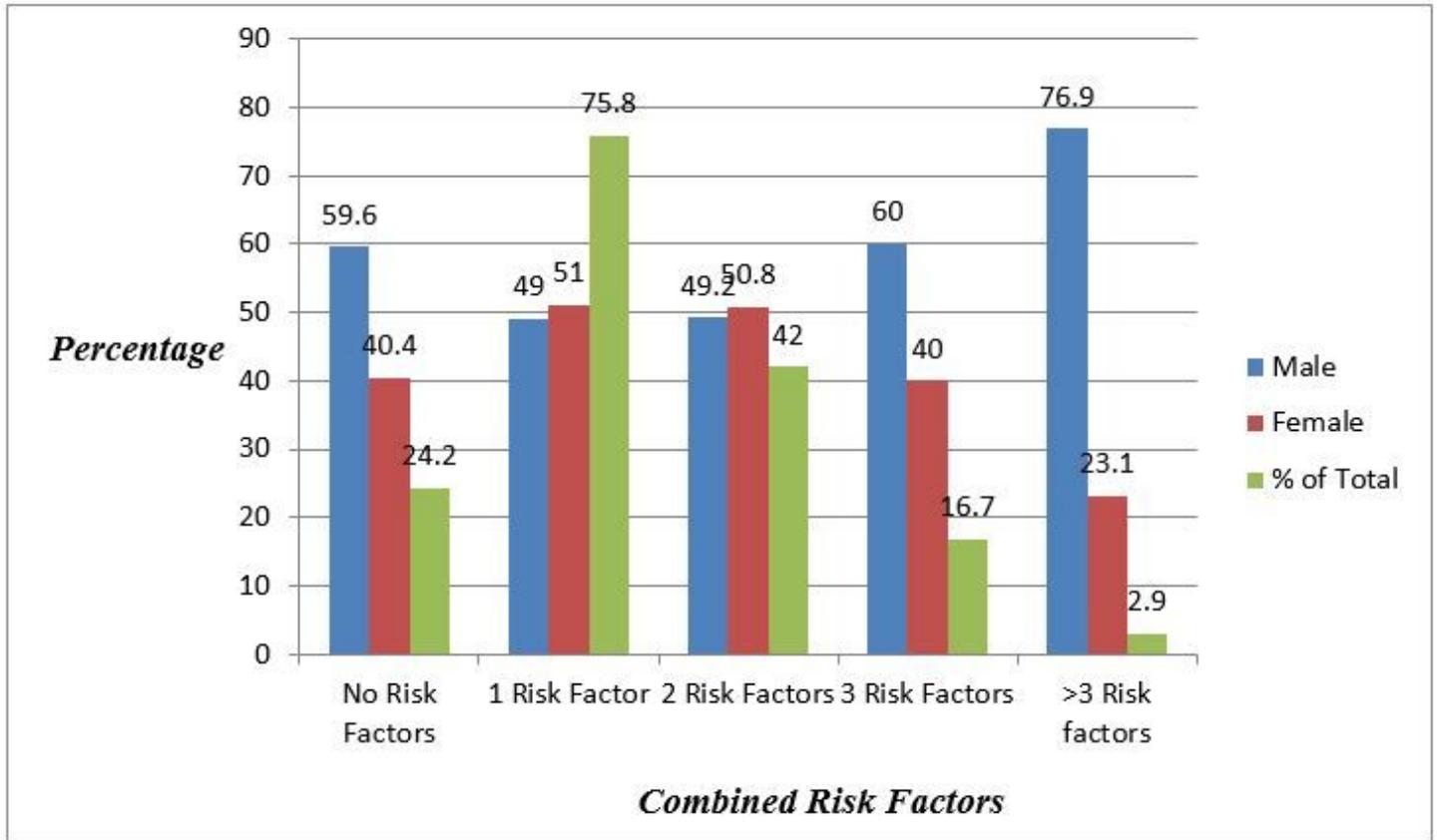


Figure 2

Summary of combined risk factors by sex of study participant based on ATP III definition, EPHI, Addis Ababa, Ethiopia, 2018 (n=450)

Supplementary Files

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