SALALE UNIVERSITY COLLEGE OF HEALTH SCIENCES DEPARTMENT OF PUBLIC HEALTH

DETERMINANTS OF METABOLIC SYNDROME IN TYPE TWO DIABETES PATIENTS AT METTU KARL COMPREHENSIVE SPECIALIZED HOSPITAL, OROMIA, ETHIOPIA; 2024

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RESEARCH THESIS SUBMITTED TO BE SALALE UNIVERSITY, COLLEGE OF HEALTH SCIENCE, AND DEPARTMENT OF PUBLIC HEALTH IN PARTIAL FULFILMENT OF REQUIREMENTS FOR MASTERS' DEGREE IN EPIDEMIOLOGY

JANUARY 2024

FICHE, ETHIOPIA

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ABSTRACT

Background: Metabolic syndrome (MetS) encompasses a range of metabolic issues, including hypertension, insulin resistance, visceral obesity, fatty liver, and atherogenic cardiovascular diseases. Lifestyle modification is the primary strategy for managing the progression of MetS, as untreated MetS significantly increases the risk of developing type 2 diabetes and cardiovascular diseases. Given its substantial contribution to global morbidity and mortality, it is crucial to investigate factors that can reduce the disease burden. This study aimed to identify determinants of metabolic syndrome in patients with type 2 diabetes at Mettu Karl Comprehensive Specialized Hospital.

Method: An institutional-based unmatched case-control study was conducted involving 482 systematically selected participants. Data were collected through a pre-tested, interviewer-administered questionnaire. Bivariate and multivariable logistic regression analyses were utilized to identify determinants of metabolic syndrome, using STAT version 17 for the analysis.

Results: The mean age (± standard deviations) for the cases and controls were53.41 ± 7.87% and 52.61± 7.24% in years, respectively. The determinants of metabolic syndrome were being male (AOR=0.112, 95% CI =0. 053-0.237), active physical exercise (AOR = 0.404; 95% CI =0.203-0.804), absence of musculoskeletal disorder (AOR=0.016, 95% CI =0.003- 0.079), presence of hypertension (AOR=4.207, 95% CI =1.858-9.525), and glycated haemoglobin>/=6.5 %(AOR=6.218, 95% CI =4.070-13.879)

Conclusions: The study identified several determinants of metabolic syndrome, including sex, physical activity, musculoskeletal disorders, and hypertension. Therefore, targeted educational and behavioral modification programs on regular exercise should be routinely practiced. Additionally, early guideline-based screening and treatment of comorbidities and complications would be required to effectively manage diabetes mellitus

ACKNOWLEDGEMENT

I would like to express my gratitude to Salale University, College of Health Sciences, and Department of Public Health for allowing them to develop this thesis paper

My advisors, Kassahun Ketema and Addisu Waleligne, for their guidance and support throughout the thesis preparation process.

Lastly, Mattu Karl Comprehensive Specialized Hospital, respondents, data collectors, and supervisors for their contributions to the study.

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ABBREVIATIONS

BMI-Body Mass Index

BP: Blood Pressure

CI- Confidence Interval

CM-Centimeter

CVD-Cardiovascular Disease

DBP-Diastolic Blood Pressure

DM-Diabetic Mellitus

HDL-High Density Lipoprotein

Kg/m^2 – Kilogram per Meter Square

LWC-Large Waist Circumference

MetS-Metabolic Syndrome

MKCSH-Mettu Karl Comprehensive Specialized Hospital

ML-Milliliter

MmHG- Millimeter of Mercury

SBP-Systolic Blood Pressure

T1DM-Type 1 Diabetic Mellitus

T2DM-Type 2 Diabetic Mellitus

W/H^2: Weight over Height Square

WHO: World Health Organization.

1. INTRODUCTION

1.1. Background

Metabolic syndrome (MetS) is a bunch of metabolic defects comprising hypertension, insulin resistance, visceral obesity, fatty liver, and atherogenic cardiovascular diseases (1). It is characterized by an accumulation of adipose tissue, primarily around the waist and trunk. Hyperuricemia, fatty liver that develops into nonalcoholic fatty liver disease, polycystic ovarian syndrome in women and erectile dysfunction in males, as well as acanthosis nigricans, are all associated conditions (2).Various diagnostic criteria have been proposed by different people and organizations over the past decades (3).

According to the new International Diabetes Federation (IDF) definition, metabolic syndrome (MetS) is identified by the presence of central obesity (waist circumference ≥ 94 cm for males and ≥ 80 cm for females) along with any two of the following four criteria: raised triglycerides, reduced HDL cholesterol, elevated blood pressure, or raised fasting plasma glucose/previously diagnosed type 2 diabetes (4). MetS takes into account central obesity, lipid profile, blood pressure and blood glucose (5).The pathogenesis of MetS encompasses multiple genetic and acquired entities that fall under the umbrella of insulin resistance and chronic low-grade inflammation. If left untreated, MetS is significantly associated with an increased risk of developing diabetes and cardiovascular diseases (CVDs) (6). Those with MetS have a twofold increased chance of death from CVD and three fold-increased chance of a CVD event. Those with metabolic syndrome have fivefold increased risk of developing T2DM.The incidence of MetS rises with the rates of obesity on the rise. The incidence of MetS rises as the world's population ages. Estimates are that 20-25% of the world's adult population and up to 1/3 of the US adult population have MetS (5).

The management of metabolic syndrome consists of two main therapeutic goals: Treatment of the underlying cause (central obesity, sedentary lifestyle) and treatment of the cardiovascular risk factors, which persist despite lifestyle modification(7). Thus, why this study aimed at to assess determinants of metabolic syndrome in type two diabetes patients at Mettu Karl comprehensive specialized hospital

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1.2. Statement of the problem

Metabolic syndrome is becoming a worldwide public health concern due to lifestyle changes, urbanization, decreasing levels of physical activity, increased intake of energy, and globalization (8). About 70–80% of diabetes mellitus (DM) and 20–25% of adult population in the world is estimated to have metabolic syndrome and they are two times as likely to die from and three-fold as likely to have a heart attack or stroke as compared to without the syndrome(4). Metabolic syndrome among type 2 DM patients is a common condition in developed and developing countries. Its magnitude was 24.3% in Europe, 21.8% in US , 69.14% in Gahanna, and 35.1% in Nigeria (10 - 13)

Similarly, the magnitude varies in different parts of Ethiopia, 21.8% in north Ethiopia Mekele City, 45.9% in southern Ethiopia Hawassa, 57% in Northwest Ethiopia university of Gondar, 68.3% in Southwest Ethiopia (MKCSH, Bedele General Hospital, Didessa Primary Hospital, and Darimu Primary Hospital) (15,9,16 , 17)

The burden of non-communicable diseases (NCDs) has caused substantial impact to health systems and economies worldwide. NCDs cause greater increase to morbidities and mortalities, reduced quality of life and escalated healthcare expenditures to governments, particularly in low- and middle-income countries Coupled with these unprecedented consequences of NCDs, global public health systems are being challenged with the rise of metabolic syndrome (MetS) incidence (14). An economic burden analysis shows that economic losses from NCDs (direct and indirect costs) make up 31.3 billion birr per year, which is equivalent to 1.84% of Ethiopia's gross domestic product in 2017 (15)

The metabolic syndrome is known to be caused by insulin resistance or insulin resistance linked obesity, a condition whereby the body's cells are incapable of taking up glucose from the blood. Insulin resistance linked to obesity is caused by a lack of regular exercise and poor dieting. Increasing age, smoking of cigarettes, alcohol intake, overweight, history of cardiac problem, chewing kchat, sedentary lifestyle, and family history of type 2 diabetes are also important risk factors (16).

Dietary changes, physical inactivity, rural-to-urban migration, industrial development, and genetic susceptibility significantly contribute to the spread of metabolic syndrome.

Studies indicate that several factors are associated with MetS, including being female, consuming red meat, engaging in sedentary leisure activities, having a BMI over 25 kg/m², increasing age, completing secondary school or higher, having diabetes for over 5 years with poor glycemic control, inadequate fruit intake, and a family history of the condition, as well as being overweight or obese (4, 19)

Any attempts made so far by different stakeholders. In 2018, the Federal Ministry of Health in Ethiopia showed increasing interest in NCD prevention and the health system reform in Ethiopia and the value of investigating the economic case for investing in NCDs. WHO has published various policy options and interventions for the prevention and treatment of NCDs. It focuses on packages of policy and clinical interventions (tobacco, alcohol, physical activity and nutrition policies, and management of CVD and diabetes) that are addressed in the economic analysis(15).

However, there are cross-sectional studies done in Ethiopia, inconsistencies seen between the variables that are associated with metabolic syndrome. In addition, these cross-sectional studies do not show the relations between the dependent and independent variables (18). Moreover, previous studies did not encompass modifiable cardiovascular risk factors such as alcohol consumption, chewing khat and smoking as well as family history of cardiac problem (19).

Therefore, this study aimed to identify determinants of metabolic syndrome including modifiable cardiovascular risk factors as well as family history of cardiac problem, in type two diabetes patients at Mettu Karl comprehensive specialized hospital. The findings of this study will help improve the preventing strategy for metabolic syndrome among type 2 diabetic patients.

1.3 Significance of the problem

Understanding the determinants of metabolic syndrome in type 2 diabetes patients can aid hospital managers and healthcare providers in creating targeted interventions and strategies for prevention and management. The study's findings encourage patients to engage in lifestyle modifications based on recommended practices. Additionally, the results can assist the zonal health bureau and administration in addressing the root causes of these determinants. Finally, this research serves as a reference for future studies by scholars in the field.

2. **LITERATURE REVIEW**

2.1 Determinants of metabolic syndrome among type –II Diabetic Patients

2.2.1. Socio-Demographic determinants of Metabolic Syndrome

Observational with a cross-sectional study conducted in Indonesia, at the Health Public Center, Ternate City, North Maluku on outpatients with type 2 diabetes mellitus has identified a multitude of factors to be associated with MetS. Demographic characteristics such as being a woman or older age were shown to escalate the risk of having MetS (20).

A retrospective, descriptive and analytic study conducted in morocco among patients with type 2 diabetes, reveals that the mean age was 52.06 ± 17.33 years with a predominance of the age group (50-59 years) ,the majority of which was female (21).

Study in China showed that MetS was also independently associated with age. In addition, Residence in the South and senior high school education attainment were associated with lower risks of MetS (22). Study in Nepal showed that, gender, and occupation were not the significant predictor of metabolic syndrome(23). Study conducted at the Diabetes Centre of the Komfo Anokye Teaching Hospital in Kumasi, the Ashanti Region of Ghana among type 2 diabetes mellitus patient's shows that, the likelihood for females to develop MetS was 3 times higher as compared to males (16). Similarly study conducted in Iran among type 2 patients showed that gender is predictive factors for metabolic syndrome in the population (24)

A clinic-based cross-sectional study conducted in the Bono Region of Ghana among out-patients attending two-selected diabetes mellitus clinics on lifestyle-related factors shows the crude analysis indicated that the odds of MetS were 2.3 times higher among women than men. Unmarried participants had 1.8 times the odds of MetS compared with married participants. Compared with farmers, respondents who were traders had 2.1 times the odds of having MetS. The odds of developing MetS among women were 2.15 times that of men (25).

A facility-based unmatched case-control study conducted at Arba Minch General hospital among type 2 diabetes patients indicates that, being female was 3.4 times higher among cases than controls as compared to being male. The odds of being a rural dweller were 2 times higher among cases

than controls as compared to rural dwellers. The likelihood being government employment was 4.4 times higher among cases than controls as compared to self-employed. The odds of being obese were 2.7 times higher among cases than controls as compared to normal body mass index(26)

A facility-based cross-sectional study conducted, at Adama Hospital Medical College, indicates, among the patients with T2DM, those who were urban residents had increased odds of metabolic syndrome compared with rural residents .Earning a monthly income greater than 4230 birrs had a significant association with MetS among the patients with T2DM (27). A clinic-based cross-sectional study conducted in the Bono Region of Ghana among out-patients attending two-selected diabetes mellitus clinics reveals, compared with farmers, respondents who were traders had 2.1 times the odds of having MS (25)

2.2.2. Behavioral and Medical Related Determinants Metabolic Syndrome

Study conducted in USA shows that, MetS and T2D were modeled separately, but results were generally similar between the two outcomes. Higher visceral fat was significantly associated with both MetS and T2D, In contrast, physical activity and CRP were not significantly associated with either MetS or T2D in any model(28)

Study in Nepal showed that, Patients who had sleep problems and had comorbidity were 21.812 and 4.024 times more likelihood to develop metabolic syndrome compared to patients who did not have sleep problem and had no other comorbidity. It indicates that sleep problem and presence of comorbid conditions were the significant predictor of metabolic syndrome among patients with diabetes mellitus. However, alcohol habit and smoking habit were not the significant predictor of metabolic syndrome(23).

Observational with a cross-sectional study conducted at the Siko Public Health Center in Ternate City reveals that the length of suffering, and diet have a partial influence on the metabolic syndrome, while physical activity has no significant effect on metabolic syndrome(20)

A facility-based cross-sectional study conducted, at Adama Hospital Medical College, indicates, having a history of hypertension and dyslipidemia were associated with increased odds of MetS among the patients with T2DM. Cigarette smokers were 6 times more likely to develop MetS than

non-smokers. Patients with T2DM with a BMI greater than or equal to 25 kg/m2 had a significant association with high odds of MetS (27)

A cross-sectional study using data from the Nutrition and Health Survey in Taiwan found that participants in the highest quartile of adherence to dietary guidelines had a significantly lower risk of various metabolic abnormalities. Specifically, the odds ratios (OR) indicated that these participants had a reduced risk of: Abnormal waist circumference (OR = 0.62, 95% CI = 0.43–0.91), abnormal HDL cholesterol levels (OR = 0.75, 95% CI = 0.58–0.98), and abnormal triglyceride levels (OR = 0.73, 95% CI = 0.55–0.97).However, the study reported no significant association between dietary adherence and the risk of abnormal blood pressure or blood glucose levels. (29).

Cross-sectional study conducted in Shiraz, Iran amongst patients with diabetes who were registered in ten special diabetic clinics, indicate adherence to medication protocol, diet, and physical activity affected the reduction of diabetic com- plications and comorbidity (30).

Across sectional study carried out in AL Kuwait University Hospital consultation clinic shows metabolic syndrome was associated with essential hypertension, dyslipidemia, hypercoagulability , hyperuricemia , endothelial dysfunction, inflammation microalbuminuria , all these are associated with increased risk of both micro and macro vascular complications of type 2 DM (31).

Recent evidence on Obesity, Metabolic syndrome, and Musculoskeletal Disease demonstrates that metabolic complications increase the risk for the most prominent Musculoskeletal Disease, such as sarcopenic obesity (muscle loss in obesity), osteoporosis, tendinopathy, and osteoarthritis, conditions which contribute significantly to disability and time lost from work (32).

A Review of the Evidence done on metabolic complications and glucose metabolism in HIV infection indicates that, HIV infection is associated with insulin resistance and metabolic syndrome, a clustering of specific health conditions that elevate risk of diabetes and cardiovascular disease (33). A clinic-based cross-sectional study conducted in the Bono Region of Ghana among out-patients attending two-selected diabetes mellitus clinics reveals, Metabolic Syndrome in respondents who had had T2DM for 5 or more years was 5.2 times compared to those with a disease duration of lesser than 5 years (34)

Cross sectional study done in Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia among patients with type 2 diabetes mellitus reveals that respondents who did not do regular physical exercise were 1.83 odds to have MetS as compared to those who did regular physical exercise (4). A cross sectional study conducted in Mizan-Aman town, Ethiopia among residents, with metabolic syndrome indicates that Participants who have physical inactivity are 2.61 times more likely to develop metabolic syndrome than those who had adequate physical activity (35). A community-based cross-sectional study conducted in West Gojjam found that adults engaged in moderate and high levels of physical activity were significantly less likely to develop metabolic syndrome compared to those with lower activity levels. The study reported adjusted odds ratios (AOR) of 0.28 (CI: 0.14–0.56) for moderate activity and 0.42 (CI: 0.18–0.97) for high activity, indicating a protective effect of increased physical activity against metabolic syndrome (36)

2.2.3. Lipid profile, anthropometrical and body composition Related Determinants metabolic syndrome

A cohort study conducted on the urban population of Zahedan city, south-eastern Islamic Republic of Iran indicated that high fasting blood sugar increases the risk of metabolic syndrome(OR = 13.22; 95% CI: 6.74–25.94%)(37).

A clinic-based cross-sectional study conducted in the Bono Region of Ghana among out-patients attending two-selected diabetes mellitus clinics on lifestyle-related factors shows the mean anthropometric and biochemical measurement of participants by sex and metabolic syndrome status (25). Between participants with MetS and those without MS, the difference in mean measurements for each component of MetS was significant for all the components except FBG. Compared with normal or under- weight participants, overweight/obese participants were more likely to have MetS (25).

Cross sectional study done in southern Chinese among Indigenous adults (aged more than or equal to 35 years) indicate Compared with patients of HbA1c < 6.5%, patients with HbA1c ≥ 6.5% had higher body weight, Waist circumference, WHR, and higher concentration of TC, triglyceride, FPG, 2h-PG and HbA1c (38).

2.4 Conceptual framework

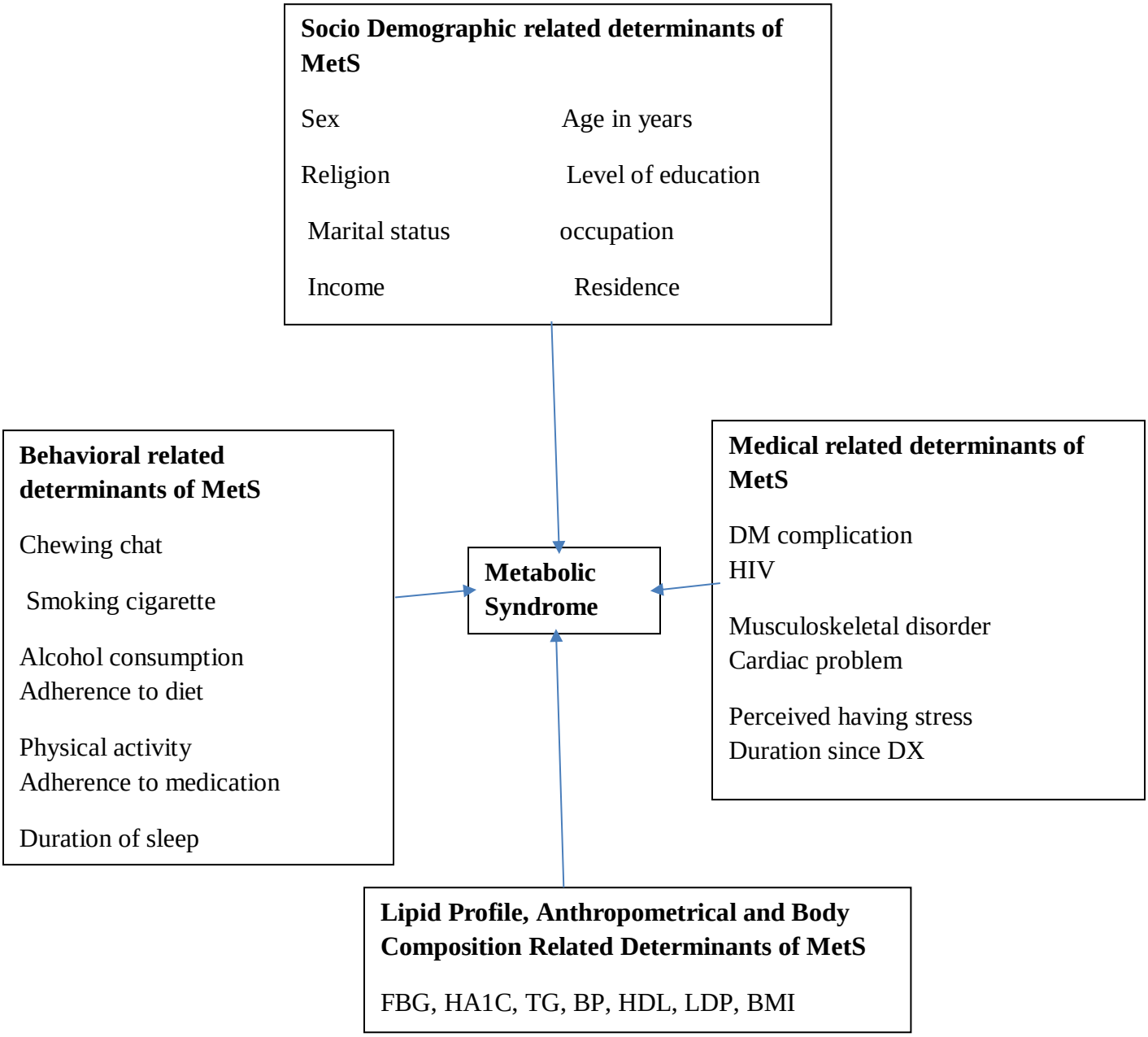

Figure 1. Conceptual framework for determinants of metabolic syndrome among type 2 diabetic patients (14-37)

3. OBJECTIVE

3.1 General objective

To assess determinants of metabolic syndrome in type two diabetes patients at Mettu Karl comprehensive specialized hospital, Ilu Ababor Zone, Oromia, Ethiopia, from May to June; 2024.

3.2 Specific Objective

To identify determinants of metabolic syndrome in type two diabetes patients at Mettu Karl comprehensive specialized hospital, Ilu Ababor Zone, Oromia, Ethiopia, from May to June; 2024.

4. METHODS AND MATERIALS

4.1 Study Area and Period

The study was conducted from April 30 to June 15; 2024 at the Diabetic Care Clinic of MKCS, Oromia Region, Southwest Ethiopia. The hospital is located in the town of Mettu, located 600 km southwest of Addis Ababa, and the capital city of Ethiopia. It serves about 2.5 million people from Ilu Ababor Zone, Gambella Regional State and the adjacent Southern Nation and Nationalities Peoples Region. The healthcare service provided by the hospital includes an outpatient department, inpatient services, a critical care unit (intensive care unit) and an emergency intervention unit. The hospital also has medical, surgical and gynecological referral clinics. Overall, the hospital provides healthcare services to approximately 15,453 inpatients and 85,000 outpatients per year. A total 4800 diabetes mellitus patients were on follow up

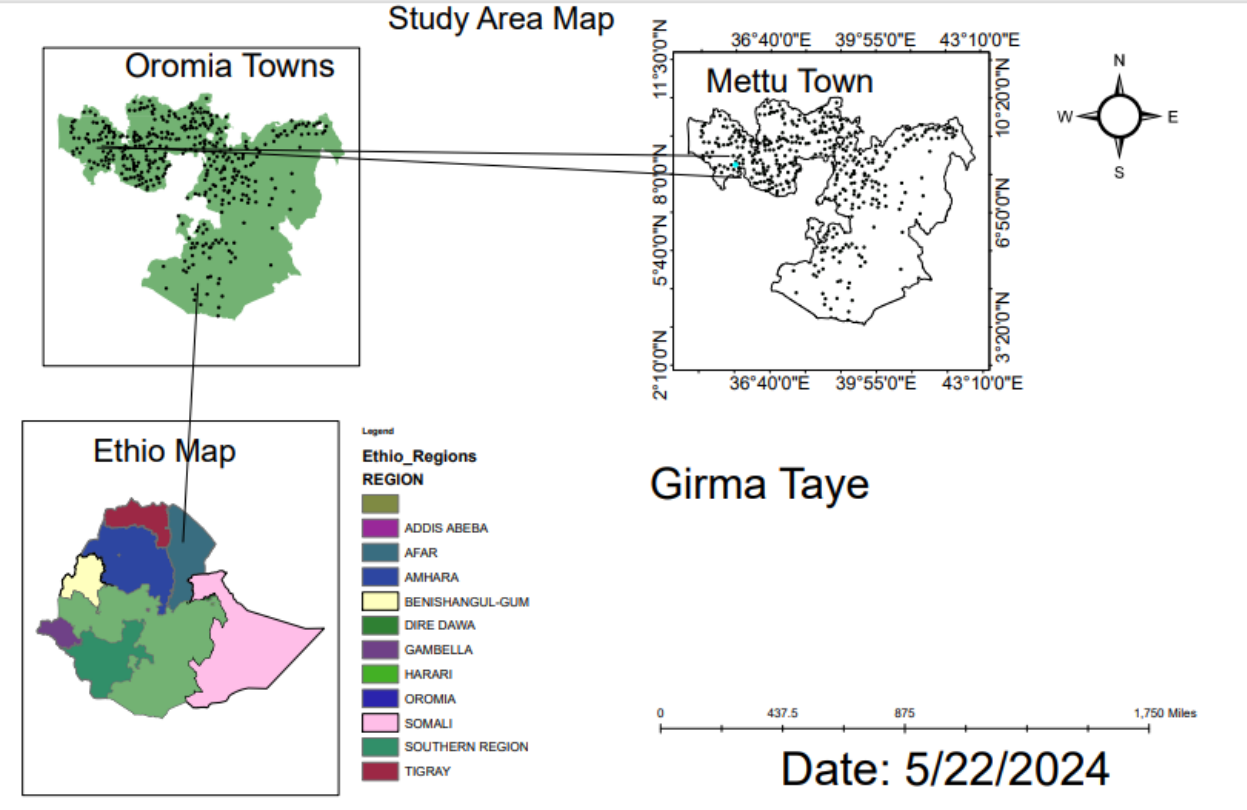

Figure 2: map of the study area

4.2 Study Design

Facility based unmatched case control study design was used.

4.3 Population

4.3.1 Source Population: The Source Population were all type 2 diabetic patients following diabetic clinic at Mettu Karl Comprehensive Specialized Hospital

4.3.2 Study Population

Cases: type 2 diabetic patients who were diagnosed with metabolic syndrome

Controls: Type 2 diabetic patients who did not develop metabolic syndrome

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion Criteria: The inclusion criteria are those type 2 diabetics with age greater than or equal to 18 years.

4.4.2 Exclusion Criteria: The exclusion criteria patients unable to respond due to illness.

4.5 Sample size and Sampling procedure

4.5.1 Sample size

The sample size was calculated using Epi Info™ software by taking the main determinants of metabolic syndrome from a previous study (26). To calculate sample size, residence was chosen as an independent variable since it gave maximum sample size, and a study conducted in Ethiopia (Arba Minch Referral Hospital) was used because it was a recently conducted study. By considering, the proportion of residence was 26.47% among controls, 40.2% and AOR 3.0, power 80%, confidence interval 95%, and case to control the ratio of 1:2 by using kelsey. By considering 10% non-response rate, the maximum the sample size 482 (161 cases and 321 controls).

Table 1. Associated Variables for sample size determination for determinants of metabolic syndrome in type two diabetes patients at Mettu Karl comprehensive specialized hospital, Ilu Ababor Zone, Oromia, Ethiopia; 2024

Variables	% of non-exposed	% of exposed	CI (95%)	Power (80%)	AOR	Sample size						
						Case	Control	Ratio of control	10% nrr	Total	Maximu	Referen
Sex	40.2	68.6	95	80	3.4	41	81	2:1	12	134	3rd	(26)
Residenc	26.47	40.2	95	80	3	146	292	2:1	49	482	1st	
Occupati	33.33	27.45	95	80	2.7	55	110	2:1	17	182	2nd	

Key: CI=Confidence interval, AOR=Adjusted odds ratio, nrr= none response rate

4.5.2 Sampling procedure

.All patients with type 2 diabetes mellitus attending the diabetic clinic during the working time of the clinic and eligible were enrolled. Study participants were selected by systematic random sampling using diabetic registration book at follow-up clinic and average weekly patient load and systematic random sampling technique was used to select the first participant. The expected monthly caseload for the control were 950 clients; based on that K=N/n=950/321=2.9 that means every three clients attending the follow up was included in the study. For controls, the expected monthly caseload were 2100 and accordingly; k=N/n=2100/161=13 that means every thirteen clients was included. Study participants were interviewed up on their exit from diabetic care clinic

4.6 Data collection tool and procedure

Data collecting tool was developed and adapted from earlier comparable publications consisting of socio-demographic determinants, behavioral determinants and medical related determinants, and lipid profile, anthropometrical and body composition related determinants were incorporated in the questionnaire (37-42)**.** An experienced four nurse working at the diabetic clinic collected the data. Two trained public health officers were recruited to supervise and monitor the overall data collection procedures. Data collection was last one month. Laboratory results including lipid profile was obtained from the record of clients. The data collection tools was undergo preliminary testing outside of the study area. Cronbach alpha was used to check reliability and validity of the tool, its value was 0.9, and the reliability of tools were good.

Information on anthropometric, socio-demographic, clinical, lifestyle and behavioral traits was gathered. Blood pressure, height, weight, and other measurements were taken using standardized equipment and techniques

4.7 Measurements and tools

Weight was measured using Seca weighing scale with participants wearing light clothing (single and thin) and without shoes to the nearest 0.1Kg. Height was measured using a stadiometer to the nearest 0.1 CM. A simple flexible steel metric tape calibrated in meters was used for measuring waist circumference. Waist circumference was measured midway between the iliac crest and the lower rib margin in the horizontal plane while the participant is standing to the nearest 0.5 cm

Blood pressure

Two blood pressure measurements taken 5 min apart was determined for each participant using a Mercury-based sphygmomanometer. Participants were measured after 10 min of rest in sitting position, and armrest on a table at heart level, back supported, on the same arm and legs rest on the ground. Then the average readings of the two measurements were recorded in the questionnaire.

4.8 Study Variables

4.8.1 Dependent Variable: metabolic syndrome.

4.8.2 Independent Variables: - includes

Socio demographic variables:-sex of respondent, age in years, residence, marital status, level of education, religion, occupation, and income.

Behavioral factors:-chewing chat, smoking cigarette**,** alcohol consumption, and adherence to diet**,** physical activity, and adherence to medication.

Individual and medical related factors:-DM complication, HIV**,** musculoskeletal disorder, cardiac problem, perceived having stress, and duration since diagnosis.

Lipid profile, anthropometrical and body composition related variables: - FBG, HBA1C, TG, BP, HDL, BMI, and LDL.

4.9 Operational definitions

Monthly family income: It was classified into three categories as inadequate (if family

income unable to fulfil their basic needs for a month), adequate (if family income was able to fulfilled basic needs) and surplus (if there was extra saving after fulfilling basic needs) (23)

Raised triglycerides : ≥150 mg/dl or specific treatment for this lipid abnormality (39).

HDL cholesterol :< 40 mg/dl in male < 50 mg/dl in female or specific treatment for this lipid abnormality (39).

Raised blood pressure: Is a systolic BP ≥ 130 mm Hg or diastolic BP ≥ 85 mm Hg, or any patient on the treatment of previously diagnosed hypertension (39).

Smoking cigarettes: Participants were categorized as smokers if they had been doing so for more than six months and smoked at least one stick a day (40)

Physical activity: Individuals who did moderate-intensity activity for at least 30 minutes per day on at least five days per week were considered as physically active (17).

Perceived having stress. It referred to feelings or thoughts that an individual has about how much stress they are under at a given point in time or over a given time period. It was measured by using perceived stress scale (PSS) containing 10 items. Each item was rated to 0 to 4 score. Total perceived stress score was calculated and further classified as: Low: (0– 13), moderate: (14–26), high: (27–40) (23)

Adherence to diet: If the respondents follow a recommended diet for more than 3 days in last seven days(19)

Adequate sleep: Participants who sleep 7 to 8 hours per day without difficulty initiating

and maintaining sleep are grouped as having adequate sleep(17)

Adherence to medication: If the patients took all his/her antidiabetic medication in the last seven days(19)

Duration since diagnosis: having diabetes for more than 5 years (41)

Alcohol consumption: Drinking categories: None; light (1– 3 drinks/day for men and 1–2 drinks/day for women); heavy (>−4 drinks/day for men and >−3 or more drinks/day drinks/day for women(42).

BMI: BMI is classified into underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), underweight (<18.5 kg/m²), overweight (25-29.9 kg/m²), and obese (>/=30 kg/m²) (43)

4.10. Data Quality Assurance

Four data collectors and two supervisors were trained for 2 days. A third person to check its consistency back translated the questionnaire into English from local languages (Afaan Oromoo). The data collection tool was first pretested on 24 (5.0%) patients with diabetes at Darimu Hospital to check the consistency, applicability and understandability of the questionnaire and abstraction format. Questions, which were misunderstood, were corrected for data collection. All

completed data collection forms was checked each day for their completeness, consistency, clarity and accuracy by the principal investigators.

4.11. Data Processing and Analysis

Prior to data entry, data were coded and edited appropriately by the principal investigators. The data were entered into Epidata Manager Version 4.6 and subsequently exported to Stata 17 for analysis. Descriptive statistics, such as frequency, proportion, mean and standard deviation (SD) was used to describe metabolic syndrome and the sociodemographic, behavioral, individual and medical, lipid profile, anthropometrical and body composition related characteristics of the patients. Categorical variables were summarized as numbers and percentages, whereas normally distributed continuous variables was presented as means and standard deviations. Bivariate logistic regression analysis was used to determine factors associated with metabolic syndrome. Variables found to be significant at p-value <0.25 in the bivariate analysis were included in the multivariate logistic regression analysis to identify determinants of metabolic syndrome. Statistical significance was set at p-value< 0.05. Model fitness was checked using Hosmer and lemshow test at cut point >/=0.05. Variable inflation factor (VIF) was used to check presence of Multicollinearity. Odds ratio (OR with 95% CI) was used at (p-value </=0.05) to declare statistical significances.

4.12. Ethical Consideration

Ethical approval was obtained from the Salale University Ethical Committee with the Reference Number of **S/U-IRERC-187/2016**, and an official cooperation letter was sent to relevant bodies. Participants were recruited after providing informed oral consent. They were informed they could skip questions or stop the interview at any time, and that their responses would remain anonymous and confidential. Interviews were conducted in private locations to ensure participants felt comfortable expressing their thoughts. The names of respondents were not recorded, and collected data was kept confidential, accessible only to the principal investigator.

5. Result

5.1. Socio-Demographic Related Characteristics of metabolic syndrome

On this study, 482 respondents (161 case and 321 controls) participated with response rate of 100%. Out of 482(161 cases, and 321 controls) of study participants (107,130) (66.46 %, 40.50%) were females. The mean ± SD age of the respondents was 53.41 ± 7.87% and 52.61± 7.24% of cases and controls in years, respectively. 85 (52.8%) study participant among cases, and 162(50.47%) of the study participants among controls were found in the age group of"50 and above years". The minimum and maximum age of study participants were (41, 42) and (85, 75) respectively. Three-fourths of participants for both cases and controls were married. More than twenty -seven percent (27.33%) of cases and eighteen percent (18.38%) of controls had no formal education. The most prevalent occupation among the participants was merchants (48, 96) (29.81%, 29.91%); more than half (102, 162) (63.35%, 50.47%) of participants were urban residents. About 77 (47.83 %,) of study participants among cases had no constant income, while 127(39.6%) study participants had a monthly income of 1500-6000 ETB (See Table 1).

Table 2. Socio-demographic related characteristics of metabolic syndrome in type two diabetes patients at MKCSH, Ilu Ababor Zone, Oromia, Ethiopia; 2024 (N=482)

Variables		Metabolic syndrome		
		Cases N (%)	Controls N (%)	Total N (%)
Age of respondent	Less than 50 years	76(47.20)	159(49.53)	235(48.8)
	50 years and above	85(52.80)	162(50.47)	247(51.2)
Place of residence	Urban	102(63.35)	224(69.78)	326(67.6)
	Rural	59(36.65)	97(30.22)	156(32.4)
Sex of respondent	Male	54(33.54)	191(59.50)	245(50.8)
	Female	107(66.46%)	130(40.50)	237(49.2)
Marital status of respondent	Single	7(4.35)	23(7.14)	30(6.2)
	Married	121(75.16)	244(76.01)	365(75.7)
	widowed	8(4.97)	20(6.23)	28(5.8)
	Divorced	25(15.53)	34(10.59)	59(12.2)
Educational status of respondent	Unable to read and write	41(25.47)	46(14.33)	87(18.0)
	Able read and write	3(1.86)	13(4.05)	16(3.3)
	Primary school	26(16.15)	74(23.05)	100(20.7)
	Secondary school	60(37.27)	123(38.32)	183(38.0)
	College and above	31(19.25)	65(20.25)	96(19.6)
Occupation	Farmer	34(21.12)	74(23.05)	108(22.4)
	Employed	31(19.25)	69(21.50)	100(20.7)
	House wife	42(26.09)	52(16.20)	94(19.5)
	Unemployed	5(3.11)	13(4.05)	18(3.7)
	Merchants	48(29.81)	96(29.91)	144(29.9)
	Self employed	1(0.62)	17(5.30)	18(3.7)
Religion	Orthodox	73(45.34)	145(45.17)	218(45.2)
	Protestant	36(22.36)	54(16.82)	90(18.7)
	Muslim	51(31.68)	118(36.76)	169(35.1)
	Other	1(0.62)	4(1.25)	5(1.0)
Income	1000-1499	7(4.35)	106(33.0)	113(23.4)
	1500-6000	59(36.65)	127(39.6)	186(38.6)
	>/=6000	18(11.18)	33(10.3)	51(10.6)
	No constant income	77(47.83)	55(17.1)	132(27.4)

5.2 Behavioral Related Characteristics of metabolic syndrome

This study showed that all study participants 482 (100%) had never smoked cigarettes. Regarding alcohol consumption (1, 20) (0.6%, 6.2%) of study participants had currently consumed alcohol. Whereas 144,268 (89.44%, 83.49%) of study participants had no history of chewing. Fifty nine percent (59%) of study population among cases and forty nine percent (48.9%) of study population among controls had difficulty of initiating sleep. More than half (84,197) (52.17 %, 60.44%) of the study participants had no regular physical exercise. Forty five percent (45%) of study participant among cases and seventy-three (72.6%) of the study participants among controls had inadequate diet adherence whereas 117(72.7%) of study population among cases and 273(85%) of the study population among controls had medication adherence (SeeTable 2).

Table 3.Behavioral related characteristics of metabolic syndrome in type two diabetes patients at MKCSH, Ilu Ababor Zone, Oromia, Ethiopia; 2024 (N=482)

Variables			Metabolic syndrome		
			Cases N (%)	Controls N (%)	Total N (%)
Khat chewing	Yes		17(10.56)	53(16.51)	70(14.5)
	No		144(89.44)	268(83.49)	412(85.5)
Alcohol consumption	Yes		1(0.6)	20(6.2)	21(4.4)
	No of bottles/ day	</=2		9(45)	
		>2	1(0.62)	11(55)	
	No		160(99.38)	301(93.77)	461(95.6)
Sleep difficulty	Yes		95(59)	157(48.9)	252(52.3)
	No		66(41)	164(51.1)	230(47.7)
Time spent for sleeping	<7 hours		95(59.01)	157(48.91)	252(52.3)
	>/=7 hours		66(40.99)	164(51.09)	230(47.7)
Physical activity	Yes		77(47.8)	127(39.6)	204(42.3)
Time spent for physical activity	< 30 minute		30(38.96)	58(45.67)	
	>/=30 minutes		47(61.04)	69(54.33)	
No			84(52.17)	194(60.44)	278(57.7)
Adherence to diet	inadequate		45(28)	233(72.6)	278(57.7)
	adequate		116(72)	88(27.4)	204(42.3)
Adherence to medication	Adherent		117(72.7)	273(85)	390(80.9)
	Non-adherent		44(27.3)	48(15)	92(19.1)

5.3 Individual and Medical Related Metabolic Syndrome

The mean time of the respondents since diagnosis with DM was 6.2 years ± 3.8(std.dev) and 6years ± 2.2% (std.dev) with a minimum of 2 years and a maximum of (25 years, 15 years) for cases and controls, respectively. The duration of diabetes was greater than 5 years in (60.2%) of the cases and (60.7%) of the controls. Hypertension was the most common comorbidity with (127,194)(78.88%, 60.44%) among study population

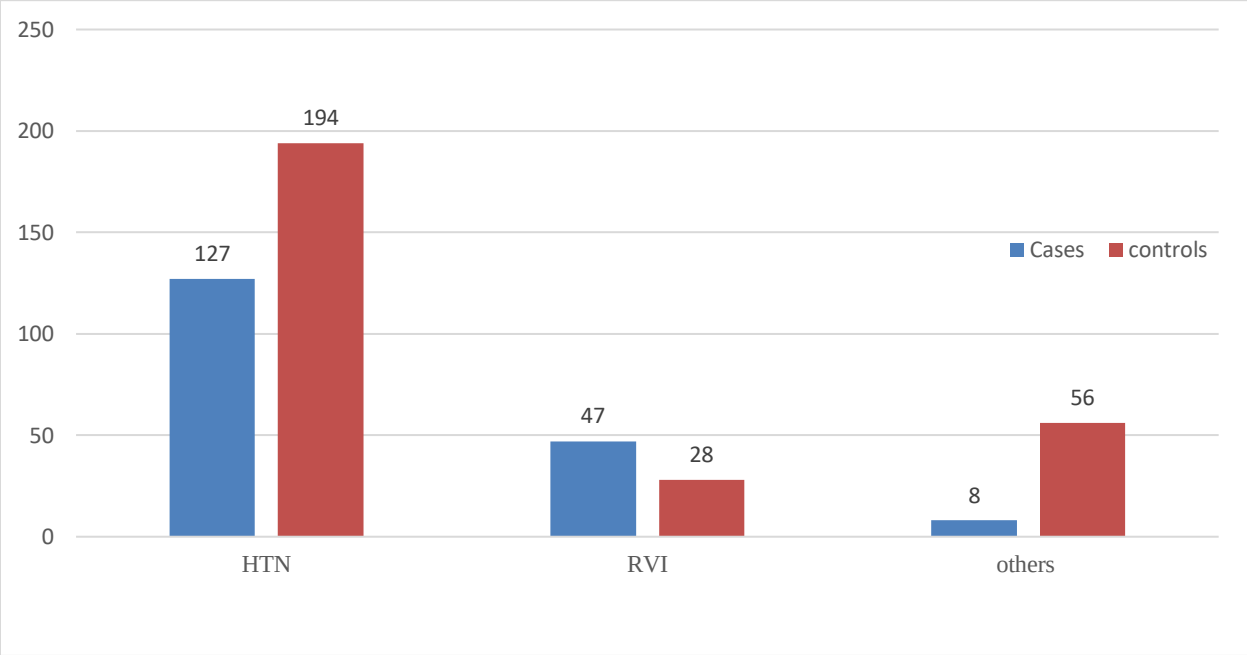

Figure 3. Comorbidities among type 2 diabetes patients at MKCSH, South West Ethiopia; 2024

Fifty three percent (53.4%) of the study participants among cases and sixty three percent (63.2%) of the study populations among controls seventy three percent (73.3%) of study participants among cases and seventy nine percent (78. 6%) of the study participants among controls had no DM complication and musculoskeletal disorder respectively. Eight-three percent (83.2 %,) of study population among cases and eight four percent (83.8%) study population had albuminuria. Majority (157,301) (97.5%, 93.8%) of the study participants had moderate perceived stress scale (See Table 4)

Table 4.Individual and medical related metabolic syndrome in type two diabetes patients at MKCSH, Ilu Ababor Zone, Oromia, Ethiopia; 2024 (N=482)

Variables					Metabolic syndrome		
					Cases N (%)	Controls N (%)	Total N (%)
Duration of illness		1-5 years			64(39.75)	126(39.3)	189(39.21)
		>5 years			97(60.25)	195(60.7)	192(60.58)
Albuminuria		Yes			27(16.8)	52(16.2)	79(16.4)
		No			134(83.2)	269(83.8)	403(83.6)
Diabetic		Yes			75(46.58)	105(32.71)	180(37.3)
Complication		No			86(53.42)	216(67.29)	302(62.7)
Cardiac problem		Yes			72(44.72)	106(33.02)	178(36.9)
		No			89(55.28)	215(66.98)	304(63.1)
Musculoskeletal		Yes			43(26.7)	60(18.7)	103(21.4)
disorder		No			118(73.3)	261(81.3)	379(78.6)
Comorbidities		Hypertension	Yes	127(78.88)	194(60.44)		321(66.6)
			No	34(21.12)	127(39.56)		161(33.4)
		HIV	Positive	49(30.43)	27(8.41)		76(15.8)
			Negative	112(69.57)	294(91.59)		406(84.2)
		Others	Yes	8(4.97)	56(17.45)		64(13.3)
			No	153(95.03)	265(82.55)		418(86.7)
Have	Low	1(0.6)			3(0.9)		4(0.8)
Perceived	Moderate	157(97.5)			301(93.8)		458(95)
stress	High	3(1.9)			17(5.3)		20(4.1)

5.4 Lipid Profile, Anthropometrical and Body Composition Related Metabolic Syndrome

For all study participants Lipid profile, anthropometrical and body composition related characteristics of respondents were determined. Majority of the respondents (159,292) (98.76%, 90.97%) of had fasting blood sugar level of greater than or equal to 130mg/dl. Ninety eight percent (98.14%) of cases compared to sixty seven percent (66.67%) of controls had triglyceride level of >/=150mg/dl. More than half (71.43% 54.52%) of the study participants had HDL higher than <40mg/dl. Forty eight percent (47.83%) of study population among cases and 206 (64.17%) of study population among controls had HA1c greater than or equal 6.5%, whereas more than half (98.76%, 73.52%) of study population had LDL>/=100mg/dl. (See Table 5).

Table 5.Lipid profile, anthropometrical and body composition related metabolic syndrome in type two diabetes patients at MKCSH, Ilu Ababor Zone, Oromia, Ethiopia; 2024 (N=482)

Variables		Metabolic syndrome		
		Cases N (%)	**Controls N (%)**	**Total N**
FBS	<130mg/dl	2(1.4)	29(9.03)	31(6.43)
	>/=130mg/dl	159(98.76)	292(90.97)	451(93.57)
Triglyceride	<150mg/dl	3(1.86)	107(33.33)	110(22.82)
	>/=150mg/dl	158(98.14)	214(66.67)	372(77.18)
HDL	<40mg/dl	115(71.43)	175(54.52)	290(60.17)
	>/=40mg/dl	46(28.57)	146(45.48)	192(39.83)
LDL	<100mg/dl	2(1.4)	85(26.48)	87(18.05)
	>/=100mg/dl	159(98.76)	236(73.52)	395(81.95)
HA1C	<6.5%	84(52.17)	115(35.83)	199(41.29)
	>/=6.5%	77(47.83)	206(64.17)	283(58.71)
SBP	<130mmHg	36(22.36)	98(30.53)	134(27.80)
	>/=130mmHg	125(77.64)	223(69.47)	348(72.20)
DBP	<85mmHg	127(78.88)	277(86.29)	404(83.82)
	>/=85mmHg	34(21.12)	44(13.71)	78(16.18)
BMI	Under weight		5(1.6)	5(1.0)
	Normal	94(58.4)	219(68.2)	313(64.9)
	Over weight	61(37.9)	93(29.0)	154(32.0)
	Obese	6(3.7)	4(1.2)	10(2.1)

5.5 Determinants of Metabolic Syndrome

In Bivariable logistic regression analysis:- sex, educational status, alcohol consumption, sleep difficulty, physical exercise, diabetes complication, cardiac problem, hypertension ,HIV, FBG,triglyceride,LDL,HA1C, diet adherence, medication adherence, albuminuria, musculoskeletal disorder, and BMI were showed significant association at P-value <0.25 with metabolic syndrome.

During multivariable logistic regression analysis:-sex, physical exercise, musculoskeletal disorder, and hypertension were found to be significantly associated with metabolic syndrome at P-value</= 0.05 (See Table 6).

The odds of the metabolic syndrome are lower for males compared to females [AOR=0.112, 95% CI (0. 053, 0.237)].Respondents who engage in active exercise had a lower chance of metabolic syndrome compared to those who are inactive [AOR = 0.404, 95% CI (0.203, 0.804)]. The odds of the metabolic syndrome are much lower for participants who do not have a musculoskeletal disorder compared to those who have a musculoskeletal disorder [AOR=0.016, 95% CI (0.003, 0.079)].The odds of the metabolic syndrome are higher for respondents who have hypertension compared to those who do not have hypertension [AOR=4.207, 95% CI (1.858, 9.525)].

Table 6. Determinants of metabolic syndrome in type two diabetes patients at Mettu Karl Comprehensive Specialized Hospital, Ilu Ababor Zone, Oromia, Ethiopia;2024 (N=482)

Variables	Categories	Metabolic Syndrome			
		case	control	COR.[95% CI]	AOR.[95% CI]
Sex of respondents	male	54	191	.343 (.231, .510)	0.112(0. 053,0.237)
	female	107	130	Ref	Ref
Physical activity	Active	61	200	0.369(0.250,0.545)	0.404(0.203,0.804)
	Inactive	100	121	Ref	Ref
Musculoskeletal disorder	Absent	118	261	0.631(0.403,0.987)	0.016(0.003,0.079)
	Present	43	60	Ref	Ref
HTN	No	34	127	Ref	
	Yes	127	194	2.445(1.575,3.795)	4.207(1.858,9.525)

AOR Adjusted Odds Ratio, CI Confidence Interval, COR Crude Odds Ratio, HTN, hypertension, HA1C, glycated hemoglobin

5.6 Discussion

This case-control study investigated the determinants of metabolic syndrome in patients with type 2 diabetes at Mettu Karl Comprehensive Specialized Hospital. In this study, being male, active physical exercise, absence of musculoskeletal disorder, and presence of hypertension were found significantly associated with metabolic syndrome.

The finding from this study showed that males have a lower probability of developing metabolic syndrome compared to females. This is in line with studies conducted in Indonesia (23), Ghana (25), and Arba Minch General Hospital (29). The possible reason might hormonal differences, body fat distribution, lifestyle factors, age and life stage, genetic factors, and psychosocial factors. Hormones play a significant role in the distribution of body fat and metabolism. For instance, the presence of estrogen in females is known to influence fat storage, which can affect metabolic risk. After menopause, women often experience shifts in body composition and higher risks of metabolic syndrome due to decreased estrogen levels. Men and women tend to have different patterns of fat distribution. Men are more likely to accumulate visceral fat (fat stored in

the abdominal cavity), which is more metabolically active and associated with higher risks of metabolic syndrome. In contrast, women typically have more subcutaneous fat (fat stored under the skin), which may confer a lower risk. Men and women may engage in different lifestyle choices that can affect health. For example, men might be more likely to engage in higher levels of physical activity, while women may have diets that are more conducive to better metabolic health. However, this can vary widely depending on individual circumstances and cultural contexts. The risk of metabolic syndrome increases with age. Differences in health behaviors, reproductive factors, and life stages (such as pregnancy and menopause) can influence metabolic health in women. Genetics can also play a role in the predisposition to metabolic syndrome. Certain genes may influence how men and women metabolize fats and sugars differently. Psychosocial Factors: Stress, depression, and other psychosocial factors can affect eating behaviors and physical activity, and these influences may vary between genders.

Respondents with active physical exercise were less likely to have metabolic syndrome compared to those with inactive physical exercise. The results of this study are consistent with study done in Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia (4), conducted in Mizan-Aman town (39),and west Gojjam (40).

The possible reason might be due to; improved insulin sensitivity, weight management, lipid profile improvement, cardiovascular health, inflammation reduction and stress relief. Regular physical activity enhances the body's sensitivity to insulin, which helps maintain normal blood sugar levels and reduces the likelihood of developing insulin resistance, a core feature of metabolic syndrome. Exercise helps in weight control and reduces body fat, especially visceral fat, which is strongly associated with metabolic syndrome. Maintaining a healthy weight is crucial in mitigating the risk of metabolic disorders. Physical activity can lead to improvements in lipid profiles, such as lowering triglycerides and increasing HDL (good) cholesterol levels, which are beneficial in reducing metabolic syndrome risk. Regular exercise strengthens the cardiovascular system, improves circulation, and helps in the regulation of blood pressure, reducing the risk of heart disease, which is often linked to metabolic syndrome. Exercise is known to reduce stress and improve mental health, both of which can positively influence metabolic health. Lower stress levels can lead to better hormone regulation, affecting weight and

metabolic processes. Physical activity can decrease systemic inflammation, which is implicated in the development of metabolic syndrome.

Individuals who do not have musculoskeletal disorders (such as arthritis, osteoporosis, or other conditions affecting muscles and bones) are less likely to develop metabolic syndrome compared to those who do have such disorders. Recent evidence on obesity, metabolic syndrome, and musculoskeletal disease (35) support this finding. The possible reason might be physical activity limitations, chronic inflammation, comorbid conditions, hormonal changes, and sedentary lifestyle. Individuals with musculoskeletal disorders often experience pain, reduced mobility, and physical limitations, which can lead to lower levels of physical activity. Reduced activity is linked with obesity, insulin resistance, and higher chances of developing metabolic syndrome. Many musculoskeletal disorders are associated with chronic inflammation. This inflammation can contribute to the pathophysiology of metabolic syndrome by altering metabolic processes and promoting conditions such as insulin resistance. People with musculoskeletal disorders may have higher rates of other conditions that are risk factors for metabolic syndrome, such as obesity and diabetes. These comorbidities can further compound the risk. The presence of musculoskeletal pain can affect the endocrine system, leading to hormonal changes that promote weight gain and metabolic disturbances, increasing the risk of metabolic syndrome. Those with musculoskeletal disorders may adopt a more sedentary lifestyle due to pain or discomfort, which decreases energy expenditure and can lead to weight gain, a key component of metabolic syndrome.

The odds of the metabolic syndrome were 4.207 times higher among participants with hypertension than without hypertension**.** This study is supported by the study carried out in AL Kuwait University Hospital consultation clinic (34). The association might be because of - common pathophysiology, obesity, increased vascular resistance, renin-angiotensin-aldosterone system (RAAS), sedentary lifestyle, and medication effects.

Hypertension, or high blood pressure, shares common biological pathways with metabolic syndrome, including insulin resistance, endothelial dysfunction, and systemic inflammation. These factors can lead to the simultaneous development of both conditions. Hypertension is often associated with obesity, which is a significant risk factor for metabolic syndrome. Increased body fat, particularly visceral fat, contributes to both high blood pressure and the metabolic

abnormalities characteristic of metabolic syndrome. Elevated blood pressure can cause changes in blood vessels that further exacerbate metabolic issues, such as impaired blood flow to tissues, which may affect metabolic regulation. Hypertension is often related to dysregulation of the RAAS, which is involved in blood pressure regulation but also impacts metabolism, promoting fat gain and interfering with insulin action. Individuals with hypertension may engage in less physical activity due to concerns about physical exertion or the psychological impact of their condition, leading to a higher risk of obesity and metabolic syndrome. Medication Effects: Some antihypertensive medications can contribute to weight gain or glucose metabolism issues, potentially increasing the risk of developing metabolic syndrome.

5.7 Strengths and limitations of the study

5.7.1 The strength of the study

Developed a structured, and piloted questionnaire was used to prevent response bias, measurement bias and social desirability bias. Finally, in this study Audio record was used to prevent interviewer bias.

5.7.2 Limitations of the study

As some parts of the questionnaire depended on the memory of respondents, it may have resulted in recall bias.

5.8 Conclusion and Recommendation

5.8.1 Conclusion

The study identified several determinants of metabolic syndrome, including sex, physical activity, musculoskeletal disorders, and hypertension. Therefore, targeted educational and behavioral modification programs on regular exercise should be routinely practiced. Additionally, early guideline-based screening and treatment of comorbidities and complications would be required to effectively manage diabetes mellitus.

5.8.2 Recommendations

Based on the findings, the following recommendations have been made:

For Health Professionals: health professionals should intervene on the identified determinants of metabolic syndrome to prevent the occurrence of metabolic syndrome, know and manage the identified determinant factors of metabolic syndrome, give health education regarding the determinant factors of metabolic syndrome to all diabetic patients, and manage and prevent the possible baseline comorbidities.

For Mettu Karl Comprehensive Specialized Hospital: hospital administrators should emphasize and determine the determinant factors of metabolic syndrome, and establish NCD screening center in collaboration with Mettu town administrative office.

For I/A/B/Z/H/O: The/A/B/Z health office should require health institutions to integrate health education focused on non-communicable diseases (NCDs).

For Community: It is advisable to develop mass sports activities to engage the community and promote a culture of physical activity.

Further Research: Researchers are encouraged to undertake experimental investigations targeting these specific variables to validate their relationship with Metabolic Syndrome.

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ANNEX I: English version

Information and Consent sheet

Hello! My name is _____. I am a data collector for a research study being conducted by Girma Taye as part of his Master's degree in Public Health at Salale University. The aim of this study is to identify the determinants of metabolic syndrome among type 2 diabetic patients attending the diabetic clinic at Mettu Karl Comprehensive Specialized Hospital. The findings from this research will help us improve routine clinical care in the future.

Please be assured that the information gathered during this interview will remain confidential and will only be used for this research purpose. Your participation is voluntary and based on your free will.

Do you agree to participate in this study?

1. Yes _____

2. No _____

Contact Address of the Investigator

Name: Girma Taye

Phone number: 0933977795

Email: tayegirma322@gmail.com

Name of data collector _____ signature _____ Date _____

ANNEX III: ENGLISH VERSION QUESTIONAIRE

Questionnaire English Version

S.NO	Questions	Response categories	Remark
101	Respondent's number/ code	_____	
102	Hospital code	_____	
Part. I: Socio-demographic related Determinants metabolic syndrome			
201	Age in years_____		
202	Residence	1.urban 2. rural	
203	Sex	1.Male 2.Female	
204	Marital status	1. Single 2. Married 3. Widowed 4. Divorced	
205	What is your educational status?	1. Unable to read and write 2. Able to read and write 3. Primary 4. Secondary 5. College and above	
206	What is your occupation?	1. Farmers 2. Employed 3. House wife	

		4. Un employed 5. Merchants 6. jobless	
207	What is your religion?	1. Orthodox 2. Protestant 3. Muslim 4. Others	
208	What is your monthly per capita income? (HH income/family size) _____		
Part. II: Behavioral related Determinants metabolic syndrome			
301	Do you chew khat?	1. No 2. Yes	
302	Do you currently drink alcohol	3. No 4. Yes (how much/day_____bottles?	
303	Do you currently smoking cigarette	1. No 2. Yes (_____stick/day)?	
304	Do you have difficulty in initiating and maintaining sleep?	1. No (For how much time do you sleep per day? _____ Hour 2. Yes	

305	Do you do have/perform regular exercise/activity?	1. No 2. Yes(how much _____ minute/day	
306	Adherence to diet	1.No 2. Yes	
307	Adherence to medication	1.No 2. Yes	
	Part. III: Individual and Medical Related Determinants metabolic syndrome		
401	Duration of illness(in years)	_____	
402	Albuminuria	1.No 2.Yes	
403	Having diabetic complications	1.No 2.Yes	
404	Cardiac problem	1.No 2.Yes	
405	Co-morbidities	1. No 2. Yes	
406	If the answer is Yes for Q 401, what type of co-morbidities?	1. Hypertension 2. Diabetes mellitus 3. RVI	

	(more than one answer is possible)	4. Others_____	
407	Perceived having stress		
	For each question choose from the following alternatives: **0 - never 1 - almost never 2 - sometimes 3 - fairly often 4 - very often**		
_____	In the last month, how often have you been upset because of something that happened unexpectedly?		
_____	In the last month, how often have you felt that you were unable to control the important things in your life?		
_____	In the last month, how often have you felt nervous and stressed?		
_____	In the last month, how often have you felt confident about your ability to handle your personal problems?		
_____	In the last month, how often have you felt that things were going your way?		
_____	In the last month, how often have you found that you could not cope with all the things that you had to do?		
_____	In the last month, how often have you been able to control irritations in your life?		
	In the last month, how often have you felt that you were on top of things?		

_____		
_____	In the last month, how often have you been angered because of things that happened that were outside of your control?	
_____	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	

Part. IV: Lipid profile, anthropometrical and body composition Related Determinants metabolic syndrome			
501	Fasting blood glucose		
502	Triglyceride		
503	HDL-C		
504	LDL-C		
505	HA1C		
506	SBP		
507	DBP		
508	Weight(in Kg)		
509	Height (in M)		
510	BMI		

ANNEX: IV AFAAN OROMOO VERSION

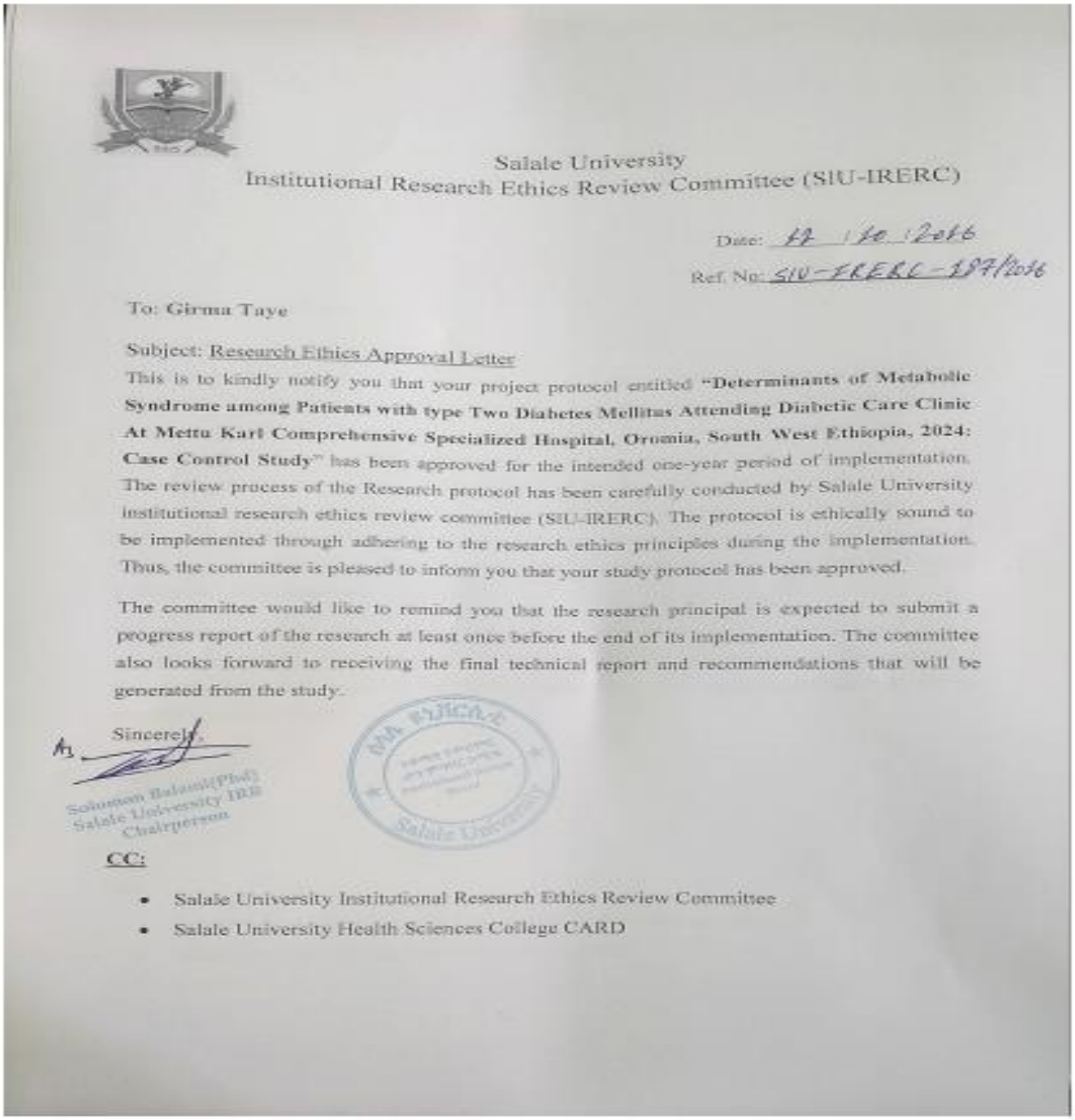
S.NO	Gaaffilee	Gosoota deebii kennuu	Yaada
101	Lakkoofsa/ koodii deebii kennituu	_____	
102	Koodii hospitaalaa	_____	
Kutaa I: Jijjiiramoota hawaas-dimoogiraafii wajjin walqabatan			
201	Umurii kee meeqa? _____		
202	Bakka jireenyaa	1. Magaalaa 2. Baadiyyaa	
203	Saala	1. Dhiira 2.Dubartii	
204	Haala gaa'elaa	1. qofa 2. Fuudhe/heerumte 3. Dubartii abbaan manaa irraa du'e ykn dhiira haati manaa jalaa duute 4. kan wal hiikaan	
205	Sadarkaa barnootaa	1. Dubbisuu fi barreessuu kan hin dandeenye 2. Dubbisuu fi barreessuu kan danda'u /ssu 3. Sadarkaa tokkoffaa 4. Sadarkaa lammaffaa 5. kollejjii fi isaa ol	
206	Hojiin kee/ keessan maali?	1. Qonnaan bulaa 2. Hojjetaa/ttuu mootummaa 3. Haadha manaa 4. Barataa/ttu 5. Daldalaa/tuu 6. Hojii dhabaa/du	
207	Amantaan kee maali?	1.Ortodoksii	

		2. Pirootestaantii 3. Muslima 4. Kanneen biroo_____	
208	Galiin nama tokko ji'a ji'aan argatu/ttu meeqa? (Galii maatii /baay'ina maatii) _____		
Kutaa II: Jijjiiramoota Amala fi Yaalaa wajjin walqabatan			
301	Jimaa/ caatii ni qaamtaa/ttuu	1. Lakki 2.Eeyyee	
302	Yeroo ammaa alkoolii ni dhugduu?	1. Lakki 2.Eeyyee (hammam/guyyaa_____qaruuraa?	
303	Yeroo ammaa kana sigaaraa xuuxaa jirtaa?	1. Lakki 2. Eeyyee (_____ulee/guyyaa)?	
304	Hirriba jalqabuu fi eeguu irratti rakkataa?	1. Eeyyee 2.Lakki (Yeroo meeqaaf raftu guyyaatti _____ sa'aatii	
305	Sochii qaamaa ni gootu?	1. lakki 2. eeyyee (guyyaatti_____ daqiiqaa)	
306	Sirna nyaataa ni hordooftu?	1.lakki 2. eeyyee	
307	Qoricha sirnaan ni fudhattu?	1.lakki 2. eeyyee	
	Kutaa III: Jijjiiramoota Dhuunfaa fi Yaalaa wajjin walqabatan		
401	Turtii dhukkuba (Waggaa dhaan).	_____	

402	Albuminuria kan jedhamu fincaan keessatti kan argamu qabdu?	1.lakki 2. eeyyee	
403	Rakkoo wal xaxaa dhibee sukkaaraatiin dhufu qabdu?	1.lakki 2. eeyyee	
404	Dhibee onnee fi ujummoo dhiigaan wal qabatu qabdu?	1.lakki 2. eeyyee	
405	Dhukkuboota meetaabolii siindiroomii waliin dhufan qabdu	1.lakki 2. eeyyee	
406	Deebiin gaaffii 405, eeyyee yoo ta'e dhibee isaa kamiin qabdu? (deebii tokkoo ol ni dandeessu)	1. Dhiibbaa dhiigaa 2.Dhibee sukkaaraa 3. infekshinii vaayirasii retroviral 4. Kan biroo_____	
407	**Iskeelii Dhiphinaa Hubatame**		
	Tokkoon tokkoo gaaffileedhaaf filannoowwan armaan gadii keessaa filadhu: 0 -gonkumaa 1 - gonkumaa jechuun ni danda'ama 2 - yeroo tokko tokko 3 - yeroo baay'ee 4 - yeroo baay'ee baay'ee		
_____	Ji'a darbe keessa sababa waan hin eegamneen yeroo meeqa mufatte?		
_____	Ji'a darbe keessa yeroo meeqa jireenya kee keessatti wantoota barbaachisoo ta'an to'achuu akka dadhabde sitti dhaga'ame?		
_____	Ji'a darbe keessa yeroo meeqa naasuun fi dhiphinni sitti dhaga'ame?		
_____	Ji'a darbe keessa yeroo meeqa dandeettii rakkoo dhuunfaa kee to'achuu irratti ofitti amanamummaa sitti dhaga'ame?		
_____	Ji'a darbe keessa yeroo meeqa wantootni karaa kee deemaa akka jiru sitti dhaga'ame?		

_____	Ji'a darbe keessa yeroo meeqa wantoota gochuu qabdu hunda dandamachuu akka hin dandeenye simudate?		
_____	Ji'a darbe keessa jireenya kee keessatti yeroo meeqa aarii to'achuu dandeesse?		
_____	Ji'a darbe keessa sababa wantootni to'annoo kee olta'aniin yeroo meeqa aariin sitti dhaga'ame?		
_____	Ji'a darbe keessa sababa wantoota to'annaa keessaniin ala ta'aniin yeroo meeqa aartan?		
_____	Ji'a darbe keessa yeroo meeqa rakkoon akka ati mo'achuu hin dandeenye ol tuulamaa akka jiru sitti dhaga'ame?		
Kutaa IV: Jijjiiramoota piroofaayilii lipidii, anthropometrical fi walnyaatinsa qaamaa wajjin walqabatan			
501	Gilukoosii dhiiga soomanaa	_____	
502	Tiraayigiliisaayidii	_____	
503	Kolestroolii liipoo pirootiinii dhangala'aa guddaa (HDL-C)	_____	
504	Kolestroolii lipoprotein density gadi aanaa qabu LDL-C	_____	
505	Gilaaykeetiid heemoogloobiin	_____	
506	Dhiibbaa dhiigaa sistoolikii	_____	
507	Dhiibbaa dhiigaa diyastolic	_____	
508	Ulfaatina (Kg dhaan)	_____	
509	Dheerina (cm dhaan)	_____	
510	Indeeksii Ulfaatina qaamaa	_____	

ANNEX V: RESEARCH ETHICS APPROVAL LETTER



Salale University
Institutional Research Ethics Review Committee (SIU-IRERC)

Date: 12/10/2016
Ref. No: SIU-IRERC-187/2016

To: Girma Taye

Subject: Research Ethics Approval Letter

This is to kindly notify you that your project protocol entitled **"Determinants of Metabolic Syndrome among Patients with type Two Diabetes Mellitus Attending Diabetic Care Clinic At Mettu Karl Comprehensive Specialized Hospital, Oromia, South West Ethiopia, 2024: Case Control Study"** has been approved for the intended one-year period of implementation. The review process of the Research protocol has been carefully conducted by Salale University institutional research ethics review committee (SIU-IRERC). The protocol is ethically sound to be implemented through adhering to the research ethics principles during the implementation. Thus, the committee is pleased to inform you that your study protocol has been approved.

The committee would like to remind you that the research principal is expected to submit a progress report of the research at least once before the end of its implementation. The committee also looks forward to receiving the final technical report and recommendations that will be generated from the study.

Sincerely,

Solomon Balasa(Phd)
Salale University IRB
Chairperson

CC:

- Salale University Institutional Research Ethics Review Committee
- Salale University Health Sciences College CARD

DECLARATION

SALALE UNIVERSITY

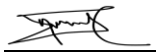
College of Health Sciences Department of Public Health

I hereby declare that this research thesis is my own work and effort and that, to the best of my knowledge and belief, I have followed technical principles of scholarship in the preparation of this research thesis. Any Scholarly matter that is included in the thesis result has been given recognition through citation. This research thesis is submitted in partial fulfillment of the requirements of MPH Degree in Epidemiology at the Salale University.

Name: **Girma Taye Bekere** Signature: 

I hereby certify that I have read and evaluate this research thesis entitled Determinants of Metabolic Syndrome in Type Two Diabetes Patients at Mettu Karl Comprehensive Specialized Hospital, Oromia, Ethiopia, prepared under my guidance by Girma Taye Bekere. I recommend that it be submitted as fulfilling the research thesis requirement.

1. **Main Advisor**: - Kassahun Ketema (Assistant Professor)

Signature:  Date: Dec 7/2024

2**. Co-Advisor**:- Addisu Waleligne (MPH, Epidemiology and Biostatistics)

Signature:  Date Dec 7/ 2024