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Metabolic Syndrome and its Associated Factors among adult Patients Attending Outpatients Clinics at Wolaita Sodo University Comprehensive Specialized Hospital, Ethiopia

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Abstract

Background: Metabolic syndrome is a group of medical and biological abnormalities that lead to a high risk of type 2 diabetes, cardiovascular disease, and liver infections. It is a grouping of many clinical features, including central obesity, high blood pressure, high concentrations of fasting glucose and triglycerides, low level of high-density lipoprotein cholesterol, and insulin resistance. However, there is an information gap in the less developed countries, including Ethiopia, for patients and clinicians. Hence, this study aimed to assess metabolic syndrome and its associated factors among adult patients attending outpatients' clinics at Wolaita Sodo Comprehensive Specialized hospital.

Method: Institutional based cross-sectional study was carried out from November 02, 2020 to January 30, 2021. A randomly selected 327 adults attending outpatient clinics at Wolaita Sodo Comprehensive Specialized Hospital were included in the study. Pre-tested questionnaire were used to gather data on socio-demographic, anthropometric measurement, and biochemical parameters. Variables with P-value <0.25 in the bivariate logistic were taken into multivariable logistic regression analysis along with 95% confidence interval and Odds Ratio was used to examine the association between Metabolic syndrome and independent variables. P -value< 0.05 was taken as statistically significant.

Result: The overall prevalence of metabolic syndrome in this study was 52.6% with 95%CI (42.5%-65.1%). Factors associated with Metabolic Syndrome among adult patients were female 65.1% as compared to men, 42.5% (AOR= 5.13, 95%CI=1.75-14.98), older age groups of 43-59 and 60-88 (AOR=4.53, 95%CI=1.77-11.62) and (AOR=8.62, 95% CI=2.36-31.59) respectively. The occurrence of metabolic syndrome increased 7.80 fold in overweight and 12.8 fold in obese individuals (AOR=7.80, 95%=6.29-9.67) and (AOR= 12.82, 95%CI=4.96-33.14) respectively. The lack of regular exercise (AOR=2.57, 95%CI=1.44-4.59), smoking cigarettes (AOR=2.09, 95%CI=1.30-3.36) and alcohol drinking (AOR=3.34, 95%CI= 1.83-6.12) were significantly associated with increased the risk of metabolic syndrome.

Conclusion: More than half of adult patients have metabolic syndrome. The prevalence of metabolic syndrome in women is higher than in men and increases with age. Periodic screening and regular physical activity should be recommended.

Keywords: Metabolic syndrome; Outpatients; Obesity

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Introduction

Metabolic syndrome (MS) is a grouping of medical and biological abnormalities that are risk factors for the occurrence of type 2 diabetes (T2DM), cardiovascular disease (CVD) and liver diseases. The components that are included in MS are central obesity, high blood pressure, increased fasting glucose and triglycerides, low level of high-density lipoprotein cholesterol (HDL-C), and insulin resistance [1].

Hyperglycemia plays a key role in the pathogenesis of retinal micro vascular injury. Several metabolic pathways have been

implicated in hyperglycemia-induced vascular injury including the polyol pathway, advanced glycation end-products accumulation, the protein kinase C pathway, and the hexamine pathway [2].

Hypertriglyceridemia triggers the release of free fatty acids, production of proinflammatory cytokines, fibrinogen, coagulation factors, and impairment of fibrinolysis which in turn may also stimulate atherogenesis. Hypertriglyceridemia frequently also leads to a decreased level of HDL cholesterol and an increase in atherogenic small dense LDL cholesterol level. Hypertriglyceridemia factor for cardiovascular disease and inflammation of pancreatis [3].

Insulin resistance is generally associated with obesity that is a pathophysiologic feature of type 2 diabetes mellitus (T2DM). An extreme adipose tissue development due to an increased intake of nutrients and insufficient energetic expenditure is regarded as Obesity. On the other hand, diabetes mellitus is a complex chronic illness marked by increased level of blood glucose, resulting from insufficiency secretion of insulin, action, or both. Obesity could cause chronic low-grade systemic and local inflammation that directs to insulin resistance associated to diabetes mellitus In addition, insulin resistance, and hyperinsulinemia can result to the development of obesity [4].

During the progression of alcoholic liver disease, alcohol reduces the insulin signaling pathway in the liver and leads to disorders of glucose and lipid metabolism [5]. Cigarette Smoking is a significant modifiable risk factor for the progress of cardiovascular diseases such as coronary artery disease, stable angina, acute coronary syndromes, sudden death, stroke, peripheral vascular disease, congestive heart failure, erectile dysfunction, and aortic aneurysms via initiation and the development of atherosclerosis. Cigarette smoking stimulates oxidative stress, vascular inflammation, platelet coagulation, vascular dysfunction, and impairs serum lipid pro-file [6]. The worldwide burden of disease study indicated that metabolic risk factors are the most important causes of the emerging problems of Non-communicable diseases (NCDs) at the international level. Metabolic syndrome is one of the most widespread metabolic disorders, which leads to numerous NCDs such as cardiovascular diseases, diabetes mellitus, some cancers, and renal disease [7].

The three most popular definitions of MS used for surveys and health care plans are World Health Organization (WHO), NCEP (National Cholesterol Education Program) ATP III, and IDF (International Diabetes Federation) [8].

World Health Organization criteria are incidence of diabetes mellitus, impaired glucose tolerance or insulin resistance, plus two or more of the following mechanism: body mass index (BMI) > 30 kg/m2 or waist-to-hip ratio(WHR> 0.90 for male and WHR > 0.85 for female), systolic blood pressure ≥140mmHg, diastolic blood pressure ≥90mmHg or on hypertension medication, triglyceride ≥ 150 mg/dl and HDL-cholesterol < 35 mg/dl in men, and < 40 mg/dl in women [9].

NCEP (National Cholesterol Education Program) ATP III criteria are the presence of any three or more of the following: Blood glucose ≥100 mg/dl or on drug treatment, HDL-cholesterol < 40 mg/dl in men, <50 mg/dl in women or on drug treatment, blood triglycerides ≥ 150 mg/dl or on drug medication for elevated triglycerides, Waist circumference ≥102 cm (men) or ≥88 cm (women) and systolic blood pressure ≥ 130, diastolic blood pressure ≥85 mmHg or drug treatment for hypertension [10].

According to IDF criteria, three or more criteria are included: waist circumference ≥ 94 cm (men) or ≥ 80 cm (women), Blood glucose ≥ 100 mg/dl, HDL-cholesterol < 40 mg/dl in men, < 50 mg/dl in women or drug treatment for low HDL-cholesterol, triglycerides ≥ 150 mg/dl or drug treatment for elevated triglycerides and systolic blood pressure ≥130, diastolic blood pressure ≥85 mmHg or drug treatment for hypertension [11].

In low and middle-income countries, the occurrence of diabetes has been gradually increased for the past 30 years. In 2017, it was estimated that there were 451 million diabetic patients and estimated 5 million deaths globally reported. In the Middle Eastern and North African parts, 39.9 million adults aged 18–99 years old were living with Diabetic Mellitus in 2017 [12].

According to 2016 World Health Organization report, more than 2 billion adults were overweight, of whom 600 million were obese and 347 million had type II diabetes mellitus. The number of people with hypertension had increased from 600 million in 1980 to 1 billion in 2010 [13].

Because of changes in lifestyle, non-communicable diseases are the main causes of diseases occurrences and death in Africa. According to a 2017 report in African countries, the prevalence of diabetes and hypertension was 3.3% and 55.2% respectively. The overweight and obesity were estimated to cause 3.4 million deaths in this year's report. Non-communicable diseases have become nearly universal in African countries [14].

Obesity, increased blood glucose, elevated blood pressure, and abnormal lipid profiles are parameters used to assess metabolic disorders that cause the development of cardiovascular diseases, type 2 diabetic Mellitus, cancers (colorectal, liver, and pancreas), and blindness. Therefore, this study will try filling the gap in the scarcity of data on metabolic syndrome and its associated factors in study area. So, this study would clearly show the prevalence and related factors of metabolic syndrome in outpatient clinics of Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia

The Study will provide direction for setting new goals in developing a preventive strategy for the disease and it also assists to minimize the deaths arise from MS complications. This would help the clinicians to provide the best possible care for patients. It also provides policymakers to have evidence for their action towards metabolic syndrome management. Additionally, this study also provides information for other researchers who are interested to carry out a study on the prevalence of those complications.

Methods and materials

Study area

The study was carried out at Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH), which is found in Wolaita Zone administration, 134km from Hawassa, capital of Southern nations, nationalities and peoples region (SNNPR), and

329km from Addis Ababa, capital of Ethiopia. The hospital gives general patient services, teaching and research activities. Patient services include both inpatient and outpatient services such as medical, surgical, pediatric, psychiatric, Ophthalmic, Emergency, oncology, dialysis, Gynecology and Obstetrics care. Inpatient ward, the hospital has a total of 370 in four major departments such as medical, gynecology/obstructive, surgical ward, and pediatric. Over 90,000 people visit outpatient department per year [15].

Study design and study period

A Hospital based cross-sectional study was conducted among adult outpatients' clinics from November 02, 2020 to January 30, 2021, at WSUCSH, Southern Ethiopia

Population

All adult patients attending outpatient at Wolaita Sodo University Comprehensive specialized hospital clinics were source population. Randomly selected adult patients who fulfill inclusion criteria during were study population.

Eligibility criteria

Adult patients (≥18 years) attending outpatient departments of Wolaita Sodo University Comprehensive Specialized Hospital after overnight fasting and willing to participate in the study. Those with Known diabetes patients, hypertensive patients, under the age of 18, pregnant mothers and patients who were admitted in the hospital were excluded from study.

Sample size calculation

Single proportion sample size determination formula was used to determine the sample size of the study. By considering the prevalence of metabolic syndrome from the study done on outpatients of Jimma University Teaching Hospital, which is 26.2% [16]. We used 5% margin of error, 95% confidence interval and 10% non-response.

So that, the sample size was determined as:

$n = (z(1-\alpha/2))2 \times P (1-P)$

d2 where: n= stands for minimum sample size, p= stands for proportion, z =stands for level of confidence, d= stands for margin of error.

$n = (1.96)2 \times 0.262 (1-0.262) = 297 \times 10\% = 297+29.7 = 327$

$(0.05)2$

Sampling technique

The total number of patients who visit adult Outpatient department per day is an average of 300. Of which average of 240 patients are requested to laboratory per day (Registration book of WSUCSH). Among requested patients, medical, gynaecology (excluding pregnant women), and surgical OPD constitute 160, 50, and 30 respectively. The 327 study participants were randomly selected from the total number of patients who visited adult outpatient and distributed to different outpatient categories by quota sampling as follows.

Medical OPD = 160/240*100=66.7%, 66.7%*327= 218

Gynaecological OPD=50/240*100= 20.8%, 20.8%*327= 68

Surgical OPD= 30/240*100= 12.5%, 12.5%*327= 41

Operational definitions

Metabolic syndrome: As criteria of ATP III central obesity (waist circumference ≥102 cm for male and ≥88 cm for female) plus the following four factors: elevated triglycerides (≥150mg/dl) reduced HDL cholesterol (< 40mg/dl for men and< 50mg/dl for women), elevated blood pressure (≥130/85mg/dl), and high fasting plasma glucose (≥100mg/dl) [16].

Outpatient department/clinic: is the part of a hospital designed for the treatment of outpatients who are not hospitalized

Alcohol consumption: Refers to the act of ingesting orally a beverage containing ethanol.

Smoking status: The categories of the current smoker, a former smoker and never smoked.

Physical exercise: Is the performance of an activity to maintain physical fitness and overall health.

Anthropometric measurement

Waist circumference measurement: Study participant's waist circumference was measured at the level of the iliac processes and the umbilicus with a tape measure to assess abdominal obesity [17].

Blood pressure measurement: Mercury-based sphygmomanometer was used to measure systolic blood pressure (SBP) and diastolic blood pressure (DBP) after the participants had rested for more than 10 minutes. For those study participants with an SBP ≥ 140 mm of mercury (mmHg) and a DBP ≥ of 90 mmHg, blood pressure was repeated and finally, the average value was taken [18].

Height measurement: Height was measurement was taken using a height measure scale (Infiniti Med Lab Pvt. Ltd., India). Participants stand erect on the floorboard of the stadiometer with their back to the vertical backboard of the stadiometer. The heels of the feet were placed together with touching the base of the vertical board. Feet were pointed slightly outward at a 60-degree angle. The buttocks, scapulae, and head are positioned in contact with the vertical backboard. During the height measurement, the participant's shoes and hats were taken off and the measurement was recorded to the nearest 0.1 cm [19].

Weight measurement: First the weight scale (Infiniti Med Lab Pvt. Ltd., India) was turn to zero then participants were asked to remove extra layers of clothing, shoes, jewelry, and any items in their pockets. Then, asked to step on the scale backward (for confidentiality) then bodyweight was evenly distributed between both feet, arms hang freely by the sides of the body, palms toward thighs, the head is up and facing straight ahead then the weight is recorded to nearest0.1 kg (100 gm).

BMI was calculated by using body weight by kilo gram divided by height in meter squared. According to the World Health Organization (WHO) classification of BMI, there are four categories: underweight (BMI 15 to 19.9), normal weight (BMI

20 to 24.9), overweight (BMI 25 to 29.9), and obese (BMI 30 to≥ 35) [20].

Variable of Study

Dependent variable is metabolic syndrome (MS)

Independent variables are Age, sex, cigarette smoking, alcohol drinking, physical exercise, anthropometrics and biochemical measurements

Data collection procedure

Socio-demographic data: age, sex, religion, marital status, education level, occupation, habits of smoking, alcohol drinking, and physical exercise was collected using a structured questionnaire through the interview by trained clinical nurses under the supervision of the principal investigator.

Anthropometric measurement

Waist circumference measurement: Study participant's waist circumference was measured at the level of the iliac processes and the umbilicus with a tape measure to assess abdominal obesity [17].

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Blood sample collection and laboratory investigation

After obtaining consent from the study participants, venous blood was collected from the area of anticubital vein by antiseptic 70% alcohol and applying a tourniquet. About 5 ml of blood was withdrawn aseptically from the anticubital vein from fasting individuals using a serum separator tube. Following collection, specimens were transported to the clinical chemistry unit of the WSUCSH laboratory for analysis. The collected blood sample was left for 30 minutes at room temperature for clotting. Then the clotted blood samples were centrifuged for 5 minutes at 4000 revolutions per minute (rpm) to separate serum from formed elements. All these procedures were done by the principal investigator. The extracted serum was kept in Nunc tube under -20oc deep freeze until laboratory analysis. These frozen sera were later analyzed for the biochemical parameters. TG, HDL-C, and FBS were measured in serum by using BS-200 Mindray clinical chemistry analyzer (Shenzhen, China) by the direct endpoint enzymatic method. During each testing procedure, a standardized operating procedure was followed and all safety measures were ensured. Finally, at the end of the procedure, the wastes were discarded according to the standard procedure.

Data quality assurance and management

The questionnaire was developed by the researchers based on findings from other similar studies. It was prepared in English first then translated into the appropriate and understandable local language (Amharic). Data collectors were oriented about interview techniques and data collection tools. Close supervision was made by the investigators during data collection and laboratory analysing time. Before starting the biochemical analysis, the expiration date of the reagent was checked. Both normal and pathological control sample was used to check accuracy. The study participant's sample was analyzed after the controls sample results were in normal range. All procedures and steps were followed based on the manufacturer's instructions. Every day, the completeness and consistency of questionnaires were checked by the principal investigators daily basis. After checking the completeness, accuracy, and clarity of the data collected, the principal investigator analyzed the data using the data analysis procedure.

Data management and Statistical analysis

The data was entered into Epi Data version 3.1 and then exported to SPSS version 25 software and analysis was done. Descriptive statistics such as frequencies and percentages were computed. Bivariate analysis was conducted to check for an association of each independent variable with the dependent variable. The variables that have an association with the dependent variable at p-value 0.25 were entered into a multivariable logistic regression to control for the possible effect of cofounding. The variables that showed significant association with a p-value less than 0.05 in the multi-variable logistic regression were considered as significant factors. The odds ratio at 95% CI was used to measure the strength of association. The final model was then tested for its goodness of fit by Homers and Lemeshow's. The result was presented by tables and figures.

Ethical Consideration

Data collection was conducted after approval of the ethical clearance by the institutional review board (IRB) of Jimma

University, Institute of Health Sciences with letter protocol number IHRPG/567/2018. Support letter was submitted to the Chief Clinical Director of the Wolaita Sodo University Comprehensive Specialized Hospital to get permission. After getting all permission from all responsible bodies, the data collector informed the patients by reading the information sheet which was translated to patients' language about the objectives of the study. Confidentiality was kept by using medical record numbers instead of names. Finally, the patient's laboratory result was printed and communicated to physicians for appropriate intervention and awareness creation on risks of metabolic syndrome to study participants.

Results

Socio-demographic characteristics of study participants

A total of 327 (181males and 146 females) study participants were participated in this study. The mean age (standard deviation) of the participants was 43.35 years and 38.2% were in the age range of 43-59 years. A quarter of the study participants, 82 (23.2%) were attended primary school and 79 (29.3%) up to college level. Regarding to monthly income, 91 (27.8%) earned above or equal to 1501birr, and 154 (47.1%) earned (601-1500) ETB birr in a month. Based their residence, 206 (63.0%) and 121(37.0%) of the participants were dwelled in rural and urban respectively. About 270 (82.6%) of respondents were married. The majority of the study participants were the government employed 68(20.8%) and housewives 81(24.8%) (**Table 1**).

Behavioural, clinical, and biochemical characteristics of study participants

From the total study participants, 47(14.4%) were smoking tobacco products at the time of the study, while 280(85.6%) were non-smokers. From the study participants, 144(44.0%) consumed alcohol at the time of the study. Regarding physical activity 137(49.1%) study participants do regular exercise among them, 84(46.4%) were males and 53(36.3%) were females. About 122(37.3%) and 176(53.8%) of respondents had a history of hypertension and Diabetic Mellitus respectively. Among the study participants, 172(52.6%) were found to be obese based on their BMI (30 ≥ kg/m2) and 101(30.9%) were found to be overweight with BMI (25-29.9) kg/m2. Among the all-study participants about 150(45.9%) had raised blood pressure and 169(51.7%) had elevated fasting glucose. About 151(46.2%) study subjects had low HDL (< 40mmHg for males and < 50 mmHg for females) of whom 83(56.8%) were females. An increased level of fasting triglyceride was found among female study participants 70(47.9%) (TG≥150mg/dl). About 166(50.8%) of the respondents had raised abdominal obesity which was defined by waist circumference ≥102cm for males and 88 cm for females based on the ATP III criteria (**Table 2**).

Table 1. Socio-demographic characteristics of the patients attending outpatient department from November 02, 2020, to January 30, 2021, at WSUCSH, Ethiopia (n=327).

Variables(n=327)		Men (181)		Women (146)		Total
		Frequency	Percentage	Frequency	Percentage	
Age category (years)	18-29	31	17.10%	30	20.50%	61(18.7%)
	30-42	50	27.60%	34	23.30%	84(25.7%)
	43-59	65	35.90%	60	41.10%	125(38.2%)
	60-88	35	19.30%	22	15.10%	57(17.4%)
Place of residence	Rural	107	59.10%	99	67.80%	206(63.0%)
	Urban	74	40.90%	47	32.20%	121(37.0%)
Marital status	Single	26	14.40%	18	12.30%	44(13.5%)
	Married	150	82.90%	120	82.20%	270(82.6%)
	Divorced	5	2.80%	3	2.10%	8(2.4%)
	Widow	0.00%	0.00%	5	3.40%	5(1.5%)
Occupation	Unemployed	44	24.30%	25	17.10%	69(21.1%)
	Gov't employed	43	23.80%	25	17.10%	68(20.8%)
	Merchant	36	19.90%	9	6.20%	45(13.8%)
	Farmer	58	32.00%	6	4.10%	64(19.6%)
	Housewife	-	-	81	55.50%	81(24.8%)
Educational status	Unable to write or read	18	9.90%	31	21.20%	49(15.0%)
	Primary	38	21.00%	38	26.00%	76(23.2%)
	Secondary	24	13.30%	16	11.00%	40(12.2%)
	High school	44	24.30%	22	15.10%	66(20.2%)
	College or University	57	31.50%	39	26.70%	96(29.4%)
Monthly Income	≤ 600	36	19.90%	46	31.50%	82(25.1%)
	601-1500	85	47.00%	69	47.30%	154(47.1%)
	≥ 1501	60	33.10%	31	21.20%	91(27.8%)

Table 2. Clinical features, biochemical values, and physical characteristics of study participants from November 02, 2020 to January 30, 2021 at WSUCSH, Ethiopia (n=327).

Clinical and biochemical characteristics		Men (181)		Women (146)		Total
		Frequency	Percentage	Frequency	Percentage	
Smoking	Yes	25	13.80%	22	15.10%	47(14.4%)
	No	156	86.20%	124	84.90%	280(85.6%)
Alcohol consumption	Yes	71	39.20%	73	50.00%	144(44.0%)
	No	110	60.80%	73	50.00%	183(56.0%)
Physical exercise	Yes	84	46.40%	53	36.30%	137(41.9%)
	No	97	53.60%	93	63.70%	190(58.1%)
Known HTN or treatment	Yes	59	32.60%	63	43.20%	122(37.3%)
	No	122	67.40%	83	56.80%	205(62.7%)
Known DM or on treatment	Yes	98	54.10%	78	53.40%	176(53.8%)
	No	83	45.90%	68	46.60%	151(46.2%)
Body mass index(kg/m2)	Normal weight	13	7.20%	23	15.80%	36(11.0%)
	Underweight	9	5.00%	9	6.20%	18(5.5%)
	Overweight	61	33.70%	40	27.40%	101(30.9%)
	Obese	98	54.10%	74	50.70%	172(52.6%)
Systolic blood pressure(mmHg)	SBP≥ 130	79	43.60%	71	48.60%	150(45.9%)
	SBP <130	102	56.40%	75	51.40%	177(54.1%)
Diastolic blood pressure(mmHg)	DBP ≥ 85	53	29.30%	54	37.00%	107(32.7%)
	DBP < 85	128	70.70%	92	63.00%	220(67.3%)
Waist circumference(cm)	Central obesity	77	42.50%	89	61.00%	166(50.8%)
	Normal	104	57.50%	57	39.00%	161(49.2%)
Fasting blood sugar(mg/dl)	FBS> 100	82	45.30%	87	59.60%	169(51.7%)
	FBS <100	99	54.70%	59	40.40%	158(48.3%)
HDL-cholesterol(mg/dl)	High	113	62.40%	63	43.20%	176(53.8%)
	Low	68	37.60%	83	56.80%	151(46.2%)
Triglycerides(mg/dl)	TG≥ 150	76	42.00%	70	47.90%	146(44.6%)
	TG < 150	105	58.00%	76	52.10%	181(55.4%)

Prevalence of metabolic syndrome and its components of study participants

The prevalence of metabolic syndrome was calculated based on modified NCEP-ATP III criteria. According to this criterion, overall prevalence of it was 52.6%, women had a high rate of metabolic syndrome, 65.1% as compared to men, and 42.5%. Its prevalence increased markedly with age but it is more increased in women (**Figure 1**). The prevalence of metabolic syndrome was higher among the older age group of 43-59 and 60-88 with 60.0% and 71.9% respectively (**Figure 2**). Among the components of metabolic syndrome, the most observed component was hypertension (83.3%), central obesity (77.7%) and hyperglycaemia (72.2%), decreased HDL-cholesterol (71.5%), and hypertriglyceridemia (67.8%). Higher prevalence of central obesity and decreased HDL-c were reported among women than men. Among women, central obesity (61.0%) was more prevalent followed by hyperglycemia (59.6%) and reduced HDL-c (56.8%), whereas the most frequent reported components among men was high body mass index (54.1%) followed by hyperglycemia (45.3%) and hypertension (43.6%) respectively. Elevated blood pressure was higher in women (48.6%) than men (43.6%) (**Table 3**).

Factors Associated with Metabolic Syndrome among Adult Patients attending outpatient clinics at WSUCSH

Candidate variables were sex, age, marital status, educational status, occupation, residence, monthly income, alcohol consumption, smoking, physical exercise, and body mass index were a candidate for multivariable analysis (p <0.25). However, from these variable sex, age, residence, alcohol consumption, smoking, physical exercise, and body mass index were significantly associated with metabolic syndrome (p<0.05).

Metabolic syndrome was more than 5.13 times likely to occur in women than in men (AOR= 5.13, 95%CI=1.75-14.98). The age group of 43-59 and 60-88 increased the risk of metabolic syndrome more than four and eightfold (AOR=4.53, 95%CI=1.77-11.62) and (AOR=8.62, 95%CI=2.36-31.59) respectively. Multivariate analysis indicated being urban was negatively associated with the development of metabolic syndrome (AOR= 0.07, 95%CI= 0.02-0.21). The risk of metabolic syndrome increased 7.80-fold in overweight compared to normal weighing study participants and 12.8-fold in obese individuals (AOR=7.80, 95%=6.29-9.67) and (AOR= 12.82, 95%CI=4.96-33.14) respectively. The lack of regular exercise 2.5 times more likely to increase the risk of MS (AOR=2.57, 95%CI=1.44-4.59) (**Table 4**).

Discussion

The present study was conducted to assess the prevalence of metabolic syndrome and its associated factors. This study revealed a high burden of metabolic syndrome among adult patients attending outpatients' clinics at Wolaita Sodo University

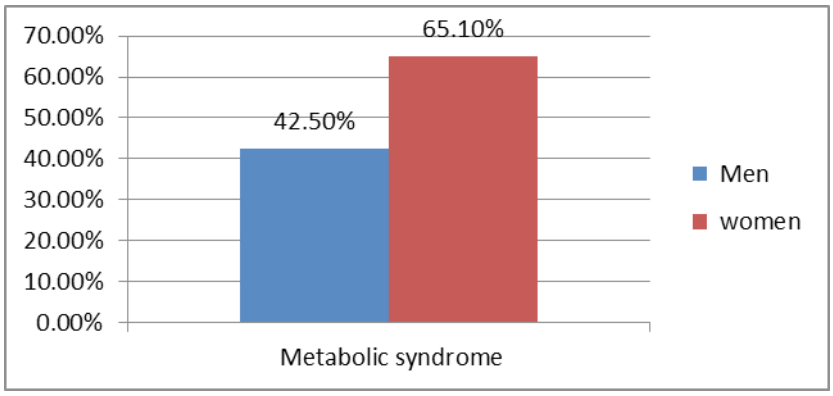

Figure 1 The Figure Shows The Prevalence of Ms In Relation To The Sex of Respondents.

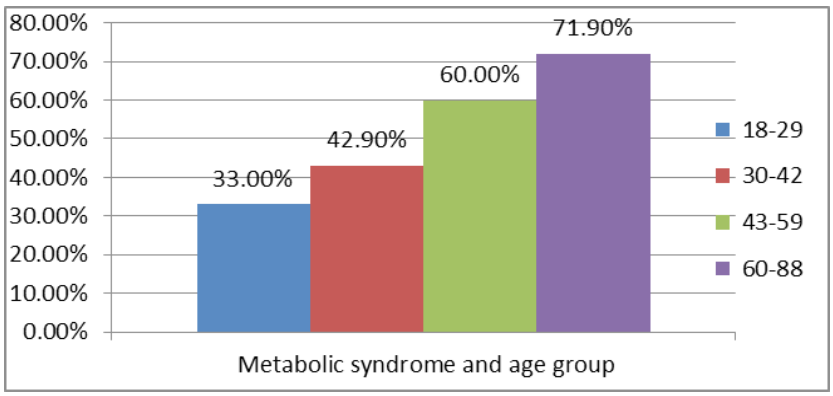

Figure 2 The graph shows the prevalence of MS in relation to the age of respondents.

Comprehensive Specialized Hospital. In the present study, overall prevalence of metabolic syndrome was 172 (52.6%). One important result revealed by the present study was the large and significant difference in the MS between women (65.1%) and men (42.5%). This study is similar to study conducted in Italy which showed that the prevalence of metabolic syndrome was higher in women compared to men. This is due to the main biological factors involved in the pathophysiology of MS, such as the insulin-resistance and the increase in abdominal fat [21]

This study is higher than a study conducted in Minas Gerais, Brazil (21.6%), Kancheepuram District (16.7%), Tunisia (30.0%) [24, 25, 30]. This variation is due to the difference in the study setting, sample size, and the criteria used to define metabolic syndrome.

The magnitude of MS in this study is lower than from the study done in Komfo Anokye (58.0%) [31]. the variation could be due to differences in the socio-cultural, study setting, and lifestyle.

Our study indicated the prevalence of MS was higher among old age groups. A similar study from Vietnam stated that the prevalence of metabolic syndrome increases as age increase and became maximum in the age group of 60-64[26]. The study from Brazil showed that the prevalence of MS was 3 times higher in elderly study participants. It was also 4 times higher among women and 2.2 times higher among men. Ervin stated that men and women aged 40–59 years were three times more likely to have MS compared with the age group of 20–39 years. In men aged 60 years, the prevalence of MS was 4 times higher, and in women of the same age, the prevalence was increased by 6 times [22]. Concerning the area of residence, the urban area was negatively associated with the development of MS in both men and women in according to our study. But the studies from Tunisia showed that rural inhabitant had higher diet quality and physical activity than their urban counterparts. Urbanization often is associated with increased income and adoption of an unhealthy lifestyle, such as bad food habits, with the transition from traditional rural diets (with a low glycemic index and a higher fiber content) to a diet rich in salt, saturated fats and poor-quality carbohydrates (such as provided by fast foods) Furthermore, increased psychological stress, which is inevitable with urbanization, may be related to the development of MS [23].

The variables such as marital status, occupation, educational status, and monthly income did not show a significant association with the increased metabolic syndrome after adjustment. This study showed that overweight/obesity, smoking cigarettes, alcohol consumption, and lack of regular exercise were significantly associated with the occurrence of metabolic syndrome. The lack of regular exercise significantly increased the risk of metabolic syndrome in our study.

Study showed that exercise is one of the most vital lifestyle changes for the prevention of many none communicable diseases and due to this reason, exercise is recognized as a

Table 3. Prevalence of metabolic syndrome and its components of study participants from November 02, 2020 to January 30, 2021, at WSUCSH, Ethiopia (n=327)

Variables(n=327)		Metabolic syndrome		
		Yes	No	P-value
Sex	Male	77(42.5%)	104(57.5%)	
	Female	95(65.1%)	51(34.9%)	0.000*
Age category (years)	18-29	20(32.8%)	41(67.2%)	
	30-42	36(42.9%)	48(57.1%)	0.220*
	43-59	75(60.0%)	50(40.0%)	0.001*
	60-88	41(71.9%)	16(28.1%)	0.000*
Residence	Urban	108(71.8%)	58(28.2%)	0
	Rural	24(19.8%)	97(80.2%)	
Marital status	Single	13(29.5%)	31(70.5%)	
	Married	149(55.2%)	121(44k.8%)	0.002*
	Divorced	6(75.0%)	2(25.0%)	0.025*
	Widow	4(80.0%)	1(20.0%)	0.053
Educational status	Unable to write or read	24(49.0%)	25(51.0%)	0.189
	Primary	28(36.8%)	48(63.2%)	0.007*
	Secondary	17(42.5%)	23(57.5%)	0.000*
	High school	38(57.6%)	28(42.4%)	0.030*
	College or university	65(67.7%)	31(32.3%)	
Occupation	Unemployed	34(49.3%)	35(50.7%)	
	Gov't employed	44(64.7%)	24(35.3%)	0.069
	Merchant	25(55.6%)	20(44.4%)	0.512
	Farmer	21(32.8%)	43(67.2%)	0.055*
	Housewife	48(59.3%)	33(40.7%)	0.222*
Monthly income in ETB birr	≤ 600	36(43.9%)	46(56.1%)	1
	601-1500	80(51.9%)	74(48.1%)	0.240*
	≥ 1501	56(61.5%)	35(38.5%)	0.021*
Smoking	Yes	41(87.2%)	6(12.8%)	0.000*
	No	131(46.8%)	149(53.2%)	
Alcohol consumption	Yes	94(65.3%)	50(34.7%)	0.000*
	No	78(42.6%)	105(57.4%)	
	Yes	100(73.0%)	37(27.0%)	
	No	72(37.9%)	118(62.1%)	0.000*
Known HTN or on treatment	Yes	99(81.1%)	23(18.9%)	0.000*
	No	73(35.6%)	132(64.4%)	
Known DM or on treatment	Yes	111(63.1%)	65(36.9%)	0.000*
	No	61(40.4%)	90(59.6%)	
Body mass index(kg/m2)	Normal weight	17(47.2%)	19(52.8%)	
	Under weight	13(72.2%)	5(27.8%)	0.087
	Over weight	22(21.8%)	79(78.2%)	0.005*
	Obese	120(69.8%)	54(30.2%)	0.011*
Systolic blood pressure(mmHg)	SBP≥ 130	125(83.3%)	25(16.7%)	0.000*
	SBP<130	47(26.6%)	130(73.4%)	
Diastolic blood pressure(mmHg)	DBP≥ 85	92(86.0%)	15(14.0%)	0.000*
	DBP< 85	80(36.4%)	140(63.6%)	
Waist circumference	Central obesity	129(77.7%)	37(22.3%)	0.000*
	Normal	43(26.7%)	118(73.3%)	
Fasting blood sugar(mg/dl)	FBS> 100	122(72.2%)	47(27.8%)	0.000*
	FBS< 100	50(31.6%)	108(68.4%)	
Low HDL (mg/dl)	High	64(36.4%)	112(63.6%)	0.000*
	Low	108(71.5%)	43(28.5%)	
Triglycerides	TG≥ 150	99(67.8%)	47(32.2%)	0.000*
	TG< 150	73(40.3%)	108(59.7%)	

Table 4. Multivariate logistic regression analysis of factors associated with metabolic syndrome among adult OPD patients from November 02, 2020 to January 30, 2021, at WSUCSH, SNNPR, Ethiopia (n=327).

Variables		Crude OR (95%CI)	P-value	AOR (95%CI)	P-value
Sex	Male	1*		1*	
	Female	0.397(0.253, 0.623)	0	5.13(1.75,14.98)	0.003*
Age category	18-29	1*		1*	
(Years)	30-42	0.650(0.327,1.293)	0.22	3.71(0.22,18,27)	0.07
	43-59	0.325(0.171,0.619)	0.001	4.53(1.77,11.62)	0.021*
	60-88	0.190(0.087,0.418)	0	8.62(2.36,31.59)	0.008*
Residence	Urban	10.31(6.009, 17.70)		0.07(0.03,0.21)	0.000*
	Rural	1*		1*	
Marital Status	Single	1*		1*	
	Married	0.341(0.171,0.679)	0.002	0.095(0.004,2.32)	0.149
	Divorced	0.140(0.025,0.786)	0.025	0.058(0.003,1.98)	0.078
	Widow	0.105(0.011,1.030)	0.053	0.007(0.00,0.35)	0.014
Educational status	Unable to write	1.545(0.807,2.957)	0.189	0.839(0.21,3.29)	0.801
	or read				
	Primary	2.837(1.328,6.060)	0.007	1.133(0.201,6.41)	0.887
	Secondary	3.594(1.909,6.767)	0	0.815(1.43,4.64)	0.817
	High school	2.184(1.079,4.419)	0.03	0.815(0.13,5.50)	0.826
	College or university	1*		1*	
Occupation	Unemployed	1*		1*	
	Gov't employed	0.530(0.267,1.052)	0.069	0.737(0.120,4.53	0.742
	Merchant	0.777(0.366,1.652)	0.512	2.197(0.36,13.56)	0.397
	Farmer	1.989(0.984,4.020)	0.055*	1.738(0.34,8.95)	0.509
	Housewife	0.668(0.350,1.276)	0.222*	0.852(0.18,3.98)	0.839
Monthly income in ETB birr	≤ 600	1*		1*	
	601-1500	0.724(0.422,1.241)	0.240*	1.029(0.26,4.13)	0.968
	≥ 1501	0.489(0.267,0.898)	0.021*	0.572(0.16,2.11)	0.402
Smoking	Yes	0.129(0.053,0.313)	0.000*	2.09(1.30, 3.36)	0.032*
	No	1*		1*	
Alcohol consumption	Yes	0.395(0.252,0.620)	0.000*	3.34(1.83,6.12)	0.004*
	No	1*		1*	
Physical exercise	Yes	1*		1*	
	No	4.429(2.747,7.141)	0.000*	2.57(1.44,4.59)	0.016*
Body mass index(kg/m2)	Normal weight	1*		1*	
	Under weight	0.344(0.101,1.167)	0.087	0.75(0.022,29.73)	0.063
	Over weight	3.213(1.433,7.201)	0.005*	7.80(6.29,9.67)	0.004*
	Obese	4.43(1.987, 9.915)	0.011*	12.82(4.96,33.14)	0.000*

medical treatment. There is evidence that regular exercise will reduce abdominal fat deposits. Reductions in abdominal fat deposits are important because it is a marker of dysfunctional adipose tissue [24]. Inactive daily physical activity in healthy young adults is associated with negative metabolic consequences such as decreased insulin sensitivity and increased abdominal fat [25]. The Chu and Moy found that participants who sat for nine hours and above per day had a 3.8-fold risk of having metabolic syndrome compared to those who sat six hours and less than per a day. Chee et al. found that those in the 'maintenance' stage of doing regular exercise were 17 times less likely to have metabolic syndrome compared to those who have not even planned exercising [26].

Our study revealed that smoking cigarettes independently associated with the development of the metabolic syndrome. It is a significant risk factor for common chronic diseases, such as cancer, lung disease, and CVD, and is a possible risk factor of MS. Cigarette Smoking is the main cause of morbidity and mortality in the young age group; it causes approximately 7.2 million deaths per year [27]. Nicotine is the major harmful component that is released from cigarette smoking. Nicotinic acetylcholine receptors are widely expressed in the central and peripheral nervous systems and it mediates a fast synaptic transmission of the neurotransmitter at the neuromuscular junction. This directly or indirectly increases the release of several important neurotransmitters and hormones [28]. The release of norepinephrine, dopamine, serotonin, and γ-amino butyric acid suppress eating, increase thermogenesis in adipose tissue (increase lipolysis and the subsequent recycling of fatty acids into triglycerides) [29].

Several earlier studies showed that cigarette smoking to be associated with a higher prevalence of MS. It was associated with critical changes in apoA1, apoB, and in the size of lipoprotein particles [30]. A meta-analysis of 13 prospective cohort studies, involving 56,691 participants from Europe, Asia, and North America reported that active smokers have a 26% increased risk of MS compared with non-smoking participants. Cigarette Smoking leads to an increase in triglyceride levels and a decreased in HDL cholesterol by increasing sympathetic activity. It causes higher level of fasting plasma cortisol concentrations and increasing visceral adipose tissue [31].

Among the more than 7,000 chemicals in cigarette smoke, many components help the pathophysiology of cardiovascular disease. Toxic chemicals such as carbon monoxide, polycyclic aromatic hydrocarbons, nicotine, and heavy metals have great damage on vascular endothelium, blood lipids, and clotting factors causing atherosclerosis. Atherosclerosis damages vessels carrying oxygenated blood to organs across various vascular beds. These effects cause adverse cardiovascular events such as myocardial infarction (heart attack), stroke (brain attack), and rupture of the aorta [32].

According to this study, alcohol consumption was independently associated with the development of the metabolic syndrome. It is part of an harmful lifestyle, contributes to many health problems. A large population-based study in the United States showed that mild-to-moderate alcohol consumption contributed to high level of lipids, waist circumference, and fasting insulin levels compared to non-drinkers. Increased alcohol consumption contributes to the development of hypertension and insulin resistance [33].

Alcoholic liver disease, a leading cause of morbidity, mortality, and cirrhosis, can range from simple steatosis to hepatocellular carcinoma. Alcohol abuse is fatal to in the people age group of 15-49 years through multiple mechanisms such as oxidative stress, mitochondrial dysfunction, and alteration in the gut-liver axis [34]. The cellular and molecular mechanisms of alcohol liver disease pathogenesis are still incompletely understood but seem to be related to a complex interaction between behavioral, environmental, and genetic factors. The histological hallmarks of alcoholic liver disease, steatosis, inflammation, and fibrosis are the result of interrelated and consecutive pathophysiological events in the context of continuous alcohol exposure [35].

The study from Brazil showed that an association between moderate or high alcohol consumption with HDL-cholesterol. Study participants who did not drink alcohol showed a higher percentage of low HDL-c (60.0%). Those who consumed,>210g per week of alcohol, the prevalence of hypertriglyceridemia was 47.8%, and in consumer groups with ≤210 g per week, the prevalence was 22.7% [22].

The risk of metabolic syndrome increased 7.80-fold in overweight and 12.8-fold in obese individuals. It can also be observed, in all age groups, a higher prevalence of MS in overweight and obese individuals. The prevalence of obesity and the MS is quickly increasing in developing countries, leading to higher morbidity and mortality. The magnitude of overweight and obesity seemed to be related to the nutrition transition in the last decades. In Brazil, between the periods 1974/75 to 2008/09, it has been observed a reduction of underweight people and an increase in the rate of overweight (18.6% to 50.1% in men and 28.6 to 48.0% in women) and obesity (2.8% to 12.8% in men and 7.8 to 16.9% in women). This is because of a sedentary lifestyle and nutrition [26].

Obesity leads to excessive ectopic fat infiltration of many organs such as the liver, heart, pancreas, skeletal muscles, and kidneys that can have severe metabolic and clinical implications. Excess fat accumulation leads to serious health problems, including metabolic syndrome, type 2 diabetes (T2DM), cardiovascular disease, and significantly associated with increased mortality [36].

Strength and limitation of the study

The study can express its strength in that it includes several demographic, clinical, and anthropometric parameters declared to be associated with the variables under study. It also gives baseline to further research on metabolic syndrome and associated factors. Despite the above-mentioned strengths, this study has several weaknesses. As the study was carried out among patients attending Outpatient clinics of WSUCSH, the findings this study cannot be generalized to the general population, and being a cross-sectional study, it cannot associate causal relationships between the factors under study.

Conclusion

At present study, more than half of the adults attending outpatient at WSUCSH were characterized having high metabolic syndrome. The prevalence of metabolic syndrome higher in women than compared to men and increased with age. Being female, older age, obesity, smoking, and drinking alcohol were significantly associated with metabolic syndrome. Metabolic syndrome is more prevalent in participants with increased body mass index and inactive individuals. This finding indicates the need for weight management and modifying of lifestyles.

Recommendation

As age increases metabolic syndrome increased. Therefore, the assessment should be followed for older age groups.

Modifying lifestyles like limiting consumption of alcohol, smoking a cigarette, and increasing the effort to physical activity will be important in preventing and controlling metabolic syndrome.

Weight management should be practiced to reduce overweight or obesity.

Periodic screening of the risk factors of metabolic syndrome at Hospital should be required.

The policymakers and researchers should aware of the designing and implementing of interventions for the prevention and control of the risk factors of metabolic syndrome.

The greater public awareness on prevalence and risk factors for metabolic syndrome and strengthening of health services to detect, prevent and treat early individuals with MS.

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