PREVALENCE OF DIABETES MELLITUS AND ASSOCIATED FACTORS AMONG ADULT INDIVIDUALS IN ASOSSA TOWN, WEST ETHIOPIA; COMMUNITY BASED CROSS-SECTIONAL STUDY

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A RESEARCH THESIS PAPER SUBMITTED TO SCHOOL OF MEDICAL LABORATORY SCIENCES, FACULTY OF HEALTH SCIENCES, INSTITUTE OF HEALTH, JIMMA UNIVERSITY; IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN CLINICAL LABORATORY SCIENCES (CLINICAL CHEMISTRY SPECIALTY)

NOVEMBER, 2022

JIMMA, ETHIOPIA

JIMMA UNIVERSITY

INSTITUTE OF HEALTH

FACULTY OF HEALTH SCIENCES

SCHOOL OF MEDICAL LABORATORY SCIENCES

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Abstract

Background: *Diabetes mellitus is becoming public health burden in developing countries like Ethiopia. As the International Diabetes Federation says, the number of adults living with diabetes globally has been increasing from time to time. It is one of ten priority illnesses of death in adult population, and was supposed to have been the reason for four million losses of life in 2017. If early screening and follow-up are done, diabetes is a manageable disease.*

Objective: *The study aimed to determine the prevalence and associated factors of diabetes in Assosa Town, West Ethiopia.*

Methods and materials*: A community-based cross-sectional study was conducted from December 1/2021 to January 28/2022 among people aged 18 years and above in Assosa Town, West Ethiopia. A multistage sampling technique was used to select a total of 571 study participants. Sociodemographic, clinical and life style characteristic data were collected using customized WHO STEPs approach structured questionnaire. 5mL venous blood samples were used to determine the level of blood glucose (hexokinase method) and lipid profile (direct enzymatic method) by using cobas c 311 Roche clinical chemistry analyzer. Diagnosis and classification of diabetes mellitus and prediabetes were based on the criteria of the American Diabetes Association.* The data were entered into Epi data version 3.1 and analyzed by using Statistical Package for Social Sciences (SPSS) version 25 (IBM, Chicago)

Results*: A total of 560 individuals with 98% response rate were included in the study. Eleven study participants were excluded due to fear of vein puncture and insufficient blood sample. The age raged 18- 98 with maximum participants (39.3%) between 30-44 age group. 54.3% male, 64.6%married, 35.9% diploma and above, 46.4% orthodox, 55% had low monthly income and 36.4% unemployed. The prevalence of diabetes mellitus was 3.9% (95% CI ; 2.31-5.54), out of which 12 (54.5%) were newly diagnosed, while the prevalence of prediabetes was 8.8%. 45.5% of DM found in 45-59 age groups. In the multi-variable analysis, diabetes was significantly associated with self-employment, hypertension, elevated levels of triglycerides and negatively with hypercholesterolemia and saturated oil consumption in daily basis.*

Conclusion: *Even though current prevalence is comparable with nationally estimated prevalence of diabetes, attention will be needed to reduce risk factors like hypertension, hypertriglyceridemia, hypercholesterolemia and saturated oil consumption.*

Key words: *Diabetes Mellitus ,prevalence, associated risk factors, cross-sectional, community-based study, Asossa, West Ethiopia*.

Acknowledgement

I would like to thank Jimma University, Institute of Health, Faculty of Health Sciences, School of Medical Laboratory Sciences, for giving this chance to conduct my MSc research project on this title and I gratefully acknowledge Benishangul Gumuz Regional Health Bureau for sponsoring my education.

My great full appreciation and heartfelt thanks goes to my advisors Mr. Aklilu Getachew Mamo (MSc, PhD fellow), Mr. Shiferaw Bekele (MSc, Assis. Prof.) and Mr. Temam Ibrahim (MSc) for their valuable advice, patience, professional support, and technical guidance throughout this research paper.

I am grateful to the Benishangul Gumuz Regional State Research Laboratory Institute and Assosa General Hospital for the laboratory equipment, materials and reagents support they offered me throughout my study.

I owe a great deal of appreciation to all Benishangul Gumuz Regional State Research Laboratory Institute director, Assosa General Hospital Manager (CEO), Medical doctor and Laboratory case team for their cooperation. I would also like to give my heartfelt thanks to Assosa General Hospital department of clinical chemistry staff for their honest support throughout the data collection period in specimen collection, sample processing and result interpretation.

My truthful thanks also go to the Assosa Town administration health department office, health extension supervisors and woreda leaders, zone (kebele) leaders whom without their valuable contribution through giving support letters, delivering data on population background information, and locating the zone (kebele) boundaries, without them, it was impossible to come up with the intended data. It is also important to give thanks to health extension professionals for collecting background data, clinical data, and behavioral data.

I am sincerely grateful to all-volunteer individuals who took part in this study for their cooperation and willingness to give proper information, without them this study would not be possible. It was not convenient to donate blood sample in the morning before breakfast; however, our study participants did this. I hope that the findings of the present study will benefit them and/or their families. Finally, the last but for the most, my deep gratitude goes to my family and friends for realizing this thesis.

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Abbreviations

***ADP*:** Adenosine diphosphate

***ADA*:** American Diabetes Association

***ATP*:** Adenosine triphosphate

***AHA*:** American Heart Association

AOR : Adjusted Odd Ratio

***BP*:** Blood Pressure

***BMI*:** Body Mass Index

***CDC*:** Centers for Disease Control and Prevention

***C.f.a.s*:** Calibrator for automated system

CI : Confidence Interval

COR : Crude Odd Ratio

***DM* :** Diabetes Mellitus

***FDA*:** Federation Diabetic Association

G-6-P: Glucose-6-phosphate

G-6-P-D : Glucose-6-phosphate dehydrogenase

***HDL*:** High Density Lipoprotein

***HK*:** Hexokinase

***IFG*:** Impaired Fasting Glucose

***IGT*:** Impaired Glucose Tolerance

***LDL*:** Low Density Lipoprotein

***NADH*:** Nicotinamide adenine dinucleotide + hydrogen

***mmHg*:** millimeter of mercury

***PI*:** Principal Investigator

***QC*:** Quality Control

***SOP*:** Standard Operating Procedure

***SST*:** Serum separator vacuum tube

***T2DM*:** Type 2 Diabetes Mellitus

***TC*:** Total Cholesterol

***VLD*L:** Very Low-Density Lipoprotein

Operational and terms definitions

Diabetes mellitus:- Fasting blood glucose level ≥126 mg/dL (for two repeated samples)

Adult: - An individuals whose age is greater than or equal to 18 years old.

Fasting: - No food intake for at least 8 hours of the first night just before the day of the sample collection (1)

Prediabetes (Impaired fasting glucose):- Individuals whose fasting blood glucose levels do not meet the criteria for diabetes but are too high (100 -125mg/dL) to be considered normal(1).

Impaired glucose tolerance (IGT): - 2-h PG during 75-g OGTT levels between 140 and 199 mg/dL (between 7.8 and 11.0 mmol/L)(1).

Oral Glucose Tolerance Test (OGTT): - A test whereby glucose is ingested into a fasting stomach and measurements of plasma glucose are taken over time (1).

Underweight: - An individual with body mass index (BMI) of less than 18.5 kg/m^2 ; **Normal**: - An individual with body mass index (BMI) of 18.5 – 24.9 kg/m^2 ; **Overweight** – An individual with body mass index (BMI) of 25 – 29.9 kg/m^2 ; **Obesity** – An individual with body mass index (BMI) of 30 – 39.9 kg/m^2 ; **Severe or morbid obesity** – An individual with body mass index (BMI) of ≥ 40 kg/m^2 (2).

Dyslipidemia/abnormal blood lipids: - An abnormality in any one of lipid profile when HDL-C ≤ 33 mg/dl in adults, LDL-C ≥130mg/dl, Cholesterol ≥ 200 mg/dl and triglyceride (TG) ≥ 150mg/dl (3).

Hypertension: - Raised blood pressure defined as average systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg on three separate measurements in five minutes intervals or an individual receiving anti-hypertensive drugs to control their raised blood pressure (4)

Current smoking: - Using any quantity of tobacco products within 30 days (about 4 and a half weeks) prior to the study. **Current alcohol use:** - Consumption of any amount of alcohol drink within 30 days (about 4 and a half weeks) prior to the study.

Family history of DM:– Clients regarded as positive if either of parents (mother or father) or sibling(s) have diabetes.

Zone (kebele):- the smallest administrative level in Assosa town

Poor diet: - Decreased consumption of fruits and vegetables (< 8 servings per day)

- Increased consumption of high-fat dairy products (> 3 servings per day) (4).

Physical activity: - Based on client report of practicing any regular physical activity like walking/riding bicycle, carrying/lifting heavy loads, digging or construction work and so on for at least 10 minutes continuously per week and categorized as

- More than 300 minutes (about 5 hours)/week (active)
- 150−300 minutes (about 5 hours)/week moderate physical activity like walking and swimming per week.

Physical inactivity: - Activities less than 150 minutes (about 2 and a half hours) per week including for those in sedentary life style like sitting at office or home, travelling in car/train/bus, reading, playing cards, but not include time spent sleeping.

Saturated fat (oil): - a type of fat/oil in which the fatty acids chains have all single bonds and considered to be less healthy in the diet than unsaturated fat. Examples of saturated fats/oils are butter, coconut oil, and palm oil.

Unsaturated fats (oil): - a type of fat/oil in which the fatty acids chains have at least one double bond, considered to be healthier in the diet than saturated fats. Examples are olive oil, peanut oil, avocado oil and vegetable oils like sunflowers oil.

WHO STEPS instrument:- is data collection instrument comprised of three different levels or "steps" of risk factor assessment: step 1 (questionnaire like demographic data, life style, diet, physical inactivity and history of high BP and diabetes), step 2 (physical measurements like body mass index, waist circumference and blood pressure) and step 3 (biochemical measurements like fasting blood sugar, fasting total cholesterol, triglycerides, HDL and LDL cholesterol levels)

Waist circumference (WC):- the measurement taken around the abdomen at the level of the umbilicus (belly button). WC values ≥ 102cm (for men) and ≥ 88cm (for women) were considered high.

CHAPTER ONE : INTRODUCTION

1.1 Background information

Diabetes is a severe, chronic disease with a significant impact on the life and interest of persons, classes, and communities on the globe. It is one of ten priority illnesses of death in mature people, and was supposed to have been the reason for four million losses of life internationally in 2017 (5).

Diabetes can be classified into the following broad categories**:** Type 1 DM (autoimmune β-cell destruction, leading to total insulin deficit), Type 2 DM (gradual lack of insulin secreting β-cells often related to insulin resistance), Diabetes detected during pregnancy particularly in the 2nd and 3rd trimester and some non-general kinds of diabetes due to varied reasons. E.g., newborn and adulthood-onset diabetes of the young, and medicine or biochemical-induced (like glucocorticoid practice as antiretroviral therapy or post organ transplantation) (1,6)

Type1 DM is about 5-10 % of diabetes cases usually considered immediate onset of polyuria, polydipsia, and quick weight loss. Patients experience insulinopenia due to destruction of pancreatic islets of ß-cells and are dependent on insulin to sustain life and prevent ketosis (7). Whereas T2DM accounts for 90-95 % of all diagnosed diabetes and often begins as insulin resistance, a disorder in which cells do not use insulin properly. As far as the need for insulin increases, the pancreas losses its capacity to secrete it (8)

Type2 DM is viewed as failure in insulin action because of muscle cells resistance to its action and exaggerated by the inability of β-cells of pancreas to yield adequate insulin to respond the resistance. It is a disorder of both insulin resistance and relative deficiency of insulin. Insulin resistance pattern disturbs the metabolism of many nutrients, including glucose, triglycerides, and high-density lipoprotein (HDL) cholesterol. Persons diagnosed with this condition may show abdominal obesity and high blood pressure and at increased risk for cardiovascular disease (9,10).

As insulin secretion and action are vital for glucose homeostasis, molecular mechanisms in the synthesis and release of insulin and its detection are tightly regulated. Defects in any of the mechanisms involved in these processes can lead to a metabolic imbalance responsible for the development of the disease (10).

Glycemia regulation in overweight patients with T2DM is central for the stoppage of serious microvascular problems that meaningfully affect the quality of life of patients (11).

Table 1: Criteria for the diagnosis of diabetes mellitus

Fasting plasma glucose ≥ 126 mg (about the weight of five grains of rice)/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h. Or

2-h plasma glucose ≥ 200 mg (about twice the weight of a business card)/dL (11.1 mmol/L) during OGTT (applying glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. Or

A1C ≥ 6.5% (48 mmol/mol). The test should be performed in a laboratory. Or
In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose $200 mg/dL (11.1 mmol/L).

Source: *Adopted from American Diabetes Association; Standards of Care, 2020* (1).

Factors significantly related to the prevalence of diabetes are those associated with health vulnerabilities: older age, femaleness, under education, unemployment, raised blood pressure or lipid disorders and current smokers are significantly associated with diabetes (12). Development of several complications (e.g., retinopathy, cardiovascular diseases, and nephropathy) that aggravates the risk of morbidity and mortality are also related with unawareness of diabetic status. Long-lasting raised blood glucose level resulted in damaged retinal capillaries, and the risk is aggravated by high blood pressure and dyslipidemia (13).

Ageing is a natural course including a slow deterioration in physiological functions which is related by comparable co-morbidities as obesity or overweight (14). At the base of obesity is adiposopathy (or "sick fat") defined as "pathologic adipose tissue anatomic/functional disturbances promoted by positive caloric balance in genetically and environmentally susceptible individuals that result in adverse endocrine and immune responses that may cause or worsen metabolic disease" (15). Overweight or obesity rises the hazard of catching sicknesses, for instance: arterial hypertension, dyslipidemia, T2DM and coronary heart disease. Body mass index (BMI), is the parameter often used to show obesity (16). However, most of the community-based studies conducted in Ethiopia did not assess the lipid profile of their study participants.

Patients with elevated BMI and other features of metabolic syndrome including diabetes mellitus, overweight/obesity, hyperlipidemia, or hypertension with mild elevations of ALT should undergo screening for nonalcoholic fatty liver disease with ultrasound (17).

Treatment of diabetes includes diet and proper physical activity in parallel with minimizing

blood glucose and levels of other known risk factors that affect blood vessels. Cessation of tobacco use, blood glucose control (insulin injection for T1DM and oral medication for T2DM), blood pressure control, blood lipid (bad cholesterol) control, patient self-hygiene for foot care and professional seeking for foot ulcer treatment and screening for early signs of diabetes related kidney disease are also among cost effective and possible interventions for diabetes control and management (18).

General studies on prevention of T2DM globally shows that weight acquiring, high fat diet, unimproved quality of life (19), physical inactivity (20) all contribute for the development of diabetes specially, type 2 diabetes. Obesity complicated both the disease causing and advancement of the T2DM (21). Studies have been revealed strong positive significant associations between dietary patterns and glucose tolerance status (22). Micro- and macro-vascular disorders exist as long- or short-term duration conditions are resulted from recurrent metabolism and homeostasis dysregulation in diabetes and diabetes-specific therapies (23).

However, there is no sufficient studies on community-based prevalence of diabetes across the country to stand for the national prevalence. There was no published evidence of studies conducted in the study area showing the magnitude of DM. Therefore, the present study was conducted to assess the prevalence of diabetes mellitus using fasting plasma glucose (FPG) (24) and its associated factors in Assosa Town, West Ethiopia.

1.2 Statement of the problem

According to International Diabetes Federation (IDF) Diabetes Atlas report in 2020 on its 9th edition, diabetes is one of the fastest growing global health emergencies of the 21st century that has no respects either for socioeconomic position or state restrictions. The regional prevalence of diabetes among adult individuals (20-79 years) is 13.3 % (highest prevalence) for North American and 3.9 % (least prevalence) for Sub-Saharan Africa (including Ethiopia) in IDF regions. Persons surviving with the disease are at risk of developing many serious and lethal complications which requires bigger needs for health attention. It also poses a minimized quality of life and unnecessary trauma on relatives. Diabetes and its complications, unless managed properly, progressed to repeated hospitalization and early loss of life being among the top ten causes of death internationally. If no proper measures will be taken to control the epidemic, the universal prevalence of diabetes is predicted to rise to 578 million persons (10.2% of the world population) and 4.1% for sub-Saharan Africa by 2030 (24).

According to National Diabetes Statistics Report of 2020, 34.1 million (13.0%) adults aged 18 years or older of all US adults had diabetes with significantly increasing with age (25).

Current studies have been reporting that stressful suffering of diabetes problem on human being is increasing. According to descriptive epidemiological data from the global burden of diseases managed by the Institute of Health Metrics and Evaluation at the University of Washington, Seattle, the epidemiology of type 2 diabetes showed the higher prevalence of diabetes. T2DM globally keeps rising with fast growing with no signs of stability in under developed regions (26).

Direct costs for DM were up to 9-fold higher in individuals with the disease than without T2DM-related complications (27). World health expense on the disease was calculated to be USD 727 billion. Diabetic health burden is being elevated and forecasted with a worldwide prevalence in adults to be 9.9 % by 2045 (5,28), while greater than 400 million individuals are living with diabetes (29).

Diabetes, especially T2DM, is a complex illness. Because of diagnostic challenges, it is a combination of diverse etiologies that we need to be better at classifying as this has primary implications for treatment and patient management and determined by several pathophysiological progressions resulting in a spread of medical features that so far are overlooked at time of care how we manage affected individuals (30).

Atherosclerotic cardiovascular disease (ASCVD) defined as coronary heart disease, cerebrovascular disease, or peripheral arterial disease assumed to be of atherosclerotic origin. ASCVD is the leading cause of morbidity and mortality for individuals with diabetes and results in an estimated $37.3 billion (about $110 per person in the US) in cardiovascular-related spending per year associated with diabetes (31).

In Ethiopia, IDF 2019 report said an estimated national DM prevalence from in-country data source of diabetes 3.2 % (24). However, DM prevalence of as high as 14.8 % has been reported in 2016 in Addis Ababa Public health facilities (32). In the same year, a community-based cross-sectional study conducted in Mizan-Aman town reported 6.5 % of DM prevalence(33). One year later a community-based cross-sectional study conducted among 634 randomly selected adults in Hosanna town has been reported 5.7 % (34). However, after two years a community-based cross-sectional study conducted in 2019 at Dessie Town reported 6.8 % prevalence (35).

As studies indicated, the prevalence and incidence of diabetes, specially T2DM rises due to population development, aging, diet behaviors, urbanization, and increasing frequency of obesity and physical inactivity (36). Even though works to minimize the disease prevalence are being undertaking by health-care professionals and policy makers on the prevention of the risk factors of diabetes, it is advisable to make effort to the level of the problem to reduce the magnitude of the disease at low level.

Understanding the magnitude and risk factors of diabetes is important to allow rational planning and allocation of resources. This study aimed to provide additional data on the magnitude of diabetes and associated risk factors among adult individuals living in Asossa town, Benishangul Gumuz Regional State, West Ethiopia.

1.3 Significance of the study

DM is one of the leading non communicable diseases in the world. In indistinguishable situation the magnitude of DM is gradually increasing in total population in Ethiopia due to several factors like older age, under education, unemployment, raised blood pressure, dyslipidemia and current smoking. Therefore, the finding of this research will be useful:

- Will inform programs to be set for the screening of diabetes, particularly T2DM, in the prediabetic stage
- It will also help to define recent risk factors associated with diabetes.
- To provide information for health professionals, policy makers and other governmental and nongovernmental organizations to maximize efforts on the prevention of diabetes mellitus in the study area and in the country as well.
- Will have direct implications for the health systems planning and resource allocations. Since hospital-based management and sub-specialist care are not sustainable strategies, resource allocations in health care budgets for prevention of diabetes needs to be comparable to expenditures on treatment. Strengthening primary health care and community restructuring for active life styles and healthy nutrition are more likely to be cost effective.
- Will establish base line for other researchers those interested to undertake another similar study at the area.

CHAPTER TWO : LITERATURE REVIEW

2.1 The magnitude of diabetes mellitus

Diabetes is a key health problem that has reached shocking levels: nowadays, half a billion (463 million) individuals are living with diabetes globally. This value will rise to be 700 million by the year 2045 in the world and in Africa it will rise by 143 % from 19 million (2019) to 47 million by 2045 (24).

According to the scientific report on analysis from 1990 to 2025 global, regional, and national burden and trend of diabetes in 195 countries and territories, T2DM is estimated to be raised to 7 % by 2030, showing a sustained increase all over the world, giving the emphasis on trends of increasing prevalence in lower-income countries. As to the analysis, the load of diabetes is obviously linked with metabolic risks (i.e., raised BMI) and lifestyle factors (i.e., bad nourishment, smoking cigarettes, and physical activity), showing the foremost risk factors in 2017 were high BMI and dietary risk (5).

According to IDF report in 2020, with its 9th edition, diabetes is among the fastest growing world health crises of the 21st century. Among individuals with the disease 2/3rd are urban dwellers while the 3/4th are in working age showing that diabetes is the disease that affects world economy through compromising the power of working since it would complicates health of individuals. Based on this report the highest magnitude of the disease (13.3%) among adult persons was observed in North America and Caribbean regions of IDF, while the lower percentage (3.9%) was seen in Sub-Saharan Africa regions of IDF that included Ethiopia. Europe 8.9%, South East Asia 8.8%, West Pacific 9.6% and Middle East and North America IDF regions with 12. 8% (24)

According to the population based, cross sectional study conducted among 75 880 participants aged 18 and older; a nationally representative sample of the mainland Chinese population using data from 2015 to 2017, the magnitude of DM amongst adult populations of China has increased (total prevalence of DM from 12% to 13.6%) between 2007 and 2017 showing that the condition is a vital community well-being problem in the country (37).

Almost half a billion human beings (9.3% of adults of 20–79 years), that was increased by 62 % throughout last 10 years from 285 million (in 2009) to 463 million (in 2019) were having life with diabetes globally. Among that, half of them did not know that they have diabetes. Diabetes prevalence was diversified by World Bank income group, by greater prevalence

among highly productive countries (10.4%) and intermediate-income countries (9.5%) in relation to lower-income ones with 4.0%. By 2045, diabetes prevalence will be formulated to reach in high income (11.9%), middle income (11.8%) and 4.7% in low-income countries. Of all population surviving with diabetes 67 % are living in urban areas of which about 79.4% of them live in low- and middle-income countries like Ethiopia. Around 4.2 million adult people aged between 20 -79 years were also died in 2019 (8,15).

A community-based cross-sectional study conducted (2019) among 773 residents aged 18 and above years in Gondar town, Ethiopia, has showed that the magnitude of DM to be 6.34%, of which 40 (81.6%) were newly diagnosed (39).

According to community-based cross-sectional study conducted among 634 randomly selected adults in Hosanna. Total prevalence of DM was found to be 5.7% in the area. Among them near 36% were unaware of about their DM status before. Current alcohol drinking, daily sitting more than 8 hrs, large BMI and high blood pressure were allied with the disease (34).

Community-based cross-sectional study was carried out in 2016 in Mizan-Aman town, Southwest Ethiopia. Among a total of 402 participants included in the study 26 individuals (6.5%) were diabetic. Of them, the proportion of previously undiagnosed individuals as diabetic was 88.5% and the prevalence of prediabetes was also found to be 15.9%. As to the study, the waist circumference (WC), body mass index, smoking habit, hypertension, and total cholesterol level were significantly associated with diabetes mellitus (33).

An institution-based cross-sectional study conducted in 2016 in selected public health institutions of Addis Ababa administrative town among a total of 758 participants selected using a multistage sampling technique showed the overall institutional prevalence of diabetes mellitus was 14.8%, with a sex-specific prevalence of 18.35% and 16.62% for males and females, respectively. As the study showed older aged participants to younger one, alcohol consumers than non-drinkers, participants with plasma HDL cholesterol ≥ 40mg/dL than those with < 40mg/dL and participants with plasma triglyceride ≥ 130 mg/dL than low level of triglyceride were found to be more exposed to the risk of developing diabetes (32).

2.2 DM associated factors

According to American Diabetes Association update guidelines on standards of medical care in diabetes-2019, the risk factors for type 2 diabetes mellitus are: age, gender, ethnicity,

family history of type 2 diabetes mellitus, obesity, physical inactivity, nutritional diet, smoking, gestational diabetes, high blood pressure, low HDL-cholesterol, increased tri-glycerides, cardiovascular diseases, high blood glucose on previous testing, impaired glucose tolerance and glycated hemoglobin ≥ 5.7% (40).

Diabetes is a central reason for loss of sight, kidney letdown, lower limb amputation and influence on quality of life while overweight (obesity) is an increasing risk factor (29). Even though overweight is the main modifiable risk factor for T2DM, individuals with severe obesity are at increased risk than those with lesser BMI for the disease (41).

Obesity is a prevalent, complex, progressive, and relapsing chronic disease, characterized by abnormal or excessive body fat (adiposity), that impairs health. People living with obesity face substantial bias and stigma, which contribute to increased morbidity and mortality independent of weight or body mass index (42).

The growing trend of factors associated with type 2 diabetes mellitus is increasing in different populations(43). According to institution-based cross-sectional study employed on 378 T2DM patients in Northwest Ethiopia in 2019, showed that hypertension is predominant among factors associated with diabetes like overweight, males sex, old age, individuals living in town and diabetic patients with poor glycemic control and current cigarette smokers (2). High LDL cholesterol, high TAG and low HDL are risk factors (44). These studies have shown that hypertension and dyslipidemia are the main risk factors among diabetic patients and both factors are in turn related to each other.

The finding from community based cross-sectional study conducted in Brazil (2018), among age of 20 to 45 years, showed that 18.4% of the total 17,580 participants having high blood glucose levels. The result also showed that BMI > 25 kg/m^2, abdominal circumference > 94 for boys and > 80 cm for females, lack of daily intake of vegetables & fruits, previously diagnosed blood pressure, history of raised blood glucose and family history of DM were predisposing factors for diabetes (45).

According to cross sectional study conducted on diabetes epidemiology among people aged 40 years and above in Shenyang, China 3922 individuals, comprising 2433 (62.0%) urban populations and 2195 (56.0%) females, has been showed the prevalence of DM 15.5% with higher magnitude in urban (17.7 %) than in rural (14.2%), in patients with dyslipidemia than without the disorder and in an inactive individuals than regularly active ones (46).The distribution of urban-rural setting and sex difference was similar with cross-sectional study

conducted in Myanmar (47). Elevated fasting blood glucose was significantly associated with hypertension (48).

According to facility-based case control study conducted in Northern Ethiopia (Tigray) in the year 2014 using samples of 73 cases and 290 controls, smoking, diet, physical inactivity, obesity/overweight and raised blood pressure were significantly associated with type 2 diabetes mellitus (49).

According to institutional-based cross-sectional study conducted in 2019 in Debre Tabor, Northwest Ethiopia, the prevalence of raised blood pressure among T2DM patients was 59.5% with larger odds among age groups 50-60 years (adjusted odds ratio (AOR) =2.8. Being town resident, long standing T2DM, BMI $\geq$ 25kg/m^2, poor glycemic control and current cigarette smoking were risk factors for hypertension(2).

From different literatures, guidelines, and world diabetes federation we could understand that diabetes is an increasing world health problem that was not hindered (prevented) with socioeconomic status and sovereignty or political strengths of nations and governments. There are also similar study findings across the globe showing several factors associated with the development of diabetes unrespect to diverse cultures, socioeconomic status, different educational backgrounds, life styles and so on. However, there is greater increase in prevalence of diabetes among under developed nations than developed ones. Developing countries like Ethiopia, has more to do on both community screening and control of the disease before victims develop complications associated with the conditions as more people who are unaware of their diabetes status are living in the community.

2.3 DM complications

Kidney disease (nephropathy) shared among individuals with diabetes than in people without it; DM is one of the top grounds for chronic kidney disease (CKD).The disease is caused by injury to small blood vessels, which can cause kidneys to be less efficient, or to fail altogether (50). It was estimated that above 5 % of patients who are newly diagnosed for type 2 diabetes previously have CKD and the lifetime risk of emerging CKD for both types of diabetes is estimated to be 40 % in which case most patients develop the disease within 10 years of diagnosis (51).

Diabetes, specially T2DM, can complicate patients with raised blood pressure particurly among patients with poor blood pressure control (2). Some scholars showed that co-

morbidity of high blood pressure and disorders of lipid metabolism became higher in T2DM patients with poor glycemic control (52). According to prospective, cross-sectional observational cohort study conducted at the diabetology clinic of Aseer Diabetes Center, Saudi Arabia, with total study duration of 12 years, from August 2005 until July 2017, with total number of patients 9340 routinely followed up in the diabetes clinic, hypertension or raised blood pressure has positive relationship with diabetes related complications as diabetic patients are at risk of cardiovascular and atherosclerotic disease development and progression (53). This indicates that blood pressure can be associated with and complicates diabetes disease.

A hospital based cross-sectional study on "Factors Associated with Poor Glycemic and Lipid Levels" was conducted (2017) among 209 diabetic patients who had regular follow-ups at general hospital found in Asmara. The study findings revealed that a single digit reduction in estimated glomerular filtration rate (eGFR) was related with poor glycemic control and about 81% of the participants was with lipid disorder. The study has shown that risk factors like ages and sex of the patients, blood pressure, abnormal waist circumference, long time of the disease and reduced eGFR are associated with poor glycemic control (54).

Therefore, the purpose of this study was to assess the magnitude of the diabetes mellitus and to identify the major risk factors associated with the condition among the adult population of Assosa Town, West Ethiopia.

2.4 Conceptual framework of the study

The study assessed the prevalence and the risk factors of diabetes mellitus. Variables were being selected based on the reports of different literatures listed above. Socio- demographic factors, behavioral factors, biochemical factors, and the outcome variable; diabetes were focused on this study.

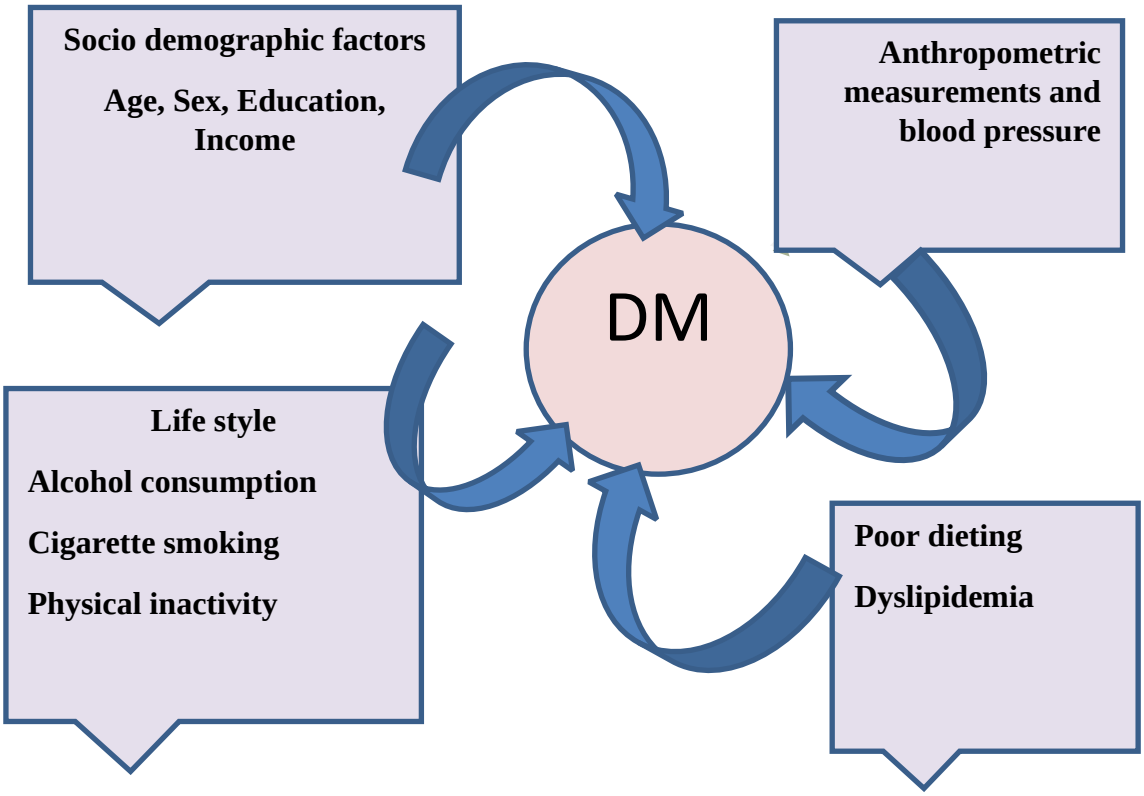

Figure1: A conceptual frame work which was adopted from different articles for the assessment of diabetes prevalence and associated factors among adult individuals.

Keys :- the arrow signs show factors associated with diabetes mellitus in their degree of association with proximity of charts to DM

CHAPTER THREE : OBJECTIVES

3.1 General objective

To determine the prevalence of diabetes mellitus and to identify associated factors among adult individuals in Asossa Town, Benishangul Gumuz Regional State, West Ethiopia; From December 1/2021 to January 28/2022

3.2 Specific objectives

1) To determine the prevalence of diabetes mellitus among adult individuals in Asossa Town, West Ethiopia; From December 1/2021 to January 28/2022
2) To determine factors associated with diabetes mellitus among adult individuals in Asossa Town, West Ethiopia; From December 1/2021 to January 28, 2022

CHAPTER FOUR :MATERIALS AND METHODS

4.1 Study area and setting

The study was conducted in Asossa town, the administrative center of Benishangul Gumuz Regional State. Benishangul Gumuz Regional State is found at West Ethiopia comprising a total population of about 1,173,123 (according to demographic health survey (DHS) data found at regional health bureau. The region has three zones, three town administrations, and twenty districts. Assosa town is found at latitude & longitude of 10°04′N and 34°31′E respectively at 679 kms (about 421.91 mile) away from Addis Ababa, the capital city of Ethiopia. The elevation of the town is 1570 meters above sea level with 1236 mm (about 4.06 ft) average annual rain fall.

According to the Asossa town municipality information center, the current total population of the town is 70,122; of which 35,271 were males. The residents of the town are Berta, Shinasha, Oromo, Amhara, Tigrayan, Gumuz and other ethnic groups with diverse cultures and life styles. There are ten zones (kebeles) consisting of 15,583 households (HH), one regional laboratory, one general hospital, two health centers and ten health post stations and twenty health extension workers (nurses) in the town. The laboratory investigations were performed at Asossa general hospital laboratory.

4.2 Study design and period

A community-based cross-sectional study was conducted from December 1/2021 to January 28, 2022, among adult population (≥18 years) in Assosa town, West Ethiopia.

4.3 Populations

4.3.1 Source populations

- ✓ All residents of Assosa town.

4.3.2 Study population

- ✓ All adults aged 18 and above years living for ≥ 6 months in Assosa town.

4.3.3 Study subjects

- ✓ study participants aged 18 years and above

4.4 Sample size determination and sampling techniques/procedures

A sample of 571 was estimated using the single population proportion formula by taking 95% confidence interval (CI), 3% margin of error, design effect of 2 for cluster survey, 6.5% prevalence of diabetes mellitus in Mizan-Aman, Southern Ethiopia (33) and adding up a 10% non-response rate.

$n = (Z_{\alpha/2})^2 \times p\,(1-p)/\,d^2$

Where; n= smallest sample size, d= 0.03 = accepted margin of error (we used 3% to increase the sample size) $Z_{\alpha/2}$= 1.96= standard normal variance with 95% confidence interval and P= 6.5 %. $n = (1.96)^2 \times 0.065 \times 0.935 / (0.03)^2 = 259$; since our study design employed multi stage sampling technique we used the design effect = 2 to minimize the sampling error. The smallest sample size calculated using single population proportion was 259*2= 519. By adding 10% contingency for compensation of non-response rate due to several factors, the final sample size became 519 + (519*10)/100 = 571.

The sample was selected using multistage sampling. At the first stage, two study sites (Assosa town district 1 Administration and Assosa town district 2 Administration) were selected; at the second stage, five zones (kebeles) (smallest administrative units of the town), three from district 1 and two from district 2 were randomly selected based on lottery method; at the third stage, each zone (kebele) was distributed to the indicated sample size proportional to the total households in each zone (kebele).

A constant number k was obtained by dividing the total household in each selected zone (kebele) by the sample size allotted to the respective zone (kebele). Then, the first household was selected from each selected zone (kebele) randomly by lottery method using the lists of households living in that zone (kebele) as a sampling frame and next households were selected by taking consecutive k^{th} (11^{th}) households until the agreed sample size for each zone (kebele) was obtained. Only one participant was recruited into the study from a household. In households where there was more than one eligible individual, lottery method was used to select one participant into the study. When an individual in a household did not fulfill the inclusion criteria, the next participant from sampling frame were included.

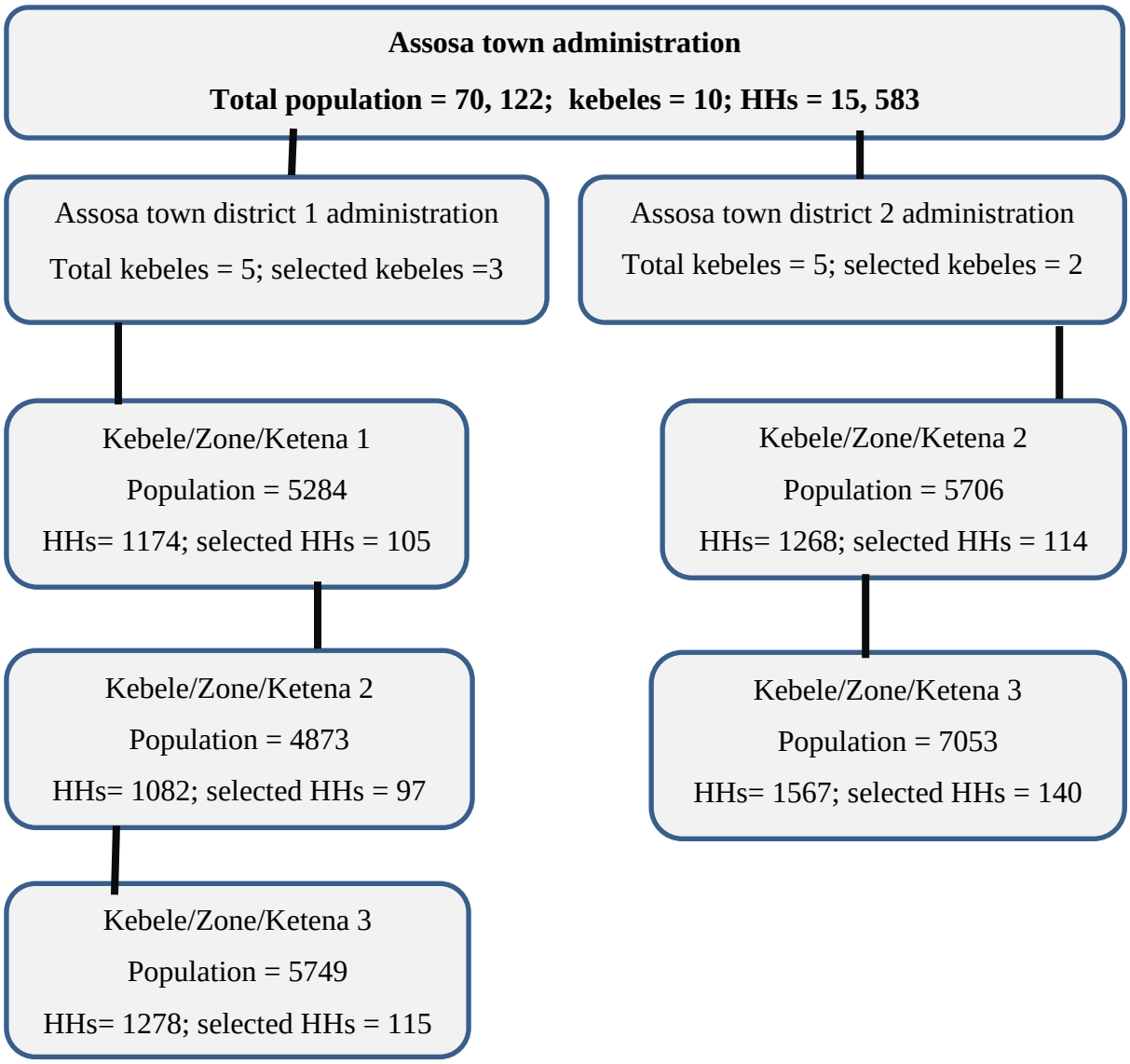

Figure 2: A flow chart showing the representative zones (kebeles) selected from both districts 1 & 2 administrations for the assessment of prevalence of diabetes mellitus and associated factors among adult individuals in Asossa town; West Ethiopia, December 1/2021 to January 28/2022 (n=560)

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

- ✓ Study participants aged 18 years and above
- ✓ Living in the town at least for 6 months
- ✓ voluntary to take part and sign the study informed consent

4.5.2 Exclusion criteria

- ✓ Critically ill patients who were unable to communicate
- ✓ Individuals who were taking any drug with impact on glucose metabolism
- ✓ Pregnant women to avoid the possible impacts on anthropometric and laboratory measurements.

4.6 Study variables

4.6.1 Dependent (outcome) variable

- ♦ Diabetes Mellitus (DM)

4.6.2 Independent (explanatory) variables

A. Socio-demographic factors
   - ✓ Age
   - ✓ Sex
   - ✓ Religion
   - ✓ Educational level
   - ✓ Occupational status
   - ✓ Monthly income
   - ✓ Family history of DM

B. Life style
   - ✓ Physical activity
   - ✓ Current smoking
   - ✓ Current alcohol consumption

C. Biochemical factors
   - ✓ Lipid profiles (HDL-C, Total cholesterol, LDL-C, Triglycerides)

D. Anthropometric measurements
   - ✓ Waist circumference
   - ✓ Body mass index (BMI)

E. Clinical profile
   - ✓ Family history of DM
   - ✓ Blood pressure measurement

F. Diet
   - ✓ Vegetable eating

- ✓ Fruit eating
- ✓ Type of oil commonly used for cooking

4.7 **Data collection procedures (instrument, personnel and & collection technique)**

The data collection tool was initially prepared in English and translated to the local language Amharic. The Amharic version was once again translated back to English to check for consistency of meaning. Four nurses and four laboratory professionals (six data collectors and two supervisors) were recruited and oriented by the principal investigator on the aim of the study, on how to collect sociodemographic data, physical measurements, and blood samples. Data were collected using a structured questionnaire customized and adapted from the WHO STEPwise approach to chronic disease surveillance tool (55).

The questionnaire held sociodemographic, life style, physical measurements, clinical characteristics and biochemical measurements developed after a review of literatures. Information on tobacco use, alcohol consumption, fruit and vegetable consumption, type of oil commonly used (saturated or unsaturated), physical activity, physical measurement, blood glucose level, lipid profiles testing, chronic disease history and family history of diabetes mellitus were collected. Standard procedures adapted from the WHO STEPwise guideline were used to measure weight, height, blood pressure and blood glucose level.

Sociodemographic and clinical characteristics data of the participants

Clinical nurses who were pre-oriented on how to collect the sociodemographic data of the study participants by using the customized WHO STEPwise questionnaires collected variables like; age, sex, marital status, occupational status, religion, educational status, monthly income and family history of diabetes status of the participants. They were also collected clinical history of raised blood glucose level and raised blood pressure within the past 12 months using structured interview.

Anthropometric and blood pressure measurements

Anthropometric assessments included height, weight, waist circumference, and systolic and diastolic blood pressure (BP) measurements. Participants' weight was measured after they were instructed to do so and stood on a digital adult weighing scale (UNICEF seca gnbh and co.kg. Germany) and recorded in kilograms to the nearest 0.1kg. Participants' height was also measured by sliding meter without them wearing footwear or head gear. Before the reading taken, the participants were requested to have their feet together, heels against the back

board, knees straight and look straight ahead. The reading was recorded in centimeters to the nearest 0.1cm. Their body mass indices were calculated from the body weight (kg) and height (m) by dividing weight to height square (kg/m^2).

Waist circumference (WC) was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a flexible plastic tape. The measurements were taken by wrapping the tape around waist directly over the light clothing after the participants put off heavy clothes, stood with their feet together and their arms at side of their body with the palms of their hands facing inwards and breathe out gently. WC values ≥ 102 (for men) and ≥ 88cm (for women) were considered high (3).

Blood pressure (BP) measurements were taken by clinical nurse in a sitting position after the participant allowed to take a rest without crossing over their legs and supported at the back from the right arm using a digital blood pressure measuring apparatus (Fazzini-Itali). Three readings were taken 5 minutes apart, and the mean was considered as the final BP result as per WHO recommendation. The right arm was used for this measurement. Blood Pressure definition- systolic measurement of <140 mmHg and diastolic measurement of <90 mmHg referred as normal and systolic measurement of ≥140mmHg and/or diastolic measurement of ≥ 90mmHg defined as hypertension(25)(3).

Life style checks

Participants were interviewed for life styles like current smoking of any tobacco products and current alcohol drink like bear, wine, arake or tella within the past 30 days before data collection, frequency of fruits and vegetables consumption per week, types of oil or fats mostly used to prepare meal at home. They were also interviewed for physical exercises. Vigorous intensity activities that cause large increase in breathing or heart rate like carrying /lifting heavy loads, digging or construction works and vigorous intensity sports, fitness, or recreational activities that cause large increase in breathing or heart rate like running or playing football for at least 10 minutes continuously. Moderate intensity activity like walking/use bicycle for at least 10 minutes continuously. Sedentary life style such as sitting at home or work places, sitting with friends, travelling in cars, reading or watching television but not including time spent sleeping.

Biochemical measurements

After the collection of sociodemographic characteristics, clinical characteristic, anthropometric blood pressure measurement and lifestyle check participants were instructed

to be on overnight fasting (≥8 hours). In the early morning of the next day, data collectors drew 5mL of blood from each participant in gel separator tube to determine the levels of TC, HDL-C, LDL-C, TG and fasting blood glucose in milligram per deciliter. The collected blood sample was stayed for 30 minute to facilitate clotting and transported to Assosa general hospital by means of triple packaging. The Roche/Hitachi cobas c 311 analyzer (Basel, Switzerland), an automated, software-controlled system for clinical chemistry were used to analyze the analytes. Fasting blood glucose level was measured using the hexokinase method. Participants who had fasting glucose levels of 126mg/ dL or above were repeated sample for second time on the next morning and checked for clinical sign and symptoms. Then those participants who have fasting glucose level of 126mg/dl or above for two consecutive fasting blood glucose level were classified as diabetic, while those who had between 100 and 125mg/dL were considered as impaired fasting glucose or prediabetic cases (1,40). The anomalous results on lipid profile and fasting blood glucose were reported immediately to the physician for further diagnosis and treatment.

4.8 Test principles of the laboratory analytes

Determination of fasting blood glucose level

Cobas c311(Basel, Switzerland) chemistry analyzer was used to determine blood glucose by hexokinase method. Cobas is a closed system which uses its own factory reagents.

Principle: Hexokinase catalyzes the phosphorylation of glucose to glucose-6-phosphate by ATP. Glucose-6-phosphate dehydrogenase oxidizes glucose-6-phosphate in the presence of NADP to gluconate-6-phosphate. No other carbohydrate is oxidized. The rate of NADPH formation during the reaction is directly proportional to the glucose concentration.

Lipid-profile: Basic lipids that are measured in the laboratory include total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol. They were measured by Cobas c311 clinical chemistry analyzer.

Principle of total cholesterol: An enzymatic colorimetric test method used to determine cholesterol in human serum. Cholesterol esters were break down by cholesterol esterase to release free cholesterol and fatty acids then cholesterol oxidized by cholesterol oxidase to cholest-4-en-3-one and hydrogen peroxide. In the presence of peroxidase, hydrogen peroxide coupled with phenol and 4-aminophenazone to form a red quinonimine dye. The color

intensity of the dye formed is directly proportional to the cholesterol concentration. It is decided by measuring increase in absorbance.

Principle of triglyceride: Triglycerides are hydrolyzed by lipoprotein lipase to glycerol and fatty acids. Glycerol is phosphorylated to glycerol-3-phosphate in ATP requiring reaction by glycerol kinase. Glycerol-3-phosphate is oxidized by glycerol phosphate oxidase to form dihydroxyacetone phosphate and hydrogen peroxide. In the presence of peroxidase, hydrogen peroxide affects the oxidative coupling of 4-chlorophenol and 4-aminophenazone to form a red-colored dye. The increase in absorbance is directly proportional to the concentration of triglycerides in the sample.

Principle of HDL-C: Homogeneous enzymatic colorimetric method is used. In the presence of magnesium ions, dextran sulfate selectively forms water-soluble complexes with LDL, VLDL, and chylomicrons which are resistant to PEG-modified enzymes. The cholesterol concentration of HDL-cholesterol is found enzymatically by cholesterol esterase and cholesterol oxidase coupled with PEG to the amino groups. Cholesterol esters are broken down quantitatively into free cholesterol and fatty acids by cholesterol esterase. In the presence of oxygen, cholesterol is oxidized by cholesterol oxidase to delta 4-cholestenone and hydrogen peroxide. In the presence of peroxidase, the hydrogen peroxide generated reacts with 4-amino-antipyrine and HSDA (Sodium N-(2-hydroxy-3-sulfopropyl)-3, 5-dimethoxyaniline) to form a purple-blue dye. The color intensity of the blue dye formed is directly proportional to the HDL-cholesterol concentration. It is figured out by measuring the increase in absorbance photo metrically.

Principle of LDL-C: Homogeneous enzymatic colorimetric assay used for determination of LDL-cholesterol. LDL-cholesterol selectively solubilized by a nonionic detergent. In the presence of Mg++ a sugar compound markedly reduces the enzymatic reaction of the cholesterol measurement in VLDL and chylomicrons. The combination of a sugar compound with detergent enables the selective determination of LDL-cholesterol in serum. In the presence of cholesterol esterase, cholesterol esters quantitatively break down into free cholesterol and fatty acids. In the presence of oxygen, cholesterol is oxidized by cholesterol oxidase to delta 4-cholestenone and hydrogen peroxide. In the presence of peroxidase, the hydrogen peroxide generated reacts with 4-aminoantipyrine and HSDA to form a purple-blue dye. The color intensity of this dye is directly proportional to the cholesterol concentration and is measured photo metrically.

4.9 Data quality management

Quality of questionnaire, laboratory investigation and anthropometric measurements were guaranteed by following different mechanism. Checking consistency of questionnaire meaning as English version translated to Amharic then back translation to English by individuals who understand both English and Amharic. Orientation was given for data collectors and the questionnaires were checked for consistency, completeness, clarity, and accuracy at the end of each data collection day.

To sustain quality of laboratory data daily maintenance of clinical chemistry analyzer was done, standard operating procedures were followed during specimen collection and processing of samples, daily quality controls were done for lipid profiles and fasting blood glucose tests before running patient samples. Expiration date for all reagents were checked, calibration was done for new reagent lot number and all the laboratory process was overseen by principal investigator.

To keep quality of anthropometric measurements calibrated weight and height measuring instrument was used and non-stretchable fiber tape was used to measure waist circumference. Furthermore, data were entered in epi data version 3.1, which improve data quality.

4. 10 Statistical analysis

After checking the data for completeness, missing values and coding of the questionnaires, the data were entered into Epi data version 3.1(Epi-Data, Odense, Denmark) and analyzed by using Statistical Package for Social Sciences (SPSS) version 25 (IBM, Chicago). Continuous and categorical variables were summarized by tables, graph, and descriptive statistics. The overall prevalence and associated factors were determined and recorded using the descriptive and inferential method of data analysis. Residuals were normally distributed and there was no multicollinearity among the independent variables included in the model and satisfied the assumptions of multiple logistic regression. Descriptive statistics were used to summarize the characteristics of study participants. Bivariate and multivariable analyses were used to assess the association between the explanatory variables and the outcome variable to control the effect of confounding and to see the independent effect of each variable on diabetes. Associations between independent variables (age, sex, cigarette smoking, alcohol use, physical inactivity, etc.) and diabetes mellitus were analyzed first using bivariate analysis (in the binary logistic regression) to identify factors eligible for the multivariable binary logistic regression analysis. Those variables with p-value < 0.25 in the bivariate analysis were

included in the multi-variable analysis. The Hosmer and Lemeshow goodness test were used to assess the fitness of the model. The magnitude of the association was measured using the regression coefficient β, the so called adjusted odd ratio (AOR) and 95% CI. A p-value <0.05 was considered statistically significant.

4.11 Ethical consideration

Ethical approval was obtained from the Ethical Review Board (ERB) of Institute of Health, Jimma University. Moreover, a letter of support was written from Jimma university research coordination office to Benishangul Gumuz Regional Health Bureau (BGRHB) and Assosa general hospital; from BGRHB to Assosa town administration health department; from health department to the two Assosa town district administrations and finally from Assosa town district administrations to the selected zones (kebeles). In addition, prior to data collection, written informed consent was obtained from each study participant following an explanation of the purpose and the possible risks of the study by the language they understand.

Participation in the study was voluntary and refusal was allowed. To ensure confidentiality of data, study participants were named using codes and unauthorized persons were not able to access the collected data. In addition, the clinical specimen collected during the study period was used for the stated goals only. The study participants' result was reported to the physician for proper management and care. Participants who were an unaware of that they had diabetes ahead of the study were linked to Assosa general hospital for further diagnosis and management of their conditions.

4.12 Plans for dissemination and utilization of results

The findings will be presented to Jimma University, Faculty of Health Science, School of Medical Laboratory Science. It will also be issued through publication on peer reviewed scientific journals and presented on scientific conferences. The study finding and recommendation will be given to Benishangul Gumuz Regional Health Bureau (BGRHB). The copy of the result will be submitted to Jimma University Faculty of Health Science.

CHAPTER-FIVE: RESULTS

5.1 Socio demographic characteristics of the study participants

A total of 560 participants were involved in the study with a response rate of 98.1%. Six individuals were disagreed to take part in this study because of the fear of vein puncture in the blood sample collection, while five study participants excluded from the study due to insufficient blood samples for laboratory analysis.

The age of the participants was ranged from 18-98 years and the median (IQR) age was 35 (27-45) years. The maximum number of participants 220 (39.3%) were between age group of 30-44 years, 304 (54.3%) male, 362 (64.6%) married, 201 (35.9%) had college diploma and above, 260 (46.4%) were Orthodox by religion, 308 (55.0%) had low monthly income between 0 to 2251 ETB, 58 (10.4%) of participants had a positive family history for diabetes mellitus, among whom 51.7% of them were related to their mothers and about one third (36.4%) of the study participants were unemployed (family dependent and homeworkers)**.**

5.2 Behavioral Characteristics of the study participants

Out of the total participants, about 30 (5.4%) reported that they were cigarette smokers (within the preceding month of data collection). Among the current smokers 50% used to smoke 5-8 cigar per a day. The prevalence of current alcohol use among the study participants was 22.7%. A considerable proportion of the alcohol users were in the age group of 30–44 years.

In the month preceding the interview, about 6.8% participants had never eaten fruits. In the same manner, 4.3% of participants had never consumed vegetables. Among those who had consumed fruits 38 % and among those who consumed vegetables 86% of the participants, consumed less than five days for fruits and vegetables per week.

About three out of five participants (62.1%) reported they have commonly used saturated fats (palm oils) for meal preparation; out of them, 3.9% were diabetic.

Only 18.9% of the respondents' physical activity met the WHO recommendations. Likewise, 63.9% of the participants did physical activity like walking or riding bicycle for less than 150 minutes in the week before the data collection. In addition, about 20.5% of the respondents spent an average of more than 8 hours per day deskbound/sitting.

Table 2: Socio-demographic characteristics of the study participants in Assosa town, West Ethiopia December 1/2021 to January 28/2022 **(N= 560).**

Variable	Response	Frequency	Percentage (%)
Sex	Male	304	54.3
	Female	256	45.7
Age	18-29	193	34.5
	30-44	220	39.3
	45-59	106	18.9
	>= 60	41	7.3
Marital status	Married	362	64.6
	Not married	145	25.9
	Widowed	29	5.2
	Divorced	24	4.3
Educational status	Diploma and above	201	35.9
	Primary school (1-8)	171	30.5
	Secondary school (9-12)	109	19.5
	No formal education	79	14.1
Occupation	Unemployed	204	36.4
	Self-employee (merchant)	141	25.2
	Government employee	123	22.0
	Others (Students…)	60	10.7
	Private (NGO) employee	32	5.7
Religion	Orthodox	260	46.4
	Muslim	212	37.9
	Protestant	87	15,2
	Catholic	1	0.2
Monthly income	Low (0-2250 ETB)	308	55.0
	Middle (2251-39700)	231	41.3
	High (>= 39700)	21	3.8
Family history of DM	Yes	58	10.4
	No	502	89.6
Family member with history of DM (n= 58)	Mother	30	51.7
	Father	16	27.6
	Brother	9	15.5
	Sister	3	5.2

Table 3: Behavioral Characteristics of the study participants of the study participants in Assosa town, West Ethiopia December 1/2021 to January 28/2022 **(N=560)**

Variable	Category	Frequency	Percentage (%)
Current smoking	Non-smoker	530	94.6
	Smoker	30	5.4
Number of cigarettes smoked daily (n=30)	1-4 cigar	14	46.7
	5-8 cigar	15	50
	9-12 cigar	0	0
	>12 cigar	1	3.3
Current alcohol use	Non-drinker	433	77.3
	Drinker	127	22.7
Frequency of drinking (n=127)	1-4 days/month	67	52.8
	1-4 days/week	48	37.8
	5-6 days/week	6	4.7
	Daly	6	4.7
Fruit consumed in the last week	Daily	24	4.3
	5-6 days/week	29	5.2
	1-4 days/week	469	83.8
	Never	38	6.8
Vegetables consumed in the last week	Daily	19	3.4
	5-6 days/week	33	5.9
	1-4 days/week	484	86.4
	Never	24	4.3
Types of oil commonly used	Saturated oil	348	62.1
	Unsaturated oil	212	37.9
Physical activity	Active	106	18.9
	Moderate	96	17.1
	Inactive	358	63.9
Time spent sitting in the last week	Less than one hour	59	10.5
	1-4 hours	200	35.7
	5-8 hours	186	33.2
	More than 8 hours	115	20.5

Key:- BMI*= *Body Mass Index,* WC*= *Waist Circumference*

5.3 Anthropometric, Clinical and Biochemical Measurements of the Study Participants

Blood pressure was measured three times and the average was recorded. The mean systolic blood pressure was 106.7mmHg, and the mean diastolic blood pressure was 75.4 mmHg. Regarding their hypertensive status (defined as systolic blood pressure of greater than or

equal to 140 mmHg and/or diastolic blood pressure of greater than or equal 90 mmHg), 4.5 % and 9.6%, respectively, were found to be systolic and diastolic hypertensive

Regarding their clinical history of chronic diseases 27 (4.8%) of participants had previous history of raised blood pressure. The higher percentage of previously raised blood pressure was observed among male participants (63%) than female (37%).

The mean total cholesterol, triglycerides, high density lipoprotein (HDL), low density lipoprotein (LDL) and fasting serum glucose level of the participants were 172.8 mg/dl, 130.4 mg/dl, 46.1 mg/dl, 95.0 mg/dl and 85.2 mg/dl, respectively. The prevalence of diabetes mellitus among participants with hypercholesteremia, high triglycerides and high LDL (bad cholesterol) were 9/61 (14.7%), 19/80 (23.7%) and 11/45 (24.4%) respectively.

Table 4: Biochemical, clinical history and anthropometric characteristics of study participants in Assosa town, West Ethiopia December 1/2021 to January 28/2022 **(N=560)**

Variable		Category	Frequency	Percent (%)
Total cholesterol		< 200mg/dl	499	89.1
		≥ 200mg/dl	61	10.9
Triglyceride		< 150mg/dl	480	85.7
		≥ 150mg/dl	80	14.3
LDL		< 130mg/dl	515	92
		≥ 130mg/dl	45	8
BMI		Normal	419	74.8
		Abnormal	141	25.2
WC	Male	< 102cm	251	82.6
		≥ 102cm	53	17.4
	Female	< 88cm	139	54.3
		≥ 88cm	117	45.7
SBP		Normal	535	95.5
		Hypertensive	25	4.5
DBP		Normal	506	90.4
		Hypertensive	54	9.6
Previously diagnosed hypertensive		No	533	95.2
		Yes	27	4.8
Previously diagnosed diabetic		No	550	98.2
		Yes	10	1.8

Keys:- SBP = *systolic blood pressure*, DBP= *diastolic blood pressure*, BMI= *Body Mass Index*, LDL= *low density lipoprotein*, WC= *waist circumference*

5.4 Prevalence of diabetes mellitus and pre-diabetes

The overall prevalence of diabetes mellitus was found to be 22 (3.9%) participants with (95% CI; 2.31– 5.54), whereas the prevalence of pre-diabetes is 49 (8.8%) of the participants. Of participants who were found to be diabetic, 12 (54.5%) of them were newly diagnosed (previously undiagnosed diabetes).

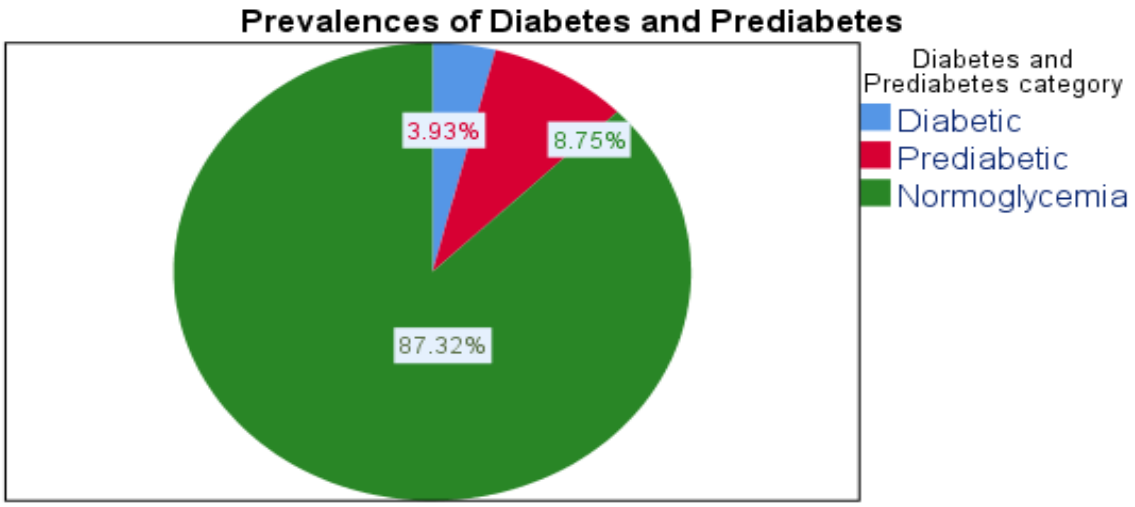

Figure 3: A figure depicting the prevalence of diabetes mellitus and prediabetes among study participants in Assosa town; West Ethiopia December 1/2021 to January 28/2022.

5.5 Prevalence of DM by socio-demographic, Behavioral, Anthropometric and Biochemical characteristics

The prevalence of DM seems to be similar between males [3.95% (95% CI; 1.75-6.15)] and in females [3.91% (95% CI; 1.52-6.30]. It was found to be highest among 45–59 age groups.

Out of current cigarette smoking participants about 6.7% were found to be diabetic. Among the current alcohol users 3.2% were found to be diabetic. Of participants who consumed fruits 11.8% of them and of participants consume vegetables 8.3% of them were found to be diabetic. Among participants using saturated oil for regular cooking at home 2.9% were found to be diabetic.

The prevalence of diabetes mellitus among participants with abnormal body mass index was 12.1%, whereas 53% and 5.1% among males and females participants with abnormal waist circumference measurements, respectively. The prevalence of diabetes mellitus among

hypertensive participants was found to be 32% in systolic and 24% among diastolic ones. While among previously hypertensive participants, 5 (18.5%) were found to be diabetic.

Table 5: Socio-demographic, Behavioral, Anthropometric and Biochemical characteristics and the association with diabetes mellitus in Assosa town, West Ethiopia December 1/2021 to January 28/2022 **(N=560)**

Variable	Category	DM		COR	95% CI	*P-value*
		Yes N(%)	No N(%)			
Sex	Female	10 (3.9)	246 (96.1)			
	Male	12 (3.9)	292 (96.1)	1.011	0.43-2.4	0.98
Age	18-29	2 (1)	191 (93)			
	30-44	4 (1.8)	216 (98.2)	1.77	0.32- 9.76	0.51
	45-59	10 (9.4)	96 (90.6)	9.95	2.14- 4.63	0.003*
	≥ 60	6 (14.6)	35 (85.4)	16.4	3.2- 8.44	0.001*
Occupational status	Employee	7 (5.7)	116 (94.3)			
	Unemployed	7 (3.4)	197 (96.6)	0.59	0.2-1.7	0.33
	Private	1 (3)	31 (97)	0.54	0.06-4.5	0.56
	Self	6 (4.3)	135 (95.7)	0.74	0.24-2.25	0.59
	Others	1 (0.2)	59 (10.5)	0.281	0.03-2.34	0.240*
Previously hypertensive	No	17 (3.2)	516 (96.8)			
	Yes	5 (18.5)	22 (81.5)	6.90	2.33- 20.41	<0.001*
Oil type used regularly	Unsaturated	12 (5.7)	200 (94.3)			
	Saturated	10 (2.9)	338 (97.1)	0.49	0.21- 1.16	0.11*
Frequency of alcohol consumption (n=127)	1-4 day/month	1 (1.5)	66 (98.5)			
	1-4 days/week	3 (6.3)	45 (93.7)	4.4	0.44- 43.65	0.21*
	5-6 days/week	0 (0)	6 (100)	0.00	0.00	0.99
	Daily	0 (0)	6 (100)	0.00	0.00	0.99
Smoking	No	27 (5)	511 (95)			
	Yes	3 (13.6)	19 (86.4)	3.0	0.83- 10.7	0.093
Time spent sitting in 24 hrs	Less than 1hr	1 (1.7)	58 (98.3)			
	1-4 hrs	4 (2)	196 (98)	1.20	0.13- 10.8	0.88
	5-8 hrs	5 (2.7)	181 (97.3)	1.60	0.18- 14.0	0.67
	> 8 hrs	12 (10.4)	103 (89.6)	6.76	0.86- 53.3	0.07*
FHDM	No	14 (2.8)	488 (97.2)			
	Yes	8 (13.8)	50 (86.2)	5.58	2.23-13.94	<0.001*
Total cholesterol	< 200mg/dl	13 (2.6)	486 (97.4)			
	≥ 200mg/dl	9 (14.8)	52 (85.2)	6.47	2.64- 15.90	<0.001*
Triglyceride	< 150mg/dl	3 (0.6)	477 (99.4)			
	≥ 150mg/dl	19 (23.8)	61 (76.2)	49.5	14.2- 172.2	<0.001*

LDL		< 130mg/dl	11 (2.1)	504 (97.9)			
		≥ 130mg/dl	11 (24.4)	34 (75.6)	14.8	6- 36.6	<0.001*
BMI		Normal	5 (1.2)	414 (98.8)			
		Abnormal	17 (12.1)	124 (87.9)	11.35	4.1- 31.40	<0.001*
WC	*Male*	< 102cm	4 (1.6)	247 (98.4)			
		≥ 102cm	8 (15.1)	45 (84.9)	11.0	3.2- 38.0	0.001*
	Female	< 88cm	4 (2.9)	135 (9.1)			
		≥ 88cm	6 (5.1)	111 (94.9)	1.82	0.50- 6.63	0.36
SBP		Normal	14 (2.6)	521 (97.4)			
		Hypertensive	8 (32)	17 (68)	17.5	6.50- 47.30	<0.001*
DBP		Normal	9 (1.8)	497 (98.2)			
		Hypertensive	13 (24.1)	41 (7.9)	17.51	7.10- 43.4	<0.001*

Key:_ SBP= *systolic blood pressure*, DBP = *diastolic blood pressure*, LDL= *low density lipoprotein*, BMI= *Body Mass Index* and WC= *waist circumference*

The prevalence of diabetes mellitus among participants with abnormal biochemical measurements were found to be 14.75% for hypercholesterolemia, 24.4% for high LDL and 23.75% for hypertriglyceridemia.

5.6 Factors associated with diabetes mellitus

In the bivariate analysis, variables significantly associated with diabetes mellitus and identified as the candidate variables for multivariable logistic regression with p-value < 0.25 were age ≥ 45 (45-59 and ≥60) years, occupational status being student or retired from governmental work negatively associated), FHDM, current alcohol use of 1-4 days/week, saturated oil, previous hypertension, spending on average more than 8 hours sitting per day, hypercholesterolemia, high triglyceride level, bad cholesterol, abnormal BMI, abnormal waist circumference in males, systolic blood pressure and diastolic blood pressure.

In the bivariate analysis**,** current alcohol use of 1-4 days per week has a statistically significant association with diabetes. However, current cigarette smoking was not significantly associated with diabetes. Saturated oil has a statistically significant association with diabetes. However, fruits and vegetables has not showed a statistically significant association with diabetes. Physical activity of the participants was not significantly associated with diabetes mellitus. However, those who spent an average of more than 8 hours per day sitting had an increased risk of diabetes.

Further multivariable analysis was performed to control the effects of confounders and to estimate the independent effects of the explanatory variables on the outcome variable. So, self-employment, abnormal triglyceride level and diastolic hypertension were found to be significantly associated with diabetes mellitus, while extensive use of saturated oil and hypercholesterolemia were negatively associated with diabetes mellitus.

The odd of developing diabetes mellitus was about 18 times more likely among self-employed when compared to governmental employee (AOR = 18.24, 95% CI; 1.04–319.9). The odds of developing diabetes mellitus were as high as 21.8 times among participants with higher triglycerides than those with normal triglycerides level (AOR = 21.8, 95% CI; 18.2-2604.8). Similarly, those participants who were diastolic hypertensive were eight times more likely to be diabetic than those who were not diastolic hypertensive (AOR = 8.24, 95% CI; 1.01–66.9). Hypercholesterolemia and using saturated oil for food preparation were negatively associated with development of diabetes mellitus.

Table 6: Bivariate and multivariate logistic regression analysis of factors associated with diabetes mellitus among study participants in Assosa town, West Ethiopia December 1/2021 to January 28/2022 **(N=560)**

Variable	**DM**		**COR**	**95% CI**	**AOR**	**95% CI**	***P-value***
	Yes	**No**					
Occupational status							
Government employee	7	116					
Unemployed	7	197	0.59	0.2-1.7	3.05	0.28- 33.1	0.36
Private(NGO)	1	31	0.54	0.06-4.5	34.90	0.48- 2555.7	0.11
Self employed	6	135	0.74	0.24-2.25	18.24	1.04- 319.9	0.047*
Others	1	59	0.281	0.03-2.34	0.83	0.024- 29.1	0.92
Total cholesterol							
< 200mg/dl	13	486					
≥ 200mg/dl	9	52	6.47	2.64- 15.90	0.035	0.002- 0.66	0.025*
Triglyceride							
< 150mg/dl	3	477					
≥ 150mg/dl	19	61	49.5	14.2- 172.2	21.8	18.2- 2604.8	<0.000*
DBP							
Normal	9	497					
Hypertensive	13	41	17.51	7.10- 43.4	8.24	1.01- 66.9	0.049*
Oil used regularly							
Unsaturated	12	200					
Saturated	10	338	0.49	0.21- 1.16	0.11	0.02- 0.79	0.028*

**Significantly associated,* DBP= *diastolic blood pressure*

CHAPTER-SIX : DISCUSSION

To our best knowledge, this study was the first in Assosa Town to assess the prevalence and associated factors of DM among the adult population. In this study, we have uncovered an inclusive prevalence of both diagnosed and undiagnosed diabetes mellitus 3.9% (95% CI; 2.31– 5.54) in the study area. Which is expected in urban setting and comparable to 3.2% national estimated and 3.9% sub-Saharan Africa regions previously reported by International Diabetes Association (IDF) in 2019 (24).

More than half (54.5%) of the diabetes cases were newly diagnosed in our study, so that they did not aware of their diabetic status preceding the study and thus untreated. This finding is supported by reports from Dessie, North Ethiopia (72.5%) (56); Mizan Amman (88.5%) and Southern Ethiopia rural setting (54%) (33,57) of previously undiagnosed diabetes at different periods of study. The high rate of undiagnosed diabetes might be due to less understanding of the public on the condition. Giving information to the community concerning the burden of chronic diseases like diabetes mellitus to initiate them for screening if suspected is better.

The determined prevalence of DM in the current study was higher than 1.9% that was reported in 2018 from Southern Ethiopia rural setting community-based study, suggesting an increasing trend of diabetes mellitus in the urban dwellers than the rural ones may be due to population characteristics, life style and sampling technics. In addition, this result was higher than those from other studies done in Addis Ababa 2.6% and Benin 1.4% (57–59).

On the other hand, the current prevalence of DM was lower than the results reported from different studies conducted in various parts of Ethiopia at different study periods. These were Mizan Aman 6.5%, Dessie Town 6.8%, Hossana Town 5.7%, and Dire Dawa 8.95% (33,34,56,60). Moreover, our result was also not as much of the findings from Bangladesh, India (9.75%), Rural Indigenous Guatemala (13.81%) and Addis Ababa public health facilities (14.8%)(61–63).

Variations may be due to differences in the sociodemographic characteristics of study participants, sample sizes, and time frames. Compared to studies done in Hawassa zuria district, might be the current study was conducted only among urban residents. If we compare the prevalence of the DM with the study conducted at Addis Ababa public health facilities, the study participants might patients who have gone to health facilities seeking for health

care, whereas in the current study participants were randomly selected individuals from the community.

Factors significantly associated with DM were occupational status (being self-employment), being hypertensive (diastolic hypertension) and high triglyceride levels, while hypercholesterolemia level and commonly use of saturated oil in daily diet were showed negative association with diabetes.

Even though not significant, participants with BMI ≥ 25.0kg/m2 (both overweight and obese) category and abnormal waist circumferences had high chance of developing diabetes (34,35,61,64). The insignificant association in the current study may be due to small sample size in the BMI ≥ 25.0kg/m^2category and abnormal waist circumferences. Obesity causes insulin resistance, decreases insulin-stimulated glucose release, leading to the development of diabetes and prediabetes condition (53).

The earlier study has shown that the prevalence of abdominal obesity was 16.5% (95%CI:14.2-19.2) (65). Waist circumference is one of the indicator of abdominal obesity. Abdominal obesity in turn is an independent risk factor for a range of non-communicable diseases such as cardiovascular diseases (CVD) and type-2 diabetes mellitus and high blood pressure (66). It is essential to understand that the associated health problems with non-communicable diseases have significant negative impact on economic development.

In our study, diabetes was significantly associated with diastolic hypertension. Earlier studies in different regions of Ethiopia showed that the prevalence of hypertension is high and increasing (34,56,57,67). It was also seen in this study with crude systolic hypertension and diastolic hypertension of 17.5% and 17.51 %, respectively. Thus, we suggest that the increasing prevalence of hypertension may play its role in increasing prevalence of diabetes.

Although, the findings of current study showed non-significant association between DM and performing regular physical activities (64), in other earlier studies, the physical inactivity had to play a role in the development of diabetes (68) and physically active parameter was significantly associated with diabetes in study conducted among Addis Ababa public health facilities (69).

In our survey, respondents who consumed saturated oil in daily basis were greater in frequency, however, they possess less prevalence of diabetes mellitus when compared with those who did not use saturated oil in this study. Now, the relationship between DM and

saturated oil consumption on daily basis was negatively associated. This association might be masked due to large number of participants who used to consume saturated oil on daily basis.

Elevated levels of total cholesterol in other studies (56,64,70–72) showed significant association with diabetes. However, in our case, its decreasing level was risk factor for the development of diabetes. Cholesterol is certainly the most widely known lipid because of its strong correlation with elevated levels of cholesterol in the blood and the incidence of human cardiovascular diseases. Less healthy importance of cholesterol is its crucial role as a part of cellular membranes and as a precursor of steroid hormones and bile acids. It is an essential molecule in many animals, including humans, but is not needed in the mammalian diet as all cells can synthesize it from simple precursors (73). The previous studies conducted in different areas indicated that increased concentration of total cholesterol in human blood is positively associated with the prevalence of diabetes mellitus (35,64,70,72,74) .

Diabetes was significantly associated with triglycerides of ≥150 mg/dl. This finding was supported by earlier studies conducted in Ethiopia (69) and elsewhere in other countries (64,71).

DM showed significant association with occupation (self-employed participants). Moreover, unemployed participants showed similar prevalence of DM compared with governmental employees (31.8%) and non-governmental employees and others (4.5%). This was in line with study conducted in semi-urban Saudi population (64).

Though the current study had no capability to show significant relationship between diabetes mellitus and increasing age (≥45 years), there was increased percent of respondents seen to be diabetic in frequency distribution. This increased age versus diabetes relationship was seen often in earlier studies (58–61,63,75).

The finding of present study revealed that the prevalence of diabetes mellitus, especially, those did not diagnose before and hidden in the community were high. It indicates that there might be a large number of people who have DM but are not aware of it. It is known that not early diagnosed and left untreated cases of chronic disease like diabetes mellitus are led to micro or macro vascular complications

6.2 Strength and limitation of the study

6.2.1 Strength of the study

The study was conducted at community level on sample size which was supposed to be representative in the study area and blood sugar level was measured on fasting at least for eight hours overnight in order not to relay on self-report of the condition, so that previously undiagnosed raised blood sugar cases were identified. The study employed three data collection methods (participants interview, physical measurements, and blood tests using standard procedures), which allowed for the inclusion of all potential explanatory factors (variables). Moreover, the WHO STEPwise approach to chronic diseases surveillance tool was used to conduct this study, which can provide comparability of our findings with other similar studies globally.

6.2.2 Limitation of the study

This study has methodological limitation of cross-sectional study design which does not establish temporal relationship between the dependent and independent variables. It is also obvious that some of the variables were taken for a study period only. For instance, vegetables and fruits consumption questions were assessed for one week prior to the survey, while alcohol consumption for thirty days before the study, so that it might not stand for the usual pattern and participants may have been prone to recall bias. Furthermore, as the number of abnormal body mass index in our study were few, its statistically significant association with diabetes was masked. Differentiation of Type 1 and Type 2 diabetes mellitus was not possible in this study. Hence, we recommend research that can address these problems by employing observational study designs and by recruiting study participants prospectively.

Chapter- Seven : Conclusion and Recommendation

7.1 Conclusion

We have summarized that almost comparable prevalence of diabetes mellitus was uncovered when compared to nationally estimated prevalence of diabetes. Hypertriglyceridemia, diastolic hypertension and occupational status like self-employment were positively significantly associated with diabetes mellitus. On the other hand, hypercholesterolemia and commonly using saturated oil for daily cooking purpose were negatively associated with the development of diabetes mellitus.

7.2 Recommendation

Based on findings we recommend the program officers for mass screening of the community for diabetes mellitus, reducing sources of risk factors like fatty foods that supply large amount of glycerol in our body, the health extension professionals should give health education on prevention of the disease, clinicians needed to treat those found to have diabetes in this survey and other interested researchers can use this finding as base line to explore more on the condition. We tell healthy lifestyle measures (like physical activity and healthy diet) that might reduce burden of diabetes mellitus which could be evaluated in future research.

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Annexes

Annex i. Questionnaire (English version)

INSTRUCTIONS: The questionnaire has a question, which were pertinent to the research goals. Study participants were kindly requested to answer all questions carefully as much as possible and the interviewer should fill blank spaces and encircle right choice according to given alternatives and as participants response.

Location of survey: Asossa Town (B/G/R/State	Interviewer ID: ----------
Date of Interview: ----------	Consent has been obtained (Y/ N): ----------
Name:----------	Participant ID: ----------
Address: ----------	Phone: ----------

Step 1 questionnaire

Part I. Socio-demographic characteristics

S/N	Questions	Choices
101	Sex	1. Male 2. Female
102	Age	Age in years ----------
103	What is your Marital Status?	1. Never married 2. Currently married 3. Separated / Divorced/ 4. Widowed
104	The highest level of education you have completed?	1. No formal schooling 2. Primary school completed (1-8) 3. Secondary (high) school completed (9-12) 4. College/University completed
105	Ethnicity	1. Berta 2. Shinasha 3. Gumuz 4. Oromo 5. Amahara 6. Maokomo 7. Tigrayan 8. Others specify ----------
106	Religion	1. Muslim 2. Orthodox 3. Protestant 4. 4.Catholic
107	Estimated average monthly income of the household	1. ≤2250 (low income) 2. 2251 – 39,700 (middle income) 3. >39,00 (high income)
108	Occupational status	1. Family dependent 2. Government employee 3. Non-government employee 4. Merchant (self-employed) 5. Homemaker 6. Retired 7. Student
109	Do you family story of DM? if yes, from whom member	1) Yes (1. Father, 2. Mother , 3. Brother, 4. Sister) 2) No.
Part ii. Smoking habit, alcohol consumption, eating fruits and vegetables - Now I am going to ask you some questions about various health behaviors. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity.		
110	Do you currently smoke any tobacco products, such as cigarettes?	1. Yes 2. No If no go to Q 111
	If yes, how many	1. 1-4 sticks per a day 3. 9-12 sticks per a day

	sticks do you smoke daily?	2. 5-8 sticks per a day	4. Greater than 12 sticks per a day
111	Have you consumed an alcoholic drink such as beer, wine, arake or tella within the past 30 days?	1. Yes 2. No	If no go Q to 112
	If yes, how often have you had at least one alcoholic drink?	1. Daily 2. 5-6 days per week 3. 1-4 days per week	4. 1-3 days per month 5. Less than once a month
112	On how many days do you eat fruit per a week**?**	1) Daily 2) 5-6 days per week	3. 1-4 days per week 4. Never
113	On how many days do you eat vegetables per a week?	1) Daily 2) 5-6 days per week	3) 1-4 days per week 4) Never
114	What type of oil or fat is most often used for meal preparation in your family?	1) Saturated oil (e.g., palm oil) 2) Unsaturated oil (e.g., sunflower oil)	

Part iii. Physical activity

Next, I am going to ask you about the time you spend doing diverse types of physical activity in a typical week. Think of work as the things that you must do such as paid or unpaid work, study/training, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

115	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?	1. Yes 2. No	If no go to Q 116
	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	1) daily 2) 5-6 days per a week 3) 1-4 days per a week	
	How much time do you spend doing vigorous-intensity activities at work on a typical day?	1) 1 5-8 hours per a day 2) 1-4 hours per a day 3) less than 1 hour per a day	
116	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	1) daily 2) 5-6 days per a week 3) 1-4 days per a week	If none go to Q 117
	How much time do you spend doing moderate-intensity activities at work on a typical day?	1) 1 5-8 hours per a day 2) 1-4 hours per a day 3) less than 1 hour per a day	
117	Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	1) Yes 2) No	If no go to Q 118
	If yes, on a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	1) daily 2) 5-6 days per a week 3) 1-4 days per a week	
	How much time do you spend walking or bicycling for travel on a typical day?	1) 5-8 hours per a day 2) 1-4 hours per a day	

		3) less than 1 hour per a day

Recreational activities (sports)

The next questions exclude the work and transport activities; that you have already mentioned. Now I would like to ask you about sports, fitness, and recreational activities (leisure).

118	Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like [running or football] for at least 10 minutes continuously?	1) Yes 2) No	If no go to Q 119
	If yes, how many days do you do per week?	1. daily 2. 5-6 days per a week	3. 1-4 days per a week
	How much time do you spend doing vigorous-intensity sports, fitness, or recreational activities on a typical day?	1. 5-8 hours per a day 2. 1-4 hours per a day 3. less than 1 hour per a day	
	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	1) daily 2) 5-6 days per a week 3) 1-4 days per a week	
	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	1) 5-8 hours per a day 2) 1-4 hours per a day 3) less than 1 hour per a day	

Sedentary behavior

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards, or watching television, but do not include time spent sleeping.

119	How much time do you usually spend sitting or reclining on a typical day?	1. Less than an hour 2. 1-4 hours per a day	3) 5-8 hours per a day 4) Greater than 8 hours per a day

Part iv. History of raised blood pressure

120	Have you previously diagnosed as hypertensive or your blood pressure measured high by a doctor or other health worker in the past 12 months?	1. Yes 2. No

Part v. History of diabetes

121	Have you previously diagnosed as diabetic or your blood sugar measured high by a doctor or other health worker in the past 12 months?	1. Yes 2. No

Step 2 - Physical measurements

Part vi. Anthropometric measurements

122	Height	---------- cm
123	Weight	---------- cm
124	Waist circumference(cm)	---------- cm
125	BMI(Kg/m2)	---------- Kg/m^2

Part vii. Blood pressure measurement

126	Systolic Blood Pressure (SBP) in mmHg	Reading 1 ---------- mmHg Reading 2 ---------- mmHg

125	Diastolic Blood Pressure(DBP) in mmHg	Reading 3 ---------- mmHg Average reading ----------
Steps 3-Biochemical measurements		
127	Total cholesterol	---------- mg/dl
128	Triglycerides	---------- mg/dl
129	HDL Cholesterol	---------- mg/dl
130	Low density lipoprotein (LDL)	---------- mg/dl
131	Blood glucose (FBS level)	Day 1 ---------- mg/dL Day 2 ---------- mg/dL(for those with ≥ 126mg/dL individuals on day 1)

***Thank you for your participation*!**

Annex ii : Questionnaire in Amahric version

ቃለ መጠየቂያ

የጥናቱ ቦታ፡ አሶሳ ከተማ (ቤኒሻንጉል ጉሙዝ ክልላዊ መንግስት)

አቅጣጫዎች፡ ቃለ መጠየቂያዉ የያዘዉ ጥያቄ ለጥናቱ ዓላማ ብቻ የምዉሉ ናቸዉ፡፡ የጥናቱ ተሳታፊዎች በተቻለ መጠን ጥያቄዎቹን ሁሉ ለመመለስ ጠያቂዎቹን በጥሞና እንድከታተሉ በትህትና እንጠይቃለን፡፡ ቃለ መጠይቅን የምሰሩ ባለሙያዎች ከፍት ባዶ ቦታዎችን መሙላት እና በተሰጠዉ አማራጭ መሰረት እና ተሳታፊዎቹ ትክክለኛ የሆኑ ክቦችንም ያከባሉ።

የጥናቱ ቦታ ----------	የጠያቂዉ መታወቂያ ቁጥር ----------
የቃለመጠየቂያ ቀን ----------	ለመሳተፍ ፍቃደኝነት አላቸዉ? ----------
የተሳታፊ ስም ----------	የተሳታፍ መለያ ቁጥር ----------
የምኖርበት ቦታ/ቀቤሌ ----------	ስልክ ቁጥር ----------

ደረጃ አንድ ቃለ መጠየቅ
ክፍል1. ማህበረሰባዊ እና ግላዊ ጥያቄዎች

ተ.ቁ	መጠይቅ	ምርጫዎች		አስታየት
101	ጾታ	1) ወንድ 2) ሴት		
102	እድሜህ/ሽ/ዎት ስንት ነው?	ዕድሜ በዓመት ----------		
103	የጋብቻ ሁኔታዎን ይግለፁልኝ	1) ያላገባ/ች 2) ያገባ/ች	3) የተፋቱ /የተለያዩ 4) የሞተባት/ችበት	
104	ከፍተኛ የትምህርት ደረጃዎን ይንገሩኝ	1) ያልተማረ/ች 2) አንደኛ ደረጃ የጨረሰ/ች	3) ሁለተኛ ደረጃ የጨረሰ/ች 4) ኮሌጅ /ዩኒቨርሲቲ የጨረሰ/ች	
105	የየትኛው ብሄረሰብ ክፍል ነዎት?	1. በርታ 2. ሽናሻ 3. ጉሙዝ 4. ኦሮሞ	5) አማራ 6) ማኦ ኮሞ 7) ትግራዋ 8) ለላ ይገለፅ	
106	የትኛውን ሀይማኖት ተከታይ ነዎት?	1) ሙስሊም 2) ኦርቶዶክስ	3) ፕሮቴስታንት 4) ካቶልክ	
107	የወር ገቢያቸዉን ግምት ልትነግሩኝ ይችላሉ?		1) ≤2250 (ዝቅተኛ ገቢ) 2) 2251-39,700 (መካከለኛ ገቢ) 3) > 39700 (ከፍተኛ ገቢ)	
108	ከምከተሉት ዉስጥ የመተዳደሪያ ስራዎት በደምብ የምገልጸዉ የቱ ነው?	1) ስራአጥ/ቤተሰብ ጥገኛ 2) የመንግስት ሰራተኛ 3) መንግስታዊ ያልሆነ ድርጅት ሰራተኛ	4) የግሉ ስራ ባለበት 5) ጡረታኛ 6) የቤት እመቤት 7) ተማሪ	
109	ከእናንተ በተሰብ ዉስጥ የሱካር ብሽታ ታርክ ያለዉ አለ? ካለ ማን ነዉ?	1) አዎ (1 አባተ 2 እናተ 3 ወንድመ 4 እህተ) 2) የለም		
ክፍል ሁለት፤ የሱስ መለክያዎች (የማጨስ እና አልኮል የመጠቀም ልምድ)				
ከዚህ ቀጥሎ የምቀርቡ መጠይቆች ስለ አንድ ጤና ሁነታዎች ናቸዉ፡፡ እነዚህም እንደ ትምባዎ ማጨስ፤ መጠጥ መጠጣት ፤ ፍራፍረዎችን እና አትክልቶችን ስለመመገብ፤ የአካል ብቃት እንቅስቃሴዎችን ስለመስራት ይሆናል። በትምባዎ እንቀጥል እስኪ፡-				
110	በአሁን ሰዓት ሲጋራ/ትምባዎ ያጨሳሉ?	1) አዎ 2) አይ አላጨስም		መልሶዎ አይ ከሆነ ወደ ጥያቄ 111 ይህዱ
	ካጨሱ በአማካይ በየቀኑ ምን ያህል ያጨሳሉ?	1) እስከ 4 ሲጋራ 2) 5 እስከ 8 ሲጋራ	3) 9 እስከ 12 ሲጋራ 4) ከ 12 በላይ	
111	ቢራ ፤ ወይን፤ አረቀ፤ ጠላ እና የመሳሰሉትን	1) አዎ		መልሶዎ አይ ከሆነ ወደ ጥያቄ 112

	በባለፈዉ 30 ቀናት ዉስጥ ጠጥተዉ ያዉቃሉ?	2) አይ አላጨስም	ይህዱ
	በባለፈዉ 30 ቀናት ዉስጥ መጠጥ ጠጥተዉ የሚያዉቁ ከሆነ ቢያንስ አንዱዋን መጠጥ ለምን ያህል ነዉ የጠጡት?	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት 3) በሳምንት 1 እስከ 4 ቀናት 4) በወር 1 እስከ 4 ቀናት 5) በወር ከ አንድ ቀን በታች	
112	በሳምንት ዉስጥ ስንት ቀን ፍራፍሬ ይበላሉ?	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት	3) በሳምንት 1 እስከ 4 ቀናት 4) በልቸም አላዉቅም
113	በሳምንት ዉስጥ ስንት ቀን አትክልት ይበላሉ?	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት	3) በሳምንት 1 እስከ 4 ቀናት 4) በልቸም አላዉቅም
114	ምግብ ለማዘጋጀት የምትጠቀሙበት ዘይት አይነት ምንድን ነዉ?	1) Palm oil (saturated oil) 2) የታልባ/የሱፍ/የኑግ/ (unsaturated oil)	
ክፍል 3. የአካል ብቃት እንቅስቃሰ			
ከዚህ ቀጥሎ የምጠይቃችሁ ጥያቀዎች በበተለያየ አካላዊ እንቅስቃሰዎች በሳምንት ዉስጥ ስለምታሳልፉት ጊዜ ይሆናል። እባኮዎ ጥያቀዎቹን በጥሞና ይከታተሉኝና የመልሱልኝ። መጀመሪያ ሥራ በመስራት ስለምታሳልፉት ጊዜ አስቡ። ተከፍሎዋቸዉ ወይም ሳይከፈላችዉ ስልምትሰሩት ሥራ፣ ጥናት/ስልጠና፣ የበት ዉስጥ ሥራ፣ ሥራ ፍለጋና የመሳሰሉት።			
115	የምትሰሩት ሥራ ሀይል የሚያስዋጣ ፣ ትንፋሽ የምጨምር ወይም የልብ ምት የምጭምር (ከባድ እቃ መሸከም ወይም ማንሳት ፣ መቆፈር ፣ ግንባታ) ቢያንስ ለ10 ደቂቃዎች በተከታታይ የያዘ ይሆናል?	1) አዎ 2) አይደለም	
	ከሆነ በሳምንት ዉስጥ ለምን ያህል ቀናት ነዉ እንደዚህ ዓይነት ስራ የምትሰሩት	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት 3) በሳምንት 1 እስከ 4 ቀናት	
116	በቀን ዉስጥስ ለምን ያህል ሰዓት ነዉ የምትሩት	1) ለ 5 እስከ 8 ሰዓት በቀን 2) ለ ቅ እስከ 4 ሰዓት በቀን 3) በቀን ከአንድ ሰዓት በታች	
ከቦታ ቦታ ስለመንቀሳቀስ			
ቀጥሎ ያሉት ጥያቀዎቹ በሥራ ቦታ ስለምደረጉ እንቅስቃሰዎችን አያካትትም። አሁን ልጠይቆዎት የወደድኩት ከቦታ ወደ ቦታ ስለምታደርጉት እንቅስቃሰ ለምሳለ፡ ወደ ሥራ፣ ወደ ሱቅ፣ወደ ገበያ፣ ወደ አምልኮ ቤት ሰለምታደርጉት እንቅስቃሰ ይሆናል።			
117	ከቦታ ቦታ ለመንቀሳቀስ ቢያንስ ለ10 ደቂቃዎች በተከታታይ ሳይክልን ይጠቀማሉ?	1) አዎ 2) የለም አልጠቀምም	
	ከተጠቀሙ በሳመንት ስንት ቀናት?	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት 3) በሳምንት 1 እስከ 4 ቀናት	
	በቀን ስንት ሰዓት/ደቂቃ?	1) 5 እስከ 8 ሰዓት በቀን 2) 1 እስከ 4 ሰዓት በቀን 3) በቀን ከ 1 ሰዓት በታች	
የመዝናኛ ጉዞዎች			
የሥራ ና ትራንስፖርት እንቅስቃሰን አይመለከትም። ነገር ግን ስለ ስፖርት፤ ስለ አካል ብቃትና ማዝናኛ እንቅስቃሰዎችን ይመልከታል።			
118	ስፖርት/አካል ብቃት/ምዝናኛ ሀይልን የምያስዋጣ፣ ትንሽ የምጨምር ወይም የልብ ምት የምጭምር (ሩጫ፤ የእግር ከዋስ ጨወታ) ቢያንስ ለ10 ደቂቃዎች በተከታታይ ይሰራሉ?	1) አዎ 2) አልሰራም	
119	በሳምንት ዉስጥ ለምን ያህል ቀን መካከለኛ ስፖርት ነክ እንቅስቃሰ ያደርጋሉ?	1) ሁል ጊዘ 2) በሳምንት 5 እስከ 6 ቀናት	3) በሳምንት 1 እስከ 4 ቀናት
	በቀን ተቀምጠዉ የምያሳልፉት ሰዓት ምን ያህል ነዉ?	1) ከ አንድ ሰዓት በታች 2) 1 እስከ 4 ሰዓት	3) 5 እስከ 8 ሰዓት 4) ከ 8 ሰዓት በላይ
ክፍል 4 ፤ የደም ግፍት እና የሱኳር ታርክ			
120	በባለፈዉ 12 ወራት የደም ግፍቶዎ ከፍ ብሎዋል ተብሎ ተነግሮዋችዉ ያዉቀዋል?	1) አዎ 2) የለም	
122	በደማችሁ ዉስጥ የምገኘዉን ስኳር መጠን ተለክተዉ (የስኳር በሽታ አለባችዉ) ተብላችዉ ያዉቃል?	1) አዎ 2) የለም	
ደረጃ ሁለት ፤ የሰዉነት ልክት			
124	የቁመት ልክት (cm)	---------- cm	

	የክብደት ልክት (Kg)	---------- Kg
	የወገብ ልክት (cm)	---------- cm
	ቦዲ ማስ እንደክስ (Kg/m^2)	---------- Kg/m^2
የደም ግፍት ልክት		
125	ሲይስቶልክ ድም ግፍት (mmHg) ዲያስቶልክ ደም ግፍት (mmHg)	ንባብ 1 ---------- (mmHg) ንባብ 2 ---------- (mmHg) ንባብ 2 ---------- (mmHg) አማካይ የደም ግፍት ንባብ ---------- (mmHg)

ደረጃ 3 የባዮሎጅካል ናሙናዎች ልክት (Biochemical Measurements)

126	ጠቅላላ ኮለስትሮል	---------- ሚሊግራም/ደሲ ሊትር
	ትራይግልሰራይድስ	---------- ሚሊግራም/ደሲ ሊትር
	ከፍተኛ ክብድት ያለዉ ሊፕድ ኮለስትሮል	---------- ሚሊግራም/ደሲ ሊትር
	ዝቅተኛ ክብደት ያለዉ ሊፕድ ኮለስትሮል	---------- ሚሊግራም/ደሲ ሊትር
	የስኳር መጠን (የፆም ጊዜ) (Fasting blood sugar)	Day 1 ---------- ሚሊግራም/ደሲ ሊትር Day 2---------- ሚሊግራም/ደሲ ሊትር (የስኳር መጠናቸዉ ከ126 ሚሊግራም/ደሲ ሊትር በላይ ለሆኑ የተደገመላቸዉ)

ለተሳትፎዎ እናመሰግናለን!

Annex iii: **Laboratory request/result reporting format**

Laboratory Request Form for lipid profile & Blood glucose

ID: ---------- age:---------- sex :----------

Physician name :---------- signature: ----------

TEST	RESULT
TC	mg/dl
TG	mg/dl
HDL-C	mg/dl
LDL-C	mg /dl
FBS LEVEL	Day 1 ----- mg/dL Day 2 ----- mg/dL (for those with ≥ 126mg/dL individuals on day 1)

Reported By:

Name of lab technologist/ technician ----------

Date reported ----------

Signature ----------

Annex iv: Information sheet (English version)

Title of the research project: Prevalence of diabetes mellitus and associated factors among adult individuals in Asossa Town, West Ethiopia.

Study design: Community-based cross-sectional study.

Name of researcher: Dagim Kemiso

Name of the organization: Jimma University, Institute of Health Sciences, School of Medical Laboratory Sciences.

Name of the sponsoring organization: Jimma University

Introduction: This information sheet is prepared for the aim of explaining the research project that you are asked to join by the group of research team.

This information sheet that supplied or read to you describes about the research. When the data collector reads the information sheet, we will expect your attentive listening and you can ask questions at any time.

This research team includes one researcher, four clinical nurses as data collectors and two laboratory technologist/technicians for sample collection and laboratory test analysis and three advisors from Jimma university, school of medical laboratory Sciences.

Aim of the study: The aim of this research project is to determine the prevalence of diabetes mellitus and identify associated risk factors in Asossa town, Benishangul Gumuz reginal state, West Ethiopia. This study may have an immense importance to determine the prevalence of diabetes in the region and supply information about the risk factors associated with diabetes in the town that will be used for health care providers, policy makers (planners) and as a base line data for other consecutive studies to be done in our country.

Procedure: If you agree to take part in the study, one of the investigators or a nurse will give you verbal and/or written information about the study and you will be given the consent form to sign. You are kindly requested to give us the correct information about yourself and the necessary measurements are performed by the assigned nurse. If you are fit for the study 3 -5 ml of blood samples will also be collected for laboratory examination of blood glucose and lipid profile testing.

Risk and discomfort: Participating in this project will not cause more discomfort than is needed you could go through for routine examination. But there could be minor pain and change in color of your skin following the blood drawing and which would disappear in short duration. If there comes any discomfort, we shall offer you necessary medical treatment freely. The amount of blood taken from each volunteer throughout the study period is 3-5ml which will not affect your health.

Benefits: If you are taking part in this research project, there may not be direct benefit to you but your participation is likely to help us an important input to find the common risk factors associated with the development of diabetes in the community that will contributed to know the existence of the disease in the community which will be important to assess the extent of and to increase patient quality of life informing prompt treatment before development of complications. And if the medical examination reveals any abnormalities that need immediate treatment, your doctor will be notified about the result.

Incentives and payment for taking part in the study: You will not be provided with any direct incentives for your participation in this study. But the cost for your laboratory tests will be covered by the project.

Confidentiality: All information about the patients will be kept confidential. Log books used in the laboratory will have no names but codes. The information sheet that links the coded number to patient name will be locked inside a computer and it will not be revealed to anyone except your physician and the principal investigator.

Right to refused or withdraw: You have full right to withdraw from taking part in this study at any time before and after consent without explaining the reason and not respond to some or all the questions. Your decision will not affect your right to get health service you are supposed to get otherwise.

Contact Address: If you have any question or concern, you can contact Mr. Dagim Kemiso at any time using the following address:

Dagim Kemiso:

Mob: +251-9-13-24-81-08/ +251-9-35-88-68-18

Email: dagimkemiso2015@gmail.com

Jimma, Ethiopia

Annex V: Information sheet in the Amharic version

Amharic version የ *ተሳታፊዎች ፈቃድና መተማመኛ ቅፅ*

የጥናቱ ርዕስ፡ “Prevalence of diabetes mellitus and associated factors among adult individuals in Asossa Town, West Ethiopia” /የስኳር በሽተኞች ቁጥር ለመለየት እና ለስኳር በሽታ ልያጋልጡ የምችሉ የተለያዩ ተጓዳኝ በሽታዎች እና ተያያዥነት ያላቸዉን ነገሮች ለመለየት በአሶሳ ከተማ ጥናት ስለማድረግ ነው/።

የጥናት ንድፍ፡ ክፍል-ክፍል ጥናት (Cross-sectional study)

የጥናቱ ባለበት፡ ዳግም ከሚሶ እባላለሁ።

የመጡበት ተቋም ስም፡ ጂማ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕክምና ላቦራቶሪ ሳይንስ ት/ክፍል የማስተርስ ድግሪ ተማሪ

ስፖንሰር ያደረግ ተቋም፡ ጂማ ዩኒቨርሲቲ

መግቢያ፡ ይህ የተሳታፊዎች ፈቃድና መተማመኛ ቅፅ **የተዘጋጀዉ የጥናቱን ዓላማ ለተስታፊዎች ለማስረዳት** ስሆን የመመረቂያ ጥናቴን በዚሁ ከተማ ለመስራት ስላሰብኩኝ የትናት ቡድኑ እናንተን ለማሳተፍ የምጠይቁበት ቅጽ ነዉ። ስለሆነም እርሰዎ በዚህ ጥናት ላይ እዲሳተፉ ተጋብዘዋል። እባክዎ በዚህ ጥናት ለመሳተፍ ከመስማማትዎ በፊት ከዚህ ቀጥሎ የሚገኘዉን ምንባብ በጥሞና ያንብቡና ግልጽ ያልሆነልዎትን ማንኛዉም ሃሳብ ይጠይቁ። የእርስዎ በዚህ ጥናት ላይ የሚኖርዎት ተሳትፎ ሙሉ በሙሉ በበጎ ፈቃደኝነት ላይ የተመሰረተ ነዉ። በዚህ ጥናት በመሳተፎዎ የምያገኙት ቀጥተኛ ትቅም ባይኖርም በተዘዋዋሪ ግን የእርሶዎ ተሳትፎ /የስኳር በሽተኞች ቁጥር ለመለየት እና ለስኳር በሽታ ልያጋልጡ የምችሉ የተለያዩ ተጓዳኝ በሽታዎች እና ተያያዥነት ያላቸዉን ነገሮች ለመለየት ይረዳናል። በዚህ ጥናት ዉስጥ ላለመሳተፍ ወይም ለመሳተፍ ከወሰኑ በጎላ ማቋረጥ ይችላሉ። ይህን በማቋረጥዎም በዚህ ከተማ የሚሰጠዉ ማንኛዉም አገልግሎት የማይቋረጥብዎ መሆኑን በክብሮት እንገልፃለን።። በጥናቱ ለመሳተፍ የሚስማሙ ከሆነ የስምምነት ቅጹ ላይ በጹሁፍ ወይም በጣት ፊርማ በማስቀመጥ እንዲተባበሩን በአክብሮት እንጠይቃለን።

የጥናቱ ተሳታፊ ለመሆን የሚጠበቅበዎት ምንድን ነው?

በዚህ ጥናት ለመሳተፍ የሚስማሙ ከሆነ ደም ናሙናዎ ለጥናቱ እንዲሚዉል እና ከርስዎ የሚወሰደው የደም ናሙና ውጤትም ከዚህ ጥናት ጋር ግንኙነት ካላቸው ሁለት ወይም ሶስት ሰዎች ውጭ ለማንኛውም ሶስተኛ ወገን የማይሰጥ መሆኑን እንገልፃለን። ነገር ግን ይህ አይነቱ መረጃ የርስዎን ማንነት የሚገልጡ መረጃዎችን ማለትም ስም፤ አድራሻና የስልክ ቁጥር የመሳሰሉትን መረጃዎቸን የማያሳይ መሆኑንም በአክብሮት እንገልፃለን። ይልቁንም ለዚህ አገልግሎት ብቻ የሚዉል እርስዎን ለማወቅ የሚያስችል መለያ ቁጥር ጥቅም ላይ እንዲዉል ይደረጋል። በአጠቃላይ እዚህ ቅጽ ላይ የሚሰጡት ማንኛውም አይነት መረጃ በምንም አይነት መልኩ የእርሰዎን ማንነት ለሶስተኛ ወገን የማይሰጥ መሆኑን እንዲገነዘቡ እናሳስባለን።

በዚህ ጥናት መሳተፍ የሚያስከትላቸዉ ችግሮች ምንድን ናቸዉ?

የደም ናሙና በሚሰጡበት ወቅት ምንም አይነት የከፋ ችግር አያጋጥምዎትም። ነገር ግን ደም በሚሰጡበት ሰኣት በጣም ትንሽዬ ህመም ሊሰማዎት ይችላል። ሆኖም ግን ናሙናዉን ለመሰብሰብ ልምድ ያለዉ ባለሙያ ስለሚመደብና አስፈላጊዉ የጥንቃቄ እርምጃ ስለሚወሰድ የህመም ስሜት አይኖርም።

የህክምና መረጃ በሚስጥር ተጠብቆ መቆየት የሚችለዉ እንዴት ነዉ?

ስለራስዎ የሰጡት ማንኛዉም መረጃና ከተወሰደዉ ናሙና ላይ የተገኘዉ የላቦራቶሪ ዉጤት የሚዉለዉ ለጥናቱ አላማ ብቻ ነዉ፡፡ ይህን ማህደር ሊያገኙ የሚችሉት የተወሰኑ የጥናቱ ተባባሪ ሰዎች ብቻ ናቸው፡፡ ከዚያም በላይ ስለ እርስዎ ያለውን ማንኛውንም መረጃ የተለየ የይለፍ ቃል ባለው የኮምፒውተር የመረጃ ማህደር ውስጥ እንዲቀመጥ ይደረጋል።

በዚህ ጥናት መሳተፍ የሚያስገኛቸው ጥቅሞች ምንድን ናቸው?

ይህ ጥናት የማስተርስ ዲግሪ መመረቂያ እንደመሆኑ መጠን በዚህ ጥናት በመካፈልዎ በገንዘብ የሚያገኙት ጥቅም ባይኖርም ከጥናቱ የሚገኘውን ውጤት ግን ያለምንም ክፍያ መውሰድ የሚችሉ መሆኑን እንገልፃለን። የእርሶዎ ተሳትፎ በእርስዎና በወገንዎ ላይ የስኳር በሽታ የምያደርሰዉ ችግር እንድሁም ምን ያህል ሰዎች በበሽታዉ እንደተጠቁ በቀላሉ ለመለየትና ለማወቅ እንዲሁም ለማከታተል ከፍተኛ ጥቅም ይኖረዋል።

በዚህ ጥናት ተሳታፊ የመሆንዎ መብቶች ምንድን ናቸው ?

በዚህ ጥናት መሳተፍ ሙሉ በሙሉ በእርስዎ ፈቃደኝነት የተመሰረተ በመሆኑ በማንኛውም ሰዓትና ቦታ የማቋረጥ ሙሉ መብት የተጠበቀ ከመሆኑም በላይ እራስዎን ከጥናቱ በማግለልዎ ምክንያት የሚቀርብዎት ምንም አይነት አገልግሎት አይኖርም ::ከዚህም በተጨማሪ ጥናቱን በተመለከተ ማንኛውንም አይነት ጥያቄ የመጠየቅና ገለጻ የማግኘት መብት አለብዎት፡፡ የላብራቶሪ ምርመራ ውጤቱንም በነጻ ማግኘት ይችላሉ፡፡ ነገር ግን እርስዎ በሚሰጡን መረጃ የችግሩን ስፋት ለመከላከል እና ለመቆጣጠር ጠቃሚ ስለሆነ ለሚቀርብልዎት ጥያቄ ቀጥተኛ መልስ ይሰጡን ዘንድ በታላቅ አክብሮት እንጠይቃለን፡፡

ጥያቄ ካለኝ ወይም ችግር ቢያጋጥመኝ ምን ማድረግ ይገባል?

ይህንን ጥናት በተመለከተ ወይም ከዚህ ጥናት ጋር በተዛመደ መልኩ ስለሚያጋጥሙ ድንገተኛ አደጋዎች ወይም ጥያቄ ካለዎት በሚመለከተው አድራሻ ይጠቀሙ፡፡

ዳግም ከሚሶ፣ ጅማ ዩኒቨርሲቲ የጤና ኢንስቲቱት፣ የጤና ሳይንስ ተቋም፣ የህክምና ላቦራቶሪ ትምህርት ቤት፡፡

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ጂማ፣ ኢትዮጵያ

Annex VI. Informed consent form in English version

ID No_____

I had been informed that the aim of this study is to assess the prevalence of diabetes mellitus and associated factors among adult individuals in Assosa Town, West Ethiopia: Cross-sectional study. The results of this study have an importance to know the magnitude of diabetes and disposing factors in the community of my town and to be used as an input for diagnosing previously undiagnosed individuals those have found to diabetes mellitus. I had been also informed about the confidentiality of this study. The principal investigator requested me to take part in the study that would require my willingness to provide the required data that include provision of blood sample and filling questionnaire and anthropometry measurements. Therefore, with full understanding of the importance of the study, I agreed voluntarily to provide the requested samples and my benefit will be only from the free laboratory investigation result/s. I_____ hereby give my consent for providing the requested information and specimens as the doctors find best for me.

Signature: _____ Date_____

Annex VII. Informed consent form in Amharic version

የተሳታፊዎች ስምምነት ማረጋገጫ

የሚስጥር ቁጥር ----------

እኔ ስሜ ከላይ የተጠቀሰው ተሳታፊ “Prevalence of diabetes mellitus and associated factors among adult individuals in Asossa Town, West Ethiopia:” ጥናት ላይ በቂ ገለጻ ተደርጎልኛል፡፡ ለጥናቱም ደም ናሙና እንደሚያስፈልግ ተገልጾልኛል፡፡የጥናቱንም አላማዎችም ተረድቻለሁ፡፡በቃለ መጠይቁ ላይ የገለጽኳቸው መረጃዎች በሙሉ በሚስጥር የተጠበቁ እንደሚሆኑ ተነግሮኛል ፡፡በጥናቱ ላይ ያለመሳተፍና ማንኛውንም መረጃ ያለመስጠት እንዲሁም በማንኛውም ጊዜ ከጥናቱ ራሴን የማግለል መብቴ የተጠበቀ እንደሆነ ተገልጾልኛል፡፡ ስለዚህ ለዚህ ጥናት መረጃና የስምምነት ቃሌን የሰጠሁት በአጠቃላይ ሁኔታውን በመረዳትና በፍጹም ፍቃደኝነት ነው፡ በተጨማሪም ጥያቄ ለመጠየቅ ተፈቅዶልኝ ለማወቅ የፈለኩትን ያህል ማብራሪያ አግኝቻለሁ ፡፡የዚህ ጥናት ተሳታፊ በመሆኔ የማገኘው ጥቅም የሁሉንም ምርመራ ውጤት በነጻ ማግኘት እንደሆነ ተረድቻለሁ፡፡ በአጠቃላይ እኔ ከላይ በመተማመኛ ቅፅ የተጠቀሱትን ሁሉ በሚገባና በተረጋጋ መንፈስ አንብቤዋለሁኝ፡፡ ስለዚህ በዚህ ጥናት ለመሳተፍ ፈቃደኛ መሆኔን በፊርማዬ አረጋግጣለሁ፡፡ ፊርማ---------- ቀን ----/---/---------- ።

Annex VIII: Laboratory producers

After the participants have agreed and signed the informed consent and are voluntary to give blood; the whole blood sample was collected and prepared for the following basic procedure for all analytes studied in this study.

- 3- 5 ml of the venous blood sample was collected and transferred gently to the gray top test tube (SST test Tube) from the syringe and then stored at room temperature for 10-15 minutes until coagulated
- After clotting, the whole blood was centrifuged at centrifugation force of 4000 rpm for 4 minutes to separate the serum from the red cells.
- Then turned on the clinical chemistry analyzer machine
- Check the expiry date of all reagents
- Check the daily, weekly, monthly, quarterly, and yearly controls, standards and
- calibration results of the analyzer
- Analyze the specimen based on the leaflet procedure for each parameter
- Finally, the result was carefully recorded from the machine to the laboratory result form.

Annex VIII: Principle of each test

A. **High-density lipoprotein (HDL cholesterol)**

- **PRINCIPLE**

HDL is measured directly in serum by enzymatic method using the principle apoB having lipoproteins in the specimen are reacted with a blocking reagent that makes them non-reactive with the enzymatic cholesterol reagent under conditions of the assay. The apoB having lipoproteins are thus effectively excluded from the assay and only HDL-cholesterol is detected under the assay conditions. The method uses sulfated alpha-cyclodextrin in the presence of Mg+2, which forms complexes with apoB having lipoproteins, and polyethylene glycol-coupled cholesteryl esterase and cholesterol oxidase for the HDL-cholesterol measurement.

The reactions are as follows:

1. ApoB containing lipoproteins + α-cyclodextrin + Mg+2 + dextran SO_4 → soluble non-reactive complexes with apoB-containing lipoproteins
2. HDL-cholesteryl esters PEG-cholesteryl esterase → HDL-unesterified cholesterol + Free fatty Acid

3. Unesterified cholesterol + O_2 →PEG-cholesterol oxidase > cholestenone + H_2O_2
4. H_2O_2 + 5-aminophenazone + N-ethyl-N-(3-methyl phenyl)-N'-succinyl ethylene diamine + H_2O + H^+ peroxidase → quinone imine dye + H_2O
5. Absorbance is measured at 600 nm

B. Low-density lipoprotein (LDL cholesterol)

- **PRINCIPLE**

The LDL-Cholesterol test is a two-reagent homogenous system. The assay is included of two distinct phases. In phase one a unique detergent solubilizes cholesterol from non-LDL lipoprotein particles. This cholesterol is consumed by cholesterol esterase, cholesterol oxidase, peroxidase and 4- amino antipyrine to generate a colorless product. In phase two a second detergent in reagent 2 releases cholesterol from the LDL – lipoproteins. This cholesterol reacts with cholesterol esterase, cholesterol oxidase and a chromogen system to yield a blue color complex which can be measured dichromatically at 540/660nm. The resulting increase in absorbance is directly proportional to the LDL-C concentration in the sample.

Reaction phase 1

1. HDL-C, VLDL-C, LDL-C Chylomicrons ***CHE, and CHO*** → Cholest-4-en-3-one + Fatty acids + H_2O_2
2. H_2O_2 - 4-AAP ***Peroxidase*** → LDL-C + Colorless product

Reaction phase

1. LDL-C ***CHE and CHO*** →Cholest-4-en-3-one + Fatty acids + H_2O_2
2. H_2O_2 + DSBmT + 4-AAP ***Peroxidase*** → Blue color complex

C. Total cholesterol

- PRINCIPLE

Cholesterol is measured enzymatically in serum or plasma in a series of coupled reactions that hydrolyze cholesteryl esters and oxidize the 3-OH group of cholesterol. One of the reaction byproducts, H_2O_2 is measured quantitatively in a peroxidase catalyzed reaction that produces color. Absorbance is measured at 500 nm. The color intensity is proportional to cholesterol concentration. The reaction sequence is as follows:

1. Cholesteryl ester + H_2O ***cholesteryl ester hydrolase*** → cholesterol + fatty acid
2. Cholesterol + O_2 ***cholesterol oxidase*** → cholest-4-en-3-one + H_2O_2
3. $2H_2O_2$ + 4-aminophenazone + phenol ***peroxidase*** → 4-(p-benzo quinone monoimino)- phenazone + 4 H_2O

D. Triglyceride

- Principle

Triglycerides are measured enzymatically in serum or plasma using a series of coupled reactions in which triglycerides are hydrolyzed to produce glycerol. Glycerol is then oxidized using glycerol oxidase, and H_2O_2, one of the reaction products, is measured as described above for cholesterol. Absorbance is measured at 500 nm. The reaction sequence is as follows:

1. Triglycerides + $3H_2O$ *lipase* → glycerol + fatty acids
2. Glycerol + ATP *glycerokinase* → glycerol-3-phosphate + ADP
3. Glycerol-3-phosphate + O_2 *glycerophosphate oxidase* → dihydroxyacetone phosphate + H_2O_2
4. H_2O_2 + 4-aminophenazone + 4-chlorophenol *peroxidase* → 4-(p-benzoquinone monoamine)- phenazone + H_2O_2 + HCl.

Instrument principle

Cobas c 311 by Cobas- Roche is a stand-alone system that offers consolidated testing from a broad menu of clinical chemistry applications. It has the capacity for photometric assays and ion-selective electrode (ISE) determination of sodium, potassium and chloride in serum, plasma, and urine. In addition, measurement of HbA1c levels in whole blood can also be performed, making it a truly flexible analyzer. Has high sensitivity and specificity.

Annex VIII: Declaration Form

I, the under signed declare that, this MSc thesis work is my original work, has not been presented for a degree in this or any other universities. I also declare that all sources of materials used for thesis have been dully acknowledged.

Name of the candidate: Dagim Kemiso Gutema

Signature ---------- *Date of submission* November 7, 2022

Place: School of Medical Laboratory Sciences, Jimma University, Ethiopia.

Approval of the advisors

This research thesis was approved by the supervision of university advisors:

External Examiner: Zerihun Ataro (BSc, MSc) / Assistant Professor of Clinical Laboratory Sciences

Signature : _____ *Date:* _____/_____/_____

Place: Department of Medical Laboratory Sciences, Haramaya University, Ethiopia

Internal Examiner: Sintayehu Asaye (BSc, MSc) Clinical Chemistry and Urinalysis Course Team

Signature: _____ *Date:* _____/_____/_____

Place: School of Medical Laboratory Sciences, Jimma University, Ethiopia.

Name of 1st advisor: Mr. Aklilu Getachew (BSc, MSc, PhD fellow)

Signature: _____ *Date:* _____/_____/_____

Name of 2nd advisor: Mr. Shiferaw Bekele (BSc, MSc, PhD fellow.) / Assistant Professor of Clinical Laboratory Sciences

Signature: _____ *Date:* _____/_____/_____

Name of 3rd advisor: Mr. Temam Ibrahim (BSc, MSc)

Signature: _____ *Date:* _____/_____/_____

Place: School of Medical Laboratory Sciences, Jimma University, Ethiopia.

Name of School head: _____

Signature: _____ *Date:* _____/_____/_____